

Briefly Noted

Celebrate GIS Day

GIS Day is November 17, and organizations around the world are planning to use the day to educate others about the benefits of GIS technology. Some ideas for how to participate include giving a presentation about geospatial technology to a local school or library, hosting a map gallery that coworkers can visit to learn about GIS, and joining the Community Maps Program to start sharing data with other ArcGIS users. Find out more and register an event at gisday.com.

GIS Boosts Data-Driven Governance in Egypt

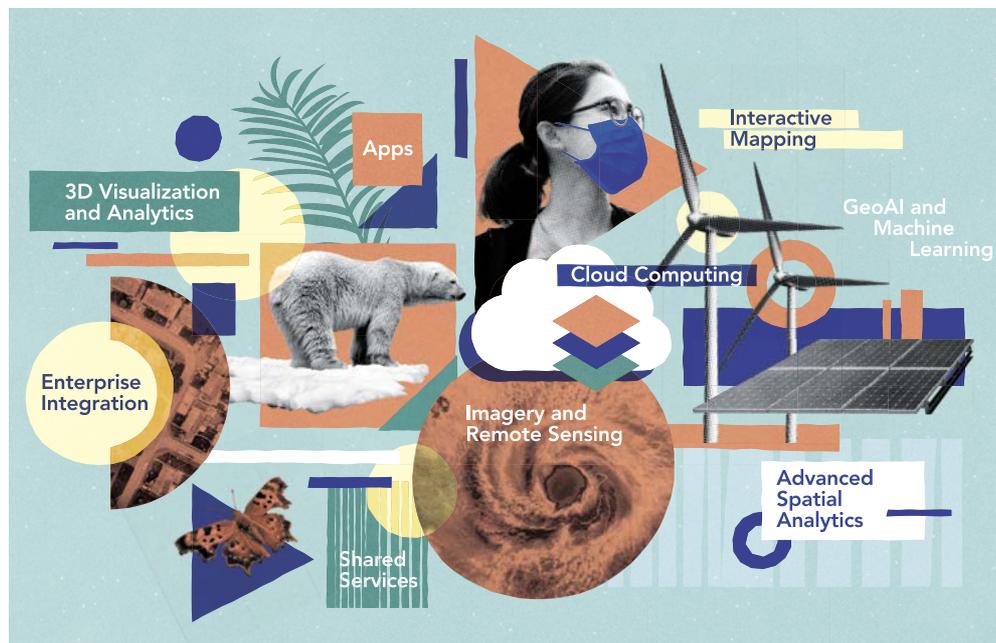
To address geographic disparities in northern Egypt, the Egyptian Ministry of Local Development and the World Bank are implementing Esri technology. A unified geodatabase and a map viewer will let users explore geostatistical information and generate reports, graphics, and thematic maps. The system will employ mobile apps for data collection and dashboards to provide policy makers with a holistic view of development projects.

Telecom Uses Esri Tech to Bridge Digital Divide

Matanuska Telecom Association (MTA), which is bridging the digital divide across south central Alaska by offering broadband, television, and telephone services to residents in a 10,000-square-mile area, signed an enterprise agreement (EA) with Esri to help streamline operations and workflows. The small utility will employ ArcGIS Online to build mobile apps and collaborate in real time. To learn more about EAs for small utilities, visit esri.com/suela.

It's Time to Act

GIS Professionals Are Essential to Creating a Sustainable Future



↑ GIS technology is interconnected and advancing quickly, making GIS professionals well suited to take on issues that range from climate change to racial injustice.

Sustainability was more than a buzzword at the 2021 Esri User Conference (Esri UC). Centering on the theme of GIS: Creating a Sustainable Future, the conference highlighted how the GIS community is confronting many of the world's challenges and, more importantly, what else needs to be done to guarantee better outcomes than what we see on the horizon.

The theme was inspired, in part, by words that Esri president Jack Dangermond read in *Why INEGI? The Saga of a Mexican Institution in Search of the Truth*. The book by Mario Palma, a founder of the National Institute of Statistics and Geography (INEGI) in Mexico, stresses the importance of the organization's role as an independent provider of statistical and geographic information in a democratic society.

Palma wrote how the lack of understanding of reality is one of the greatest risks that every society faces and that the future depends on creating and applying understanding.

"These were the beacons that started INEGI, but these words speak to me because they are a purposeful way of describing our work [*as GIS professionals*]: creating and applying understanding," Dangermond said during the Esri UC, which was held virtually for about 71,000 registered attendees July 12–15, 2021.

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Caribbean GeoPortal Builds Local GIS Capacity and Inspires Collaboration

The volcanic eruption that covered Saint Vincent and the Grenadines in ash in April, the numerous hurricanes and tropical storms that have swept through the region this season, and the magnitude 7.2 earthquake that hit Haiti in August are reminders of the threats people in the Caribbean face all too often.

Amid these crises, a group of organizations has begun to improve regional GIS capabilities, increase GIS capacity and geographic thinking, and foster an environment for information sharing and collaboration. The aim is twofold: to better support work across the region, especially during responses to natural hazards, and to prepare for a more resilient and sustainable future.

They are doing this via the new Caribbean GeoPortal, a comprehensive, cloud-based platform from Esri that combines GIS technology with geospatial data to build local capacity. Launched in collaboration with the United Nations Regional Committee on Global Geospatial Information Management for the Americas (UN-GGIM: Americas), the Caribbean Geospatial Development Initiative (CARIGEO), the UN's Economic Commission for Latin America and the

Caribbean (ECLAC), and others, the Caribbean GeoPortal is focused on advancing the following three goals for the region:

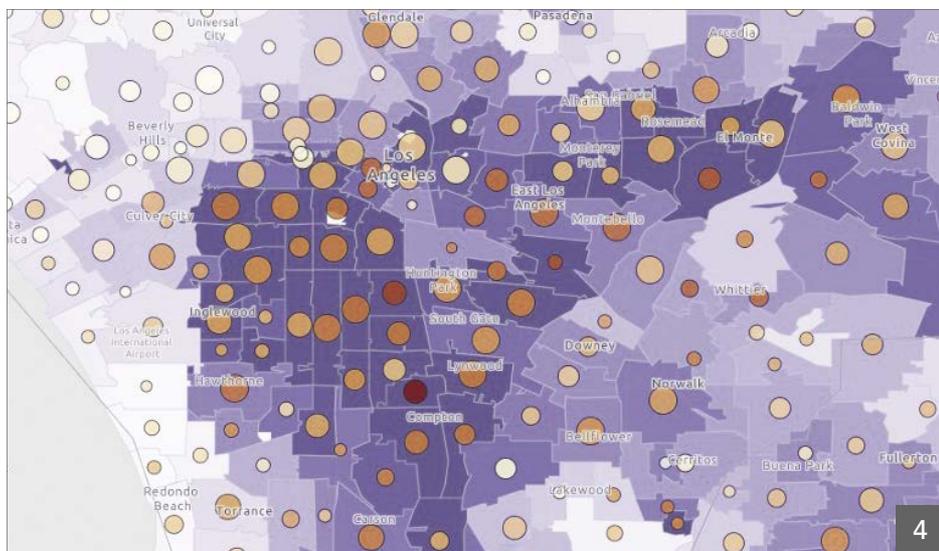
- Increasing organizations' GIS capacity through training and education

- Improving collaboration and information sharing among organizations
- Providing organizations with the necessary GIS capabilities to support their work

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↑ When La Soufrière erupted in Saint Vincent and the Grenadines in April, emergency personnel used the Caribbean GeoPortal to see how volcanic ash was affecting neighboring islands.



Throughout the COVID-19 pandemic, the US military has provided aid to hospitals and communities in need. To have the greatest impact, officials needed to know where spikes in infections would happen next and, once vaccines became available, where inoculation was lagging. But this information was hard to come by. Relying on a novel data source, plus some targeted mapping, the military was able to optimize its mission—and this methodology is still being used today to monitor vaccine efficacy.



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Create a Hybrid Workplace with Indoor Mapping

Over the past 18 months, business leaders have had to rethink work culture and how their organizations utilize space. Throughout the COVID-19 pandemic, many businesses have continued to run smoothly with employees working largely from home. And with the recurrent rise of worrying COVID-19 variants, several large companies have had to reevaluate when—and how—to have employees return to the office.

A significant number of organizations are planning to take a more flexible approach to the workplace in the future. According to Microsoft's 2021 Work Trend Index, 66 percent of decision-makers at businesses around the world are considering redesigning their office spaces to better serve hybrid work environments, wherein employees can regularly work from the office and/or home.

This isn't so surprising, given that rental space is one of the biggest costs for many organizations. But there's more to it than that. How people interact with their workplaces is undergoing permanent change. So facilities need to be transformed in ways that are both flexible and sustainable.

This process starts with data. And ArcGIS Indoors—a system of record that visualizes facilities data on a digital indoor map—can help.

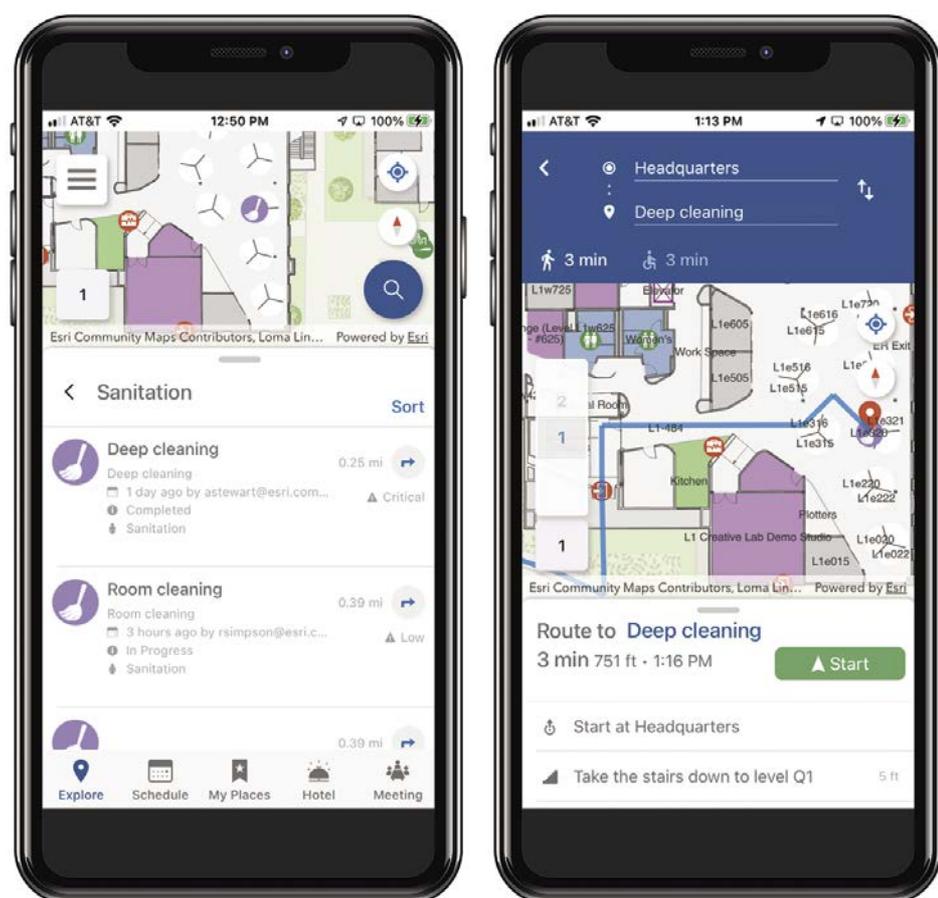
A Central Repository for Facilities Data

For too many organizations, their facilities data isn't interoperable. It consists of paper documents, Microsoft Excel spreadsheets, or thousands of records organized in tabular formats in integrated workplace or facility management systems. People can't share the data, let alone find what they need, and this costs businesses money.

Using ArcGIS Indoors as a central repository for storing and managing facilities data allows stakeholders to easily share this information and visualize it all on a map. Anyone within an organization—from decision-makers to new employees—can use Indoors to see where specific rooms are and locate amenities, resources, and people. The software also helps managers plan space use and enables employees to book rooms and offices, as well as navigate within and among buildings.

Additionally, Indoors organizes computer-aided design (CAD) and building information modeling (BIM) drawings, plus site scans and operational data, into floor-aware indoor maps. This ensures that these important resources can be used not only for the design and construction of buildings but also for facility operations and maintenance.

In short, Indoors gives everyone in an organization a common operating picture of facilities, which streamlines workplace planning; aids with facility maintenance; and, ultimately, reduces operating costs.



↑ ArcGIS Indoors makes it easy to see which areas have recently been cleaned and when.



What kinds of articles do you want to read in *ArcNews*, *ArcUser*, and other Esri publications? And how would you like to receive them—in print or in a digital format?



Please take a few minutes to fill out this short survey. We appreciate your responses.

Open the camera app on your smartphone, focus the QR Code in the center, and follow the instructions that appear on-screen.

Seamlessly Plan and Use Flexible Work Spaces

ArcGIS Indoors offers two ways to explore data: with a native mobile app and via the browser-based Indoor Viewer. As many workplaces seek to limit how many people are in one space at a time, these apps can help employees navigate modified offices—both by guiding them through updated floor plans on a map and by helping them book conference rooms and new types of work spaces, such as temporary-use office hotels and hot desks.

These apps can also make employees active participants in reporting facility issues, including areas that need to be cleaned and broken assets that require repair. Indoors does this by integrating with computerized maintenance management systems, such as Esri partner Cityworks or ServiceNow, which makes facility information readily available to all occupants of a building.

For decision-makers and managers, the Indoor Space Planner app makes it easier to reorganize office spaces; assign employees to specific offices, desks, or work areas; and create office hotels—work spaces that employees can reserve for set amounts of time. Users are able to visualize their plans and changes on a map and evaluate several scenarios before deciding on the best option. They can then merge the accepted plan into the ArcGIS Indoors Information Model so it becomes the default map across the organization's Indoors apps.

Continuity Among Systems and User Experiences

Without doing any custom coding, ArcGIS Indoors can be integrated with various facility, asset, incident, and work order management systems. For example, Esri recently announced a new extract, transform, and load (ETL) procedure for IBM's integrated workplace management solution, TRIRIGA. This makes it easier and quicker to incorporate TRIRIGA-based floor plans and spatial data into Indoors maps.

Other ways users can incorporate Indoors into their already-existing facilities management systems and procedures include the following:

- Loading facility data, such as floor plans, rooms, and assets, into ArcGIS Indoors maps
- Adding floor-aware maps to facility management systems and apps such as IBM TRIRIGA or Cityworks
- Smart launching other facility apps from Indoors, such as ServiceNow to report an issue
- Smart launching Indoors from a facility management system to do location sharing or make a work space reservation

Connecting an organization's facility management systems with Indoors makes all facility and building information available to stakeholders from one central location and allows everyone to interact with it via a simple map interface. This makes data management easier; enables space planning; and helps maintain continuity among different systems, applications, and user experiences.

To learn more about ArcGIS Indoors and get a demo of the apps, head to go.esri.com/indoors.

Mapped Medicare Data Helps US Military Deliver Pandemic Support

By Dr. Bettina Experton, Humetrix

When the COVID-19 pandemic took the world by storm, the United States military quickly mobilized to move personal protective equipment (PPE), hospital beds, and other supplies to facilities in need and send extra staffing to overwhelmed medical centers. As the country now contends with highly contagious variants of the virus while engaging in the biggest vaccination campaign in its history, the US military is still at work helping to distribute vaccines and administer shots.

To optimize this critical mission, the military needed a clear vision of where its assets and resources would be most useful—namely, in places where people were most susceptible to developing severe cases of the disease and, later, where vaccinations were lagging. The best way to do this was to build an operational dashboard that mapped COVID-19 cases, predicted where the pandemic was heading, and allowed the military to keep track of its mobilization efforts. This was especially important at the outset of the vaccination program to ensure that priority was given to the most at-risk populations.

To launch the operation, the Joint Artificial Intelligence Center (JAIC) at the United States Department of Defense (DoD) assembled leading technology companies, including Amazon, Microsoft, IBM, Dell, and Esri, under Project Salus. (Salus is the Roman goddess of health and well-being.) Digital health innovation company Humetrix was brought in to analyze data about older individuals and others who are most at risk for severe COVID-19 and to build a dashboard to present the results in an easy-to-interpret visual format. But getting that data was going to be a challenge.

A Novel Way to Track Infections

In March 2020, when Project Salus got under way, it was difficult to understand the spread of COVID-19, let alone forecast where spikes in infections would happen next, because tests for the

disease were not yet widely available. Time was of the essence, however, as more individuals were getting infected and hospitalized each day—particularly older individuals and people with other serious health problems.

To fill the gap caused by limited COVID-19 testing and reporting, the health mission chief for JAIC, US Navy captain Dr. Hassan Tetteh, had an idea. A thoracic surgeon and informatics specialist who was caring for COVID-19 patients, Tetteh realized that the diagnosis and other medical codes that are included on the Medicare claims that health-care providers submit to Medicare for payment could help track where people were contracting the disease.

Medicare provides health-care coverage to most US citizens and permanent residents over the age of 65, as well as for people with disabilities and end-stage kidney disease. So data from Medicare claims, broken down into the diagnostic codes that indicate diseases such as diabetes, chronic kidney disease, chronic lung disease, and now COVID-19, would provide essential information about a population that's at high risk of experiencing severe COVID-19 symptoms.

"The military has always led with medical advances, beginning with General George Washington's Continental Army and the first mass military inoculation campaign to address the deadly smallpox disease and continuing with the US Army's pioneering innovation in blood banking to save lives from the Civil War to the present," said Tetteh. "Today, technology, data, and mapping are more advanced than ever, and the DoD Joint Artificial Intelligence Center has led an important initiative through Project Salus to help support the nation's COVID-19 response."

Mapping Risk Across the Nation, Down to the Local Level

By early April 2020, Project Salus had received tens of millions of deidentified Medicare claim records from the Centers for Medicare & Medicaid Services (CMS) in a secure government enclave. This database of Medicare claims, which had all personal

identification information removed, was designed to capture COVID-19 diagnoses in a large, Medicare-covered population that was geographically distributed across the United States.

The Humetrix team processed and analyzed this data using its analytics platform, which employs various algorithms and relies on a classic statistical analysis method called logistic regression to identify risk factors for different disease outcomes, including COVID-19. With help from Esri, Humetrix used the DoD's ArcGIS Enterprise system to map the results of its analyses and display them on a dashboard created with ArcGIS Dashboards.

The dashboard showed, at the county and ZIP code levels, confirmed COVID-19 cases among Medicare beneficiaries, as well as areas where the population was more likely to be hospitalized and die from the disease. The military was then able to use this dashboard, which was updated on a weekly basis, to carry out its pandemic support mission.

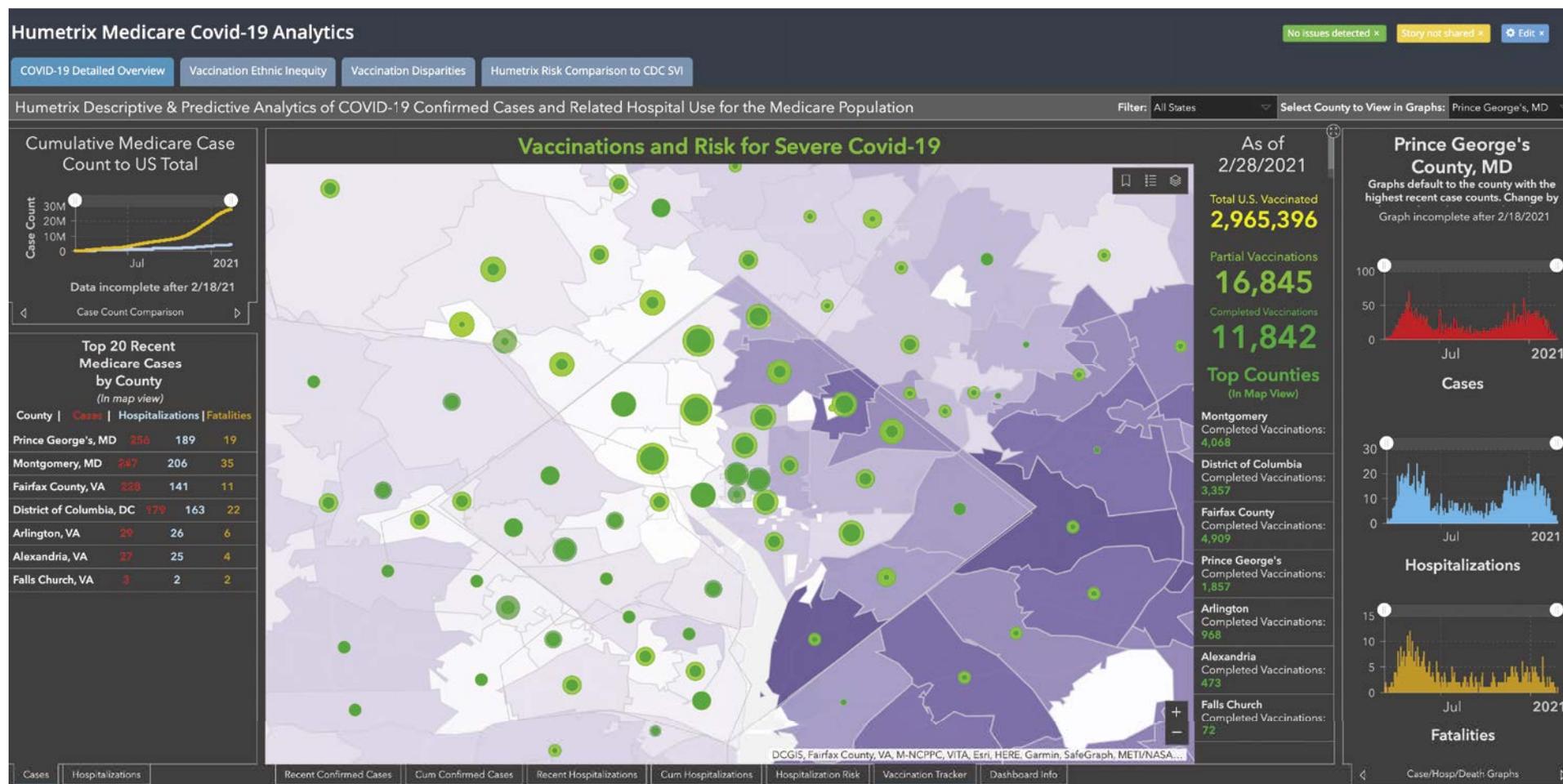
Validated Data Helps Transform Vaccination Campaigns

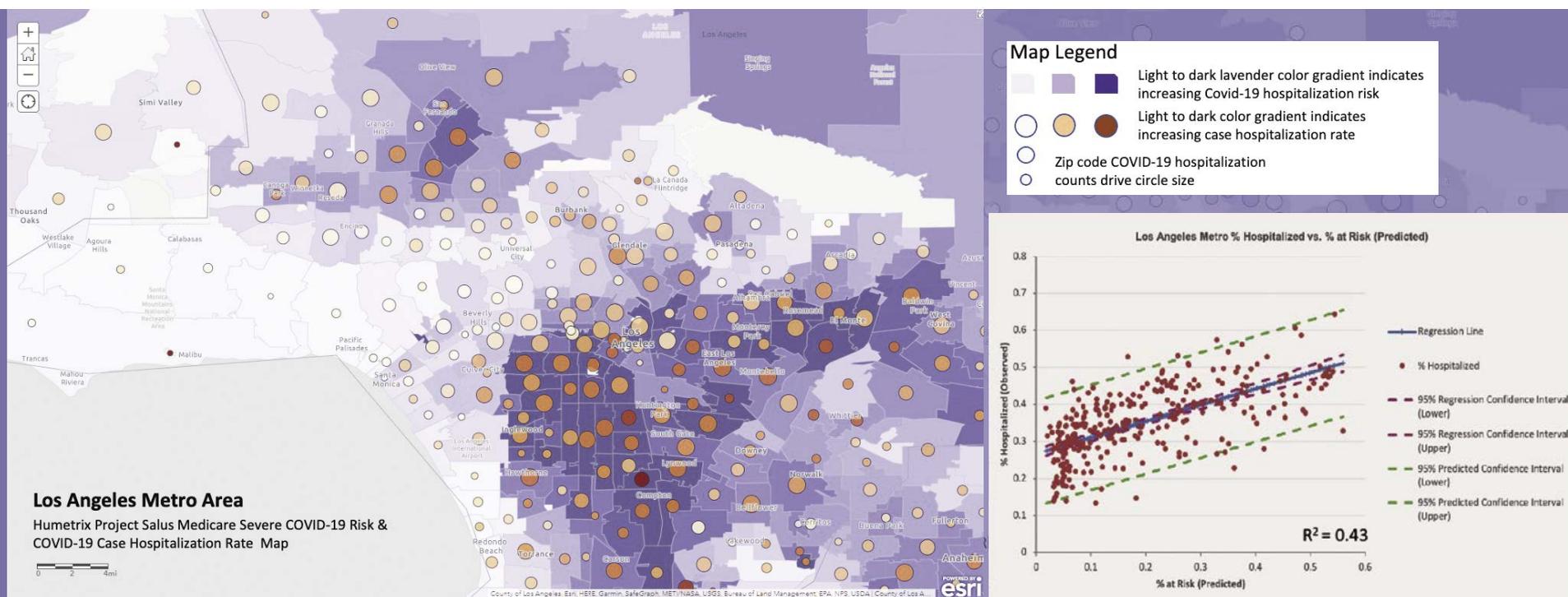
Between April 2020 and July 2021, the number of Medicare beneficiaries in the Project Salus database grew from 5 million to 20 million. By August 2021, the cohort of Medicare patients that Humetrix was observing included more than 2.7 million COVID-19 cases and accounted for about 50 percent of all the COVID-19 hospitalizations (986,000 out of about 1,981,300) and deaths (329,000 out of about 613,700) in the United States.

The predictive risk map that Humetrix had developed using this information was later validated by observed COVID-19 hospitalization rates throughout the United States. So, reassuringly, Humetrix and the rest of the Project Salus team had gotten their predictions right.

Once COVID-19 vaccines became available, Medicare claims began including codes that showed when patients had received their shots. Humetrix was able to overlay this vaccination data on the COVID-19 risk map it had already built to see where vaccination campaigns needed to be ramped up.

↓ Analysis of the data showed that ZIP codes where the population is at higher risk of developing severe COVID-19 symptoms tend to coincide with areas where fewer people are vaccinated. This pattern is apparent across the United States.





↑ Places where people have been hospitalized at higher rates for COVID-19 are indicated by dark-orange circles. These locations coincide with areas where the Project Salus team predicted higher hospitalization rates, which are represented in dark purple.

The results showed a nationwide pattern of inadequate prioritization. In general, areas with low vaccination rates coincided with populations that were at high risk of developing severe COVID-19. Presenting this information on the dashboard helped the military support local health departments in opening more vaccine clinics and instituting targeted outreach.

Continued Monitoring of COVID-19 and Vaccine Variables
Now that the COVID-19 vaccination program has reached the majority of American adults, Humetrix is currently tracking the effectiveness of the vaccines.

According to Humetrix, the deidentified Medicare claims are showing that, while breakthrough cases in fully vaccinated individuals are happening—likely caused by some waning vaccine immunity and the prevalence of the more contagious Delta variant—the vaccines remain highly effective against severe disease. The number of breakthrough cases being recorded in the cohort amounts to only 2.6 percent cumulatively, according to Humetrix as of mid-

August 2021. Of those breakthrough cases, 20 percent were hospitalized compared to 32 percent of the COVID-19 cases in the cohort before vaccinations began. (Keep in mind that Humetrix is studying a specific and high-risk population, so more breakthrough cases are severe compared to the population at large.) The vaccines are indeed preventing most at-risk people from developing severe COVID-19 that requires hospitalization or results in death.

Because Humetrix has access to Medicare beneficiaries' deidentified prior medical histories, the company's analytics can also pinpoint when individuals experience adverse events following vaccination and use the diagnosis codes to see if those ailments are new or were present before. The company is providing its data to the Centers for Disease Control and Prevention (CDC) and the US Food and Drug Administration (FDA) for further study.

From January to June 2021, Humetrix recorded a 90 percent reduction in daily COVID-19 cases in its Medicare cohort, thanks to the massive vaccination campaign that got under way and that the military helped execute. But the fight isn't over. Using

advanced analytics and GIS technology, Humetrix will continue to track the pandemic and deliver critical insight to federal government stakeholders until the United States—and the world—can get this public health crisis under control.

About the Author

Bettina Experton, MD, MPH, is the founder and CEO of Humetrix and has led the company for 25 years in developing chronic care management software, consumer-facing mobile health apps, and the company's health analytics cloud platform. She is a physician trained in internal medicine, pediatrics, and public health. Experton is a former public health officer for the State of California and is an adjunct professor of medicine at the University of California, San Diego, School of Medicine.

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Caribbean GeoPortal Builds Local GIS Capacity and Inspires Collaboration



↑ The new Caribbean GeoPortal is a comprehensive, cloud-based platform that combines GIS technology with geospatial data.

“The geoportal’s data and solutions are local to the Caribbean community,” explained Sean McGinnis, Esri’s geoportal program manager. “Everyone who signs up gets credits to use Esri content and services to help them address the situations they are dealing with, whether that’s responding to a disaster or crowdsourcing information about economic development and opportunities.”

Connecting Technology, Authoritative Data, and People

In recent years, the availability of and access to geospatial, statistical, and earth observation data in the Caribbean has grown. Yet there is still a need to organize, discover, share, and analyze this data to more effectively support decision-making. Many organizations in the region have embarked on this journey individually, but they could have a much greater impact if they are able to work together more easily.

“There are many geospatial portals across the Caribbean that provide a variety of datasets and services. This...means that there are a commensurate number of groups and initiatives having similar objectives, which are often under-resourced with few technical experts,” explained Cecille Blake of the UN-GGIM Secretariat in the UN Statistics Division, who joined the organization after 18 years of leading Jamaica’s National Spatial Data Management Division. “The challenge we need to address is how these shared datasets and experts can best support the people and processes within each country to make better decisions.”

In a nutshell, that’s what the Caribbean GeoPortal aims to do. For those who have lacked access to GIS technology and location data, they can now work within the geoportal to build their skills and knowledge by using ArcGIS technology along with data from agencies such as the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA).

The geoportal enables users to quickly search and discover various geospatial resources, including data about the region, imagery, raster datasets, and readily usable web services. Because the Caribbean GeoPortal is federated and managed by authoritative organizations across the region, users can validate and ensure the quality, timeliness, and availability of registered resources to support their work.

All this is made possible by employing three key components of the ArcGIS system. First, the core technology and capabilities of the Caribbean GeoPortal are built on ArcGIS Online and ArcGIS Hub. Together, these allow users to display, analyze, and share data. Next, ArcGIS Living Atlas of the World gives users a curated collection of authoritative data from providers around the world. The Caribbean GeoPortal also has a selection of ArcGIS Living Atlas data that is specific to the region so users can access open and authoritative data from providers and producers in the Caribbean. And finally, Learn ArcGIS lessons that are available on the Caribbean GeoPortal enable users to expand their general GIS skills, increase their geographic

literacy, and learn how to make better use of the new capabilities and data shared within the geoportal.

Contributing to Natural Hazard Planning and Response Efforts

The Caribbean GeoPortal has already served as a significant resource in preparing for, responding to, and providing relief efforts for several crises that have occurred in the region in recent months.

When La Soufrière erupted in Saint Vincent and the Grenadines, one of the first questions asked was, What is the impact? Given the magnitude of the eruption, the effects were not limited to the immediate area and seismic activity; they extended to neighboring islands as well, as ash from the eruption scattered far.

By employing data from NASA made available through the Caribbean GeoPortal, users were able to quickly understand how the eruption affected the rest of the region. For instance, they ran plume models to get a better idea of how the volcanic ash was moving through the air and anticipate where response and recovery efforts would be needed.

Users in the Caribbean community are also beginning to use the geoportal to get ready for and better discern the impacts of potential storms.

“The Caribbean GeoPortal has now become an important go-to resource for me in tracking Atlantic storms,” said

security.manager for ArcGIS

Making Sharing Data Smarter, Easier and More Secure

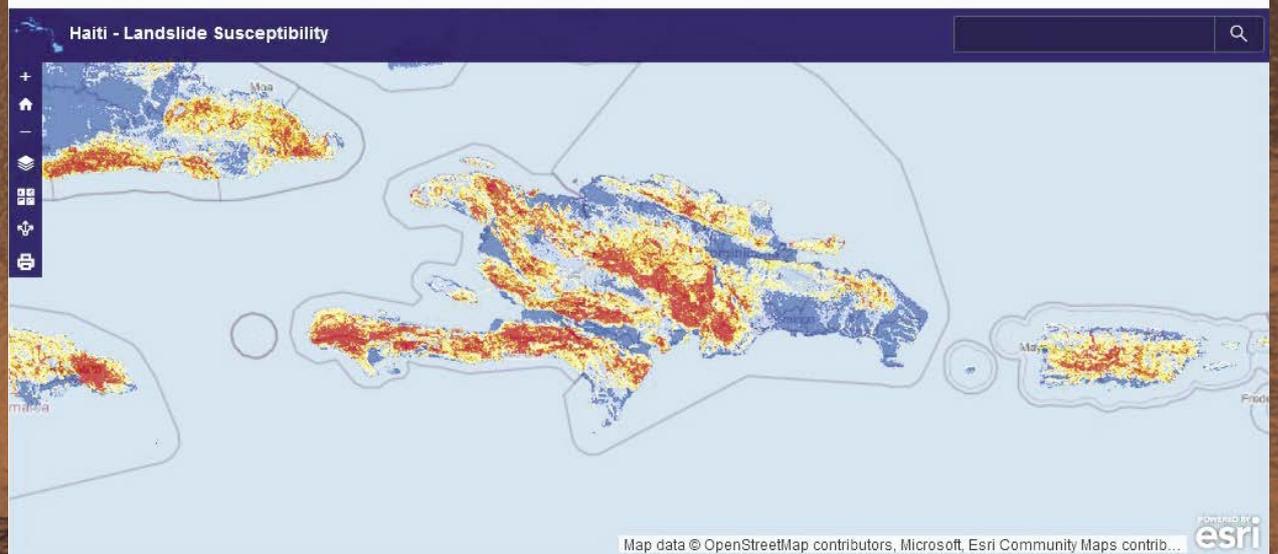
- extend ArcGIS Enterprise with fine-grained access control
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Understanding and Mitigating Risk

Knowing where at risk, high density populations exist in relation to factors like flood zones or earthquake zones can be critical in a time of need.



↑ Dynamic mapping provides a better understanding of the risks the Caribbean faces during natural hazards such as hurricanes.

Lavern Rogers-Ryan, GIS manager for the Government of Montserrat's Ministry of Agriculture, Land, Housing and the Environment. "I am able to view the associated NOAA layer, which provides real-time data on hurricane watches, warnings, and tracks. In the 3D scene viewer, I am able to zoom in, zoom out, and pan around the map to see which islands will potentially be affected."

Rogers-Ryan finds the information on wind speed particularly useful to give her an idea of how severe a storm may be.

"[Because I live] in the Caribbean, this dynamic mapping gives me a better understanding of the potential risks faced by my island and neighboring islands, especially during the active hurricane seasons," she said.

When a powerful earthquake struck Haiti on August 14, the Caribbean GeoPortal team was able to act quickly. With the technology's infrastructure already in place, the group was able to stand up a new geoportal for Haiti straight away to get vital information to residents, responders, and decision-makers who were mobilizing to help the community.

The Caribbean GeoPortal allowed the team to rapidly configure the country-specific site and federate key data sources that were critical to the event, such as NASA's data on soil moisture and landslide susceptibility and the UN Satellite Centre's damage assessment imagery. The geoportal also enabled organizations to easily share their authoritative data among its users, including data scientists, emergency response professionals, teachers and students, and the public. This was crucial for decision-makers, who could trust that they were using the appropriate data when determining plans of action.

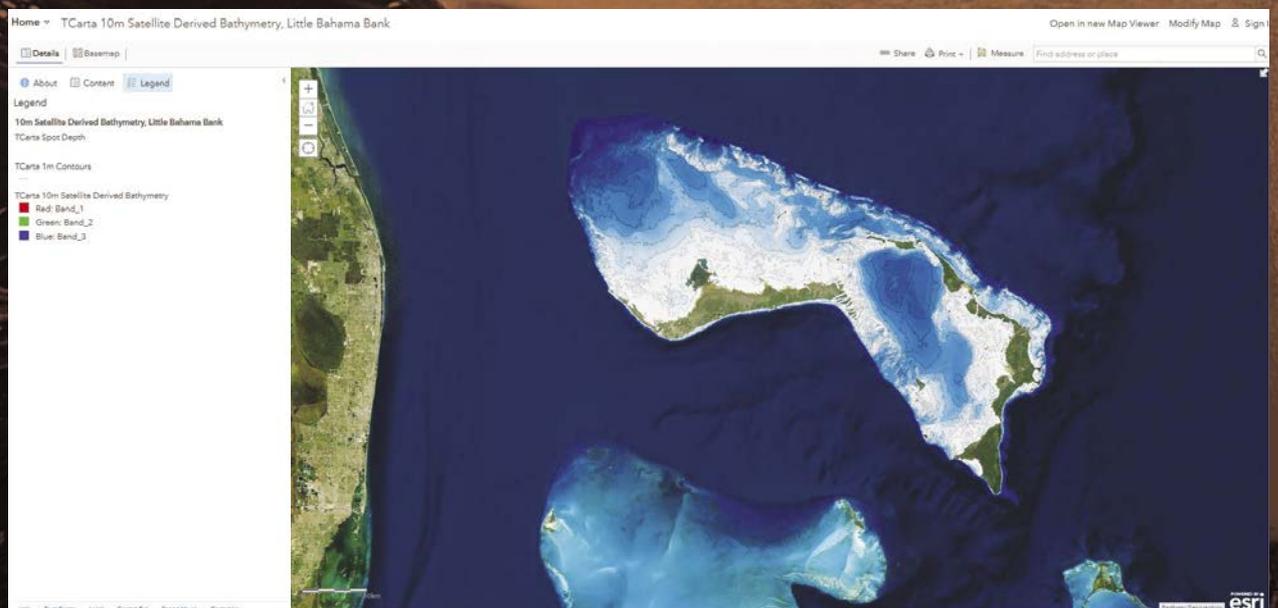
Initiating a More Collaborative and Sustainable Future

Building geospatial infrastructure and geographic knowledge across the Caribbean region is a critical and shared goal for the Caribbean GeoPortal team—one that has immediate ramifications as hurricane season wraps up, as well as larger, long-term gains.

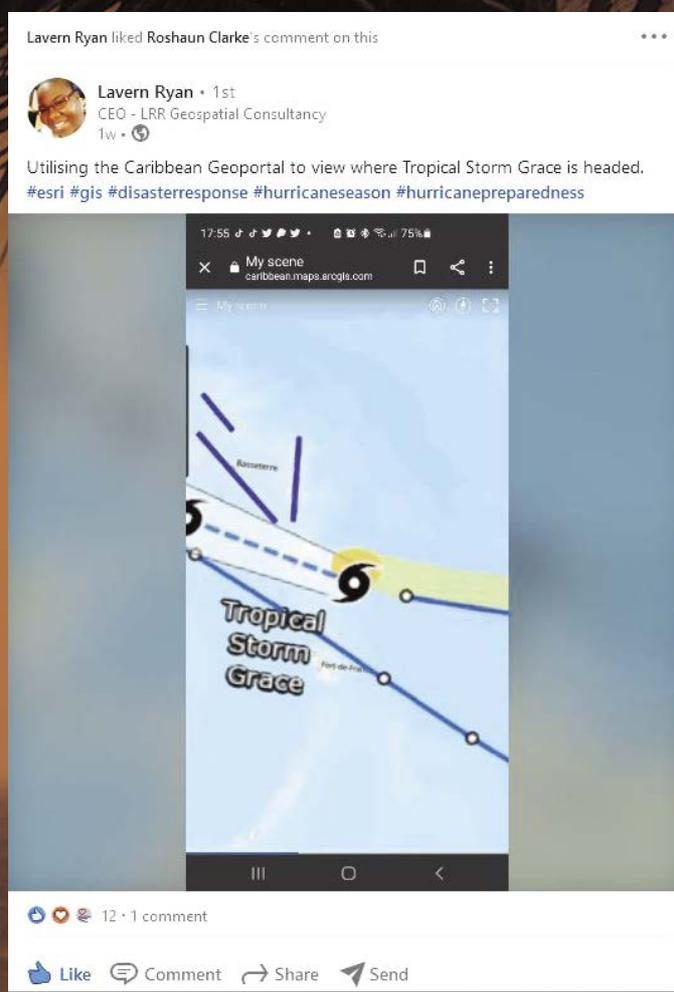
"I was really inspired by [Esri president Jack Dangermond's] vision for collaboration," said Paloma Merodio Gómez, vice president of Mexico's National Institute of Statistics and Geography (known by its Spanish acronym *INEGI*) and chair of UN-GGIM: Americas. "Thanks to the help of Esri, this CARIGEO project is really the start of something bigger."

As more partners join the Caribbean GeoPortal and begin to collaborate, and as more people learn how to use GIS technology to better understand risk and vulnerability in the region, a more sustainable and resilient future will begin to take form.

The Caribbean GeoPortal is open to all organizations in the region that want to contribute to maximizing the economic, social, and environmental benefits of using geospatial information. Similar efforts exist for other regions of the world. The Africa GeoPortal has been up and running for almost two years (see the recent ArcNews article "The Africa GeoPortal Brings Together a Whole Continent of GIS Users" at ow.ly/nKMN50G1YMt), and soon there will be an Americas GeoPortal. To get involved with the Caribbean GeoPortal, visit caribbeangeoportal.com.



↑ Bathymetric imagery from Esri partner TCarta of the Little Bahama Bank in the Bahamas can be used to better understand how to develop resilience to climate change.



← For Lavern Rogers-Ryan, a GIS manager in Montserrat, the Caribbean GeoPortal is her go-to resource for tracking Atlantic storms.

It's Time to Act

The world, according to Dangermond, is a complex and highly interdependent ecosystem that is undergoing rapid changes, mainly due to human activities.

“Geologists are starting to call this the Anthropocene epoch, where humans absolutely dominate the history, the life, and future of our world,” he said. “Today our world is being challenged because we, as humans, are living recklessly and unsustainably. And this is threatening our future.”

Dangermond noted some of the problems we face: pollution, severe drought, racial injustice, pandemics, human-induced climate change, and a steep decline in biodiversity. Reversing course will require creating a future that’s environmentally, economically, and equitably sustainable. This will mean saving wild lands, developing renewable energy, conserving oceans, promoting equity, improving business efficiencies, scaling back consumption, and preserving and creating green infrastructure.

“Applying our best science, our best technology, and our best creative thinking will clearly be necessary,” Dangermond said. “And...geographic thinking is going to be essential in this. Sustainability requires that we see the world as one single ecosystem. Geography provides the science and language to do this.”

Dangermond lauded the work toward these ends that users are already doing using GIS. But he noted that we need to scale up our collective efforts exponentially—and that GIS can help. Technology that supports the sustainability mission includes GIS in the cloud, advanced spatial analytics, artificial intelligence and machine learning, 3D visualization, imagery and remote sensing, and visual storytelling.

In addition, geospatial infrastructure—an expanding, interconnected network of systems, services, and apps—is making data, apps, and maps more widely available for sustainability projects, according to Dangermond.

“This is helping us collaborate. It’s helping us share,” he said. “It’s transforming workflows and decision-making at many scales.”

With the myriad sustainability issues society faces, there’s no time to waste putting forward GIS-based solutions.

“I feel like I am all in, and I want to encourage you to go all in,” Dangermond stressed. “Act with urgency.”

Four keynote speakers at the Esri UC outlined how they and their organizations are stepping up to advocate for and create a sustainable future. They were Wade Crowfoot, secretary of the California Natural Resources Agency (CNRA); National Geographic Explorer in Residence Enric Sala; journalist and National Geographic Explorer Paul Salopek; and La June Montgomery Tabron, chief executive officer (CEO) of the W.K. Kellogg Foundation (WKKF).

A Platform for Conserving California

Earlier this year, Esri and the CNRA entered into a collaborative agreement to build the CA Nature Geographic Information System (CA Nature GIS). According to the agency, CA Nature GIS will synthesize data and information on biodiversity, climate change, public access to recreation, and other key factors across the state of California.

During his keynote presentation, Crowfoot spoke about CA Nature GIS and its role in supporting California governor Gavin Newsom’s executive order that commits to conserving 30 percent of California’s waters and lands by 2030—known as the 30x30 goal. The platform will be used to integrate data about California’s ecosystems, places where biodiversity is rich or threatened, climate change vulnerability, and where access to nature is equitable or restricted. Local governments will use the platform’s tools to identify areas that should be prioritized for protection.

This type of scientific and data-driven geographic approach is needed to meet the 30x30 goal, according to Crowfoot.

“The challenges that we face as a planet, a nation, and a state are daunting,” he said. “Climate change in California now means a catastrophic wildfire season bearing down on us, the second straight pernicious megadrought in a decade, and extreme heat across our state that we’ve never experienced.”

Jennifer Norris, deputy secretary for biodiversity and habitat at the CNRA, joined Crowfoot and Dangermond online to preview CA Nature GIS. She said that the platform can provide a baseline assessment of the amount and location of land and coastal waters currently conserved in the state, establish a process to track progress toward the 30x30 goal, and identify areas that could be conserved.

The CA Nature GIS platform will be available to the public via a website built using ArcGIS Hub. Through it, people will be able to access mapping and visualization tools and authoritative data, giving them the ability to view and analyze information about California’s natural resources. A set of data exploration apps is also being developed, including an online app designed to explore data on biodiverse areas in California.

Dangermond asked Crowfoot how communities will be brought in to help achieve the goal of conserving 30 percent of the state’s land and water in less than a decade.

“The goal is driven from the top, but the solutions are driven from the grass roots,” Crowfoot said.

What will be helpful, he added, is that CA Nature GIS will be publicly accessible, so environmental, conservation, equity, and hunting and fishing groups can participate.

“The challenges are unprecedented, but I think the 30x30 [commitment] is a galvanizing target like none other on environmental conservation,” he said.

Nature can be restored, Crowfoot pointed out, as evidenced by the return of the California condor, the resurgence of sea otters, and the repopulation of beavers in rivers.

“This can happen and will happen if we marry the political will with scientific understanding and the technology tools,” he said.

Establishing Marine Reserves That Protect and Provide

As a professor at the Scripps Institution of Oceanography in San Diego, Sala’s life in academia was humming along. He taught students and wrote scientific journal articles that focused on the negative impact of humans, climate change, and fishing on ocean life. Then he had a revelation.

“I was publishing lots of papers with more and more data about how fast marine life was dying because of us,” said Sala during his Esri UC Keynote Address. “But one day, looking out from the ivory tower, I realized...that all I was doing was writing the obituary of the ocean. I felt like I was the doctor who was telling you how you were going to die...but not offering a cure.”

Today Sala is working toward that cure. He is the founder and leader of the National Geographic Society Pristine Seas project, which is dedicated to saving a minimum of 30 percent of the world’s oceans by 2030. His team of scientists, filmmakers, conservationists, and policy experts explore what Sala calls “the last wild places in the ocean.” The research the team members conduct and the films they make help build cases for the creation of marine protected areas (MPAs). They collaborate with nonprofit organizations, communities, and governments to preserve the areas.

According to the National Geographic Society, the Pristine Seas project has helped establish 23 of the largest marine reserves on the planet, covering an area of 6.5 million square kilometers.

MPAs ban activities that are harmful to marine life, including fishing. In the long run, said Sala, this can actually provide sustainable benefits to commercial fishing. He told the story of a small marine reserve created 20 years ago off the Baja, California, coast with support from the fishing community. The area was overfished, so the community stopped fishing there temporarily. What Sala described as an “underwater desert” in 1999 was teeming with fish, including large predators, a decade later.

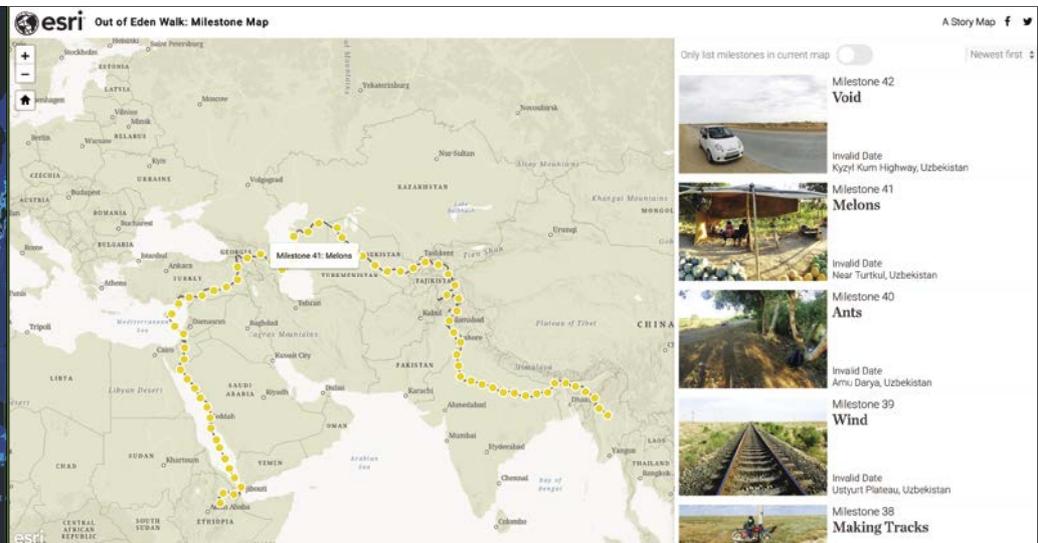
“You know who else is thriving? Those visionary [fishers],” he said. “They are making far more money now from tourism inside the reserve—diving tourism—and from fishing around it.”

Less than 3 percent of the world’s oceans are fully protected from fishing and other harmful activities, according to Sala. To determine how much of the planet’s oceans need protection and the areas to prioritize, Sala and his team are using a scientific approach that includes the use of GIS.

The Pristine Seas team, for example, wanted to know which areas of the ocean contained unique and irreplaceable marine life that is threatened by fishing or other human activities. The team launched a scientific study three years ago to determine which areas of the ocean must be protected first based on a number of



↑ The Pristine Seas project has helped establish 23 of the largest marine reserves on the earth, according to the National Geographic Society.



↑ Journalist and National Geographic Explorer Paul Salopek is using ArcGIS StoryMaps to chronicle his journey and show the concrete problems caused by climate change and inequality.

variables, such as the risk of extinction. GIS technology was used to map data that helped reveal the highest-priority areas. The team also created a map to rank areas that, if protected, would ultimately benefit fisheries outside the MPAs.

“If we protected the right areas in the ocean, these areas could provide an extra 10 million fish and invertebrates for us to eat,” Sala said.

Pristine Seas used Esri technology to build a web app, available at ow.ly/Yrfl50FNvku, that ranks priority areas based on biodiversity protection, food production, and carbon storage to mitigate climate change. According to Sala, this tool will inform government officials’ and other stakeholders’ decision-making.

“We will be able to help countries not only be reassured that protection is going to benefit the fisheries and help reduce carbon emissions, but they will also know this tool will help them implement that commitment,” he said.

The Concrete Realities of Climate Change and Inequality

While Sala’s eyes focus on the world’s oceans and marine life, Salopek keeps close watch on the land and its people.

Salopek founded and is leading the Out of Eden Walk, a National Geographic Society project to retrace the ancient path of global migration. Salopek is doing this by walking 24,000 miles from Ethiopia to the southern tip of South America, chronicling his journey along the way with articles published in *National Geographic* and other publications, as well as through stories created using ArcGIS StoryMaps, available at ow.ly/pd9M50FNvij.

Salopek began the Out of Eden Walk in 2013 and is currently in China. He expects to finish the walk in about seven years.

In his Esri UC talk, Salopek said he confronts sustainability issues, from climate change to income inequality, all the time.

“It’s concrete. It’s not abstract,” he said.

The impact of climate change was glaringly apparent when Salopek joined Afar pastoralists as they herded camels in East Africa’s Great Rift Valley.

“Fickle rains are getting more unpredictable. Pastureland is shriveling up. Water holes are drying out,” he said. “[The Afar people’s] entire way of being—this pastoral economy of moving animals across an unreliable landscape—is becoming increasingly untenable and pushing them into cities. A whole way of life is thinning out and vanishing.”

In India, Salopek said he witnessed the negative impact of the country’s green revolution that boosted crop production in part by using fossil fuels to pump groundwater. Now the nation is plagued by water pollution and a lack of water.

“India is going through the most severe water crisis of any country in the world,” he said. “They are not just running out of water to drink but [also] water to

grow their foods and to stoke their industries. [And] now water quality is highly compromised by pesticides [and] by chemicals.”

Though the problem is overwhelming, local communities are responding to increase sustainability.

“[People] were digging tens of thousands of small surface wells to capture rainfall,” Salopek said. “They were [planting] old crops that were better adapted to drought conditions to feed themselves.”

Salopek left the virtual audience with words of wisdom about the importance of sharing resources, embracing openness, and seeking solutions.

“We are an amazing problem-solving species,” he said. “We have lots of problems—most of them created by ourselves—and we have to resolve them. But our ancestors—the ones who walked across the earth back in the Pleistocene [epoch] and those hunters and gatherers whom I’m following from campfire to campfire—they problem solved their way across unknown landscapes. We’ve got to continue using those muscles.”

Equity as a Path Toward Sustainability

Promoting equity is an important part of creating a sustainable future, according to Dangermond. He invited Montgomery Tabron to talk about this topic in front of the global Esri UC audience.

Her organization, WKKF, awards grants to support the health, welfare, and education of children; assist families; and build equitable communities. The foundation, launched by Kellogg Company founder William Keith Kellogg in 1930, awarded \$252 million in grants in the fiscal year that ended in August 2020.

“[Kellogg] gave us, as a north star, [a mission to] create a place where all children can thrive,” Montgomery Tabron said. “To make sure that children thrive, you must look at issues of racial equity, community engagement, and leadership.”

GIS technology can be used to better understand systems and structures that create these issues, according to Montgomery Tabron.

“By mapping data on COVID-19, for example, you start to see, as we did, that people of color were having more complications as it related to COVID-19 and were even maybe dying more than others,” she said. “That allowed us to [ask], What are the systems that are producing these outcomes? And we learned that more people of color were essential workers who couldn’t stay inside their homes and quarantine. Therefore, they were exposed [to the disease] by greater measures.”

WKKF, its grantee the PVBLC Foundation, Esri, and the United Nations have developed a partnership called the SDG Data Alliance in support of the United Nations’ Sustainable Development Goals (SDGs), including goal 10: reduced inequalities.

“This alliance will enable 20 countries in Africa, Latin America, and the Caribbean to achieve the Sustainable Development Goals,” Montgomery Tabron said, adding that many of these nations face practical and technological barriers to working on the goals. “The grant will build the information technology capacity and infrastructure to allow these countries to monitor and report their efforts toward achieving the goals.”

WKKF is partnering also with the Southern Communities Initiative to create an action plan to tackle issues related to equity in communities such as Atlanta, Georgia; Birmingham, Alabama; Memphis, Tennessee; Houston, Texas; New Orleans, Louisiana; and Charlotte, North Carolina. One aspect of the project is the production of community action hubs, where data and maps on wealth creation, jobs, education, health, and housing can be accessed to promote better-informed decision-making by government officials, business leaders, and others. To see an example of a community action hub, visit the New Orleans Community Action Hub at nola-wkcf.hub.arcgis.com.

“We hope the GIS community will help us realize this vision,” Montgomery Tabron said. “We have the tools. We want the GIS community to stand up these community action hubs all over the nation.”

Taking Collective Responsibility for the Future

Dangermond praised the work of Crowfoot, Sala, Salopek, and Montgomery Tabron and their organizations for the leadership roles they are taking in creating a sustainable future. He then encouraged everyone to get involved.

“Our world is being challenged on many fronts, and we will increasingly need to be responsible for its future,” Dangermond said.

He pressed audience members to move forward with purpose, doing things such as providing leadership, thinking geographically and holistically, applying new tools and methods, and collaborating and exchanging ideas with other organizations. Now is the time to act, he said.

“These are the times we are going to have to get it together and move at many different scales,” Dangermond concluded.



All objectives

If we look at each objective in isolation, there are tradeoffs. Protecting the top areas for biodiversity could result in a loss of fishing catch, for example. To solve this problem, we developed a new framework to optimize for all three benefits.

This map shows overall priority areas when all three objectives—biodiversity protection, food production, and carbon storage—are weighted equally.



↑ National Geographic Explorer in Residence Enric Sala and his team have used a scientific approach along with GIS to determine which areas of the ocean to prioritize for protection.



↑ Community action hubs, like this one for New Orleans, Louisiana, have data and maps on topics such as jobs, education, and health to support governments and businesses with decision-making.

Scientific Currents

By Dawn Wright
Chief Scientist, Esri



Biodiversity Matters to Everyone, So Let's Protect It

Biodiversity is the variety of life on Planet Earth, from microscopic genes to entire ecosystems. But the natural world is under siege. The rate of species extinction right now is at least 10 times to hundreds of times higher than the average over the past 10 million years—and is accelerating—according to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

It is essential that we all care about biodiversity. As Dr. Healy Hamilton, chief scientist of NatureServe (natureserve.org), pointed out in her Keynote Address during the Esri Science Symposium at this year's Esri User Conference, diversity of life is the foundation of our ecological, cultural, economic, and spiritual well-being. It has everything to do with the food we eat: 15 crop plants feed 90 percent of the world's population, yet 400,000 plant species are known to have edible parts, Hamilton noted. It has everything to do with the medicines we take: 40 percent of drugs come directly from the biodiversity in creatures such as amphibians, sea cucumbers, and bats, she said. We cannot survive on the earth without the services that biodiverse ecosystems provide, such as pollination from honeybees, native bees, and even flies; nutrient cycling, wherein nutrients move from the environment to plants and animals and back again; and the purification of air and water.

The implications of a less biodiverse planet are gargantuan for agriculture, forestry, recreation, real estate development, energy infrastructure, transportation, and even military readiness. And yet biodiversity remains a blind spot for humans. As the venerable naturalist E. O. Wilson has warned, the only hope for the species that are still living is a human conservation effort that's commensurate with the magnitude of the problem.

For many scientists, 2021 is the year of biodiversity—the year in which we finally get serious about preserving the diversity of life on this planet. Momentum has been building toward a series of very important global biodiversity conferences. They include the United Nations (UN) Biodiversity Conference in Kunming, China; the UN Climate Change Conference UK 2021 in Glasgow, Scotland; and the E.O. Wilson Biodiversity Foundation's Half-Earth Day in London, the United Kingdom (UK). Publishing around the same time from Esri Press is *GIS for Science, Volume 3: Maps for Saving the Planet* (gisforscience.com), which focuses heavily on biodiversity and analyzes it through the lenses of global satellite observation, forestry, marine policy, artificial intelligence, conservation biology, and environmental education. These meetings and the book all explore the actions we need to take and the essential tools we need to use to reverse the planet's loss of biodiversity and address the impacts that this has already had on ecosystems, species, and people.

Esri is involved in many efforts to reduce biodiversity loss, primarily by helping people leverage geospatial technology to monitor at-risk species, control invasive species, protect critical habitats, improve water quality, help policy makers make science-informed decisions, and more. While there are so many important projects under way, one to call attention to is the Half-Earth Project (half-earthproject.org). Put on by the E.O. Wilson Biodiversity Foundation, the project aims to safeguard half of the earth's land and sea.

The Half-Earth Project puts species front and center for conservation. If species are accurately represented in how we characterize the planet's biodiversity and half of all land and sea are eventually protected to better manage species' habitats, then this can help reverse the current extinction crisis. To this end, one of the project's goals is to map species distribution around the globe and track conservation progress at the species level to identify places where additional conservation actions would best preserve biodiversity. The Half-Earth Project Map—a joint effort from Yale University, Map of Life, Vizzuality, and Esri that's available at map.half-earthproject.org—allows users to interactively explore global biodiversity data, areas that are prioritized for conservation, and various biodiversity indicators.

A recent update to the Half-Earth Project Map introduces National Report Cards with a Species Protection Index (SPI). This measures how many and how well groups of species are protected by a country's conservation efforts at the national level. The SPI is a very important biodiversity indicator for policy making because it helps ensure that conservation actions continue to reflect and achieve conservation goals over time by prioritizing areas where biodiversity protection is most needed. The layers of priority areas for conservation show where efforts can be directed to make the most rapid gains in species protection. And the Half-Earth Project updates the SPI regularly to reflect when additions are made to protected area networks, which is particularly significant in countries with low SPI values. The Convention on Biological Diversity is considering adopting SPIs as a trial indicator for collaborative, coordinated global action plans to protect biodiversity. Additionally, SPIs have been made available for use to organizations such as the UN Environment Programme World Conservation Monitoring Centre, the Group on Earth Observations Biodiversity Observation Network, and the IPBES.

Indeed, the foundational science of the Half-Earth Project is the forerunner of other initiatives such as the emerging 30x30 movement. Dozens of countries have recently committed to

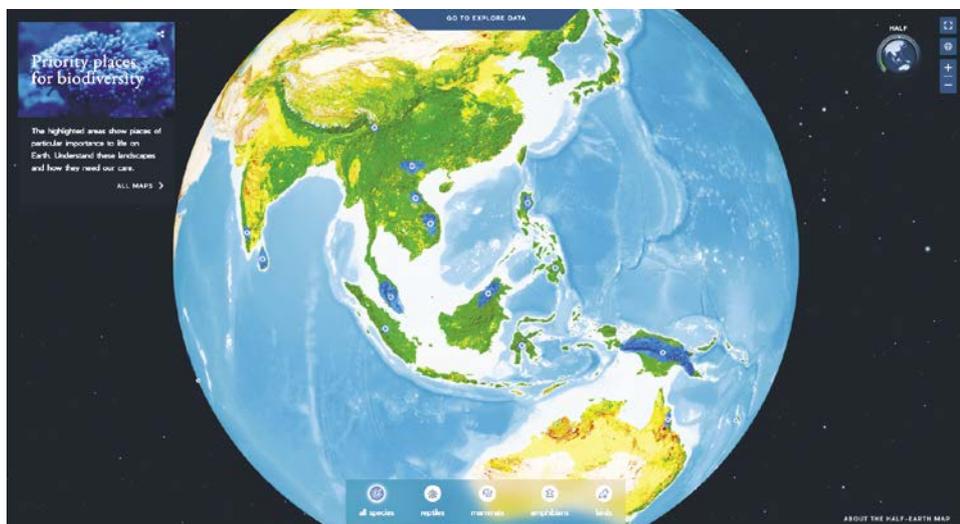
conserving 30 percent of their land and waters by 2030. The United States' commitment includes an executive order signed by President Joseph R. Biden that went into effect in January, as well as pledges to do the same from tribal nations (in the spirit of equity and reconciliation) and states such as Hawaii, Illinois, Maine, Michigan, Nevada, New Mexico, New York, South Carolina, Virginia, and California. Not surprisingly, Esri is playing a major role in California's 30x30 efforts by providing an open geospatial infrastructure, available at californianature.ca.gov, that facilitates holistic conservation planning, incorporates indigenous and other community feedback, and allows users to evaluate scenarios for sustained landscape conservation. (More information about Esri's 30x30 efforts can be found at ow.ly/8ndM50G4adn.)

It is essential to discover, identify, and map not only as many species as possible but also those species that are at risk and aren't already safeguarded. In "Open Science Is Good Science," a column I wrote for the fall 2020 issue of *ArcNews*, I briefly mentioned NatureServe's Map of Biodiversity Importance. Available at ow.ly/40vx50Bmeib, the map offers the first high-resolution view of the habitats of more than 2,200 at-risk species across the United States. At the Esri Science Symposium this summer, Hamilton shared the latest updates to the map and its data within ArcGIS Living Atlas of the World, plus the many other tools and resources that NatureServe makes available for mapping the distribution of imperiled species. (Posts and information from the Esri Science Symposium are available at ow.ly/cJnR50G4ae0.)

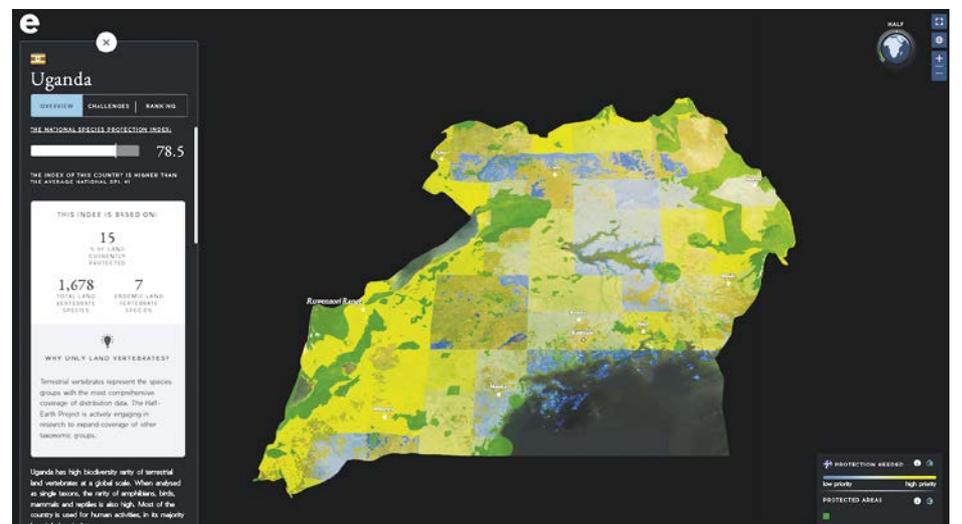
Projects such as Half-Earth, 30x30, and the Map of Biodiversity Importance are showcasing how critical geospatial technology is to fighting the existential threat of biodiversity loss. This will ultimately affect the food we eat, the medicines we take, the buildings we live in, and all the natural spaces that we hope to enjoy. Biodiversity matters to all of us, so let's get to work protecting it by joining these and other causes.

About the Author

As chief scientist of Esri, Dr. Dawn Wright aids in strengthening the scientific foundation for Esri software and services while also representing Esri to the scientific community. A specialist in marine geology, Wright has authored and contributed to some of the most definitive literature on marine GIS.



↑ The Half-Earth Project Map shows the richness and scarcity of species diversity on land for amphibians, birds, mammals, reptiles, cacti, and conifers.



↑ The National Report Card for Uganda shows that its current Species Protection Index (SPI) is higher than in many other countries.

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Urban Design Training Goes Virtual with ArcGIS Pro

In Singapore, the Urban Redevelopment Authority (URA) is responsible for urban planning in the city-state. With the goal of making Singapore a better place to live, work, and play, the URA regularly provides core foundational training to the organization's planners and architects to give them an in-depth understanding of cutting-edge urban design techniques and sensibilities.

This training typically requires participants to collaborate in groups on an urban design project. They're given a site and a design brief that tasks them with developing a well-considered proposal that accounts for surrounding land use, the streetscape, the area's heritage value, topography, the environment, transportation networks, and community needs. At the end of the course, teams present their projects for discussion in both 2D and 3D, complete with concept sketches, drawings, and physical models.

The onset of the COVID-19 pandemic, however, meant that the traditional approach to training—which includes in-person workshops and requires teams to build physical models for critiquing—would no longer be viable. By mid-2020, the majority of people in Singapore were working from home. Determined to continue and improve its training program, URA's training team opted to digitally transform its courses to an online format where participants could collaboratively develop, share, and evaluate their urban design projects. ArcGIS Pro was key to executing this plan.

ArcGIS Pro Takes On a New Role

To ensure that the program could continue virtually, members of URA's training team explored alternatives to their traditional approach. They decided to keep the same course requirements but pivoted to a digital approach. They needed a technology solution that allowed participants to collaborate, incorporated 2D and 3D data, and was easy to implement.

"[The] capability [of ArcGIS Pro] to work with both 3D and 2D data made it a great choice for us," said Julian Cheng, executive architect at URA's Design and Planning Lab. "There was also no need to specifically deploy additional 3D software to the participants, as ArcGIS Pro was already used and deployed across the organization as our main GIS software."

Indeed, what proved vital to the new training program was staff members' experience in leveraging advanced GIS technology across a range of sophisticated urban planning workflows. When they needed to swiftly transition to remote work,

employees could still access URA's geospatial data from anywhere, anytime they needed it.

Having already digitally transformed workflows across the organization in previous years, URA's training team was familiar with conducting courses virtually and incorporating ArcGIS Pro into the curriculum. Many participants had also used the technology in other analytical training courses in which ArcGIS Pro is taught as the main software.

Digital 3D Models Produce Richer Detail

In September 2020, the URA training team launched its first virtual urban design course.

To begin, participants were brought up to speed on working with 3D models in ArcGIS Pro so they could use it effectively to

convey their design ideas. URA also provided participants with an existing 3D digital model of Singapore that they could import into ArcGIS Pro. This helped participants visualize and analyze how their designs would fit into the real world.

"They quickly realized how much more they could do with ArcGIS Pro as opposed to work-

ing with physical models alone. For example, participants learned how to conduct 3D analyses, such as shade, solar, and viewshed simulations, to test out and explain their urban design proposals in a more visual and data-informed manner," said Cheng. "By integrating existing 3D digital models—including those from other platforms—with our 2D GIS datasets and pushing boundaries of other 3D technologies, including [ArcGIS] CityEngine, we were able to enhance our urban planning training and develop new workflows for greater efficiencies and effectiveness."

Members of the training team noticed that by changing from physical models to ArcGIS Pro simulations, participants created design plans richer in detail and more comprehensive than those produced using the previous, more traditional approach.

Virtual Becomes the New Normal

As of September, URA has conducted two urban design courses remotely. In total, approximately 60 participants have built their 3D designs in ArcGIS Pro and have developed a more comprehensive understanding of urban planning technology.

The collaborative workflows established through this training program are set to become the norm for future training and urban planning projects at URA. According to Cheng, the training team is in the process of finding more ways to incorporate ArcGIS Pro across courses.

"We have conducted three runs of another internal vocational training course virtually, using ArcGIS Pro to build efficiency in the use of spatial data and analytics for urban planning work," he explained.

Through these additional programs, more than 80 participants have done virtual learning at URA in 2020 and 2021.

"To facilitate continuous learning, we have also published some self-paced e-Learning content, which we will continue to build up and supplement over time," said Cheng.

As the training team looks toward a postpandemic future, virtual 3D models will continue to be a core aspect of courses that help planners and architects learn to make smart planning decisions.

"After the pandemic, the course will have a mix of virtual as well as in-person sessions to facilitate interactions, discussions, group work, and hands-on activities," said Cheng. "We will continue to develop competencies in using ArcGIS Pro—together with other digital tools, such as parametric design and environmental simulation tools—to enhance our work."

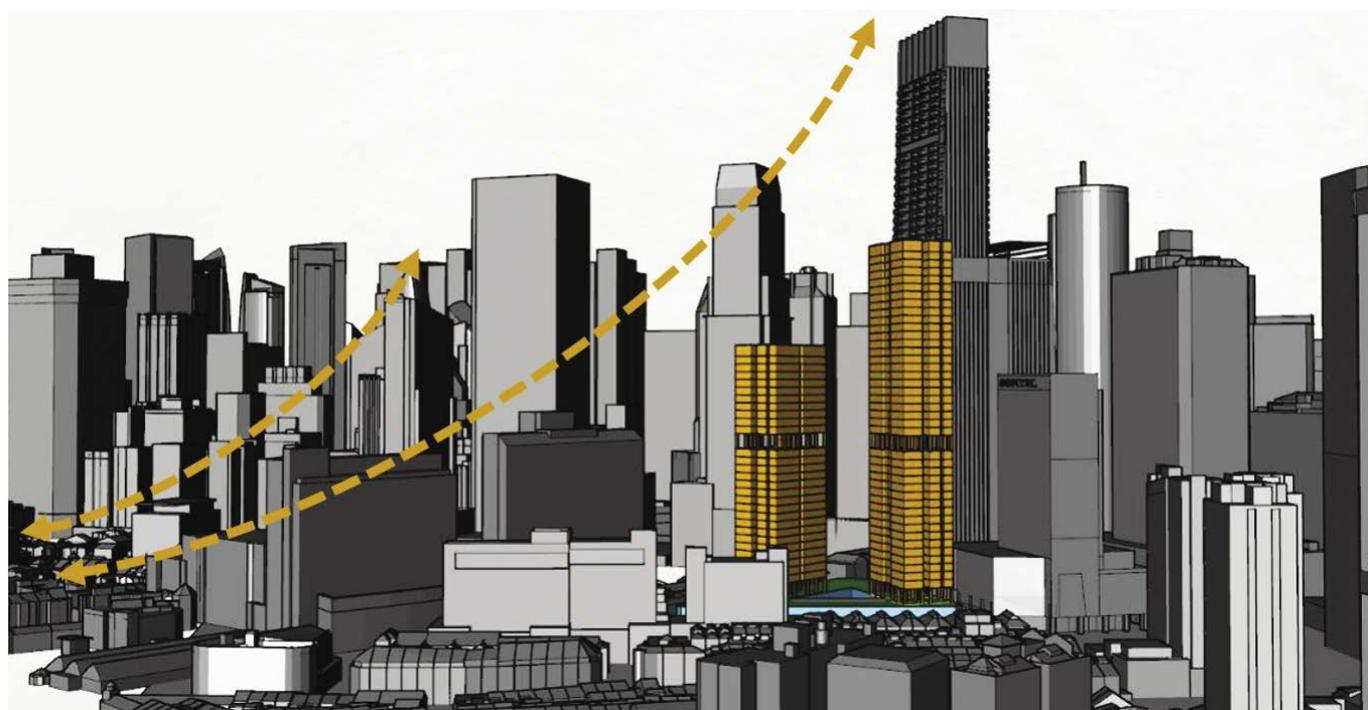
By digitally transforming its design courses and conducting this training program remotely, URA can improve the skills of more urban planners and architects throughout Singapore. Those who complete this new method of training will be able to leverage the latest technological capabilities for urban design, including geographic building information modeling (BIM), 3D digital twins, and smart city planning.

URA's trailblazing use of modern urban planning technology will ensure that today's decisions will make Singapore a livable and sustainable city for future generations.

“ [Participants] quickly realized how much more they could do with ArcGIS Pro as opposed to working with physical models alone. ”

Julian Cheng

Executive Architect, Urban Redevelopment Authority's (URA) Design and Planning Lab



↑ Participants sculpted the skyline by augmenting 3D massing studies with the 3D digital model of Singapore provided by the Urban Redevelopment Authority (URA).

← ArcGIS Pro enabled participants to do viewshed analyses to examine proposed buildings in relation to identified view corridors.

New ArcGIS Urban Capabilities Drive Neighborhood-Level Planning and Design

In a city, each space affects and reflects the function of every other. The size and shape of each building, parking structure, and green space, taken together, make up the physical form of the city—for better and for worse.

Over the last half century, urban development has tended toward tall glass buildings and wide roads that accommodate lots of cars, with little regard for walkability or more equitable mobility options. But if we look at the kinds of cities that most people seem to want to live in today, we often see that they devote very little space to road transportation and instead center on useful destinations like shops and cafés that people can easily walk or bike to.

To directly take on these challenges, urban designers must take geospatial context into consideration when formulating development plans. That's where ArcGIS Urban comes in. The web-based 3D modeling software enables users to sketch out various design scenarios, model buildings, and measure the performance of their plans by using interactive metrics.

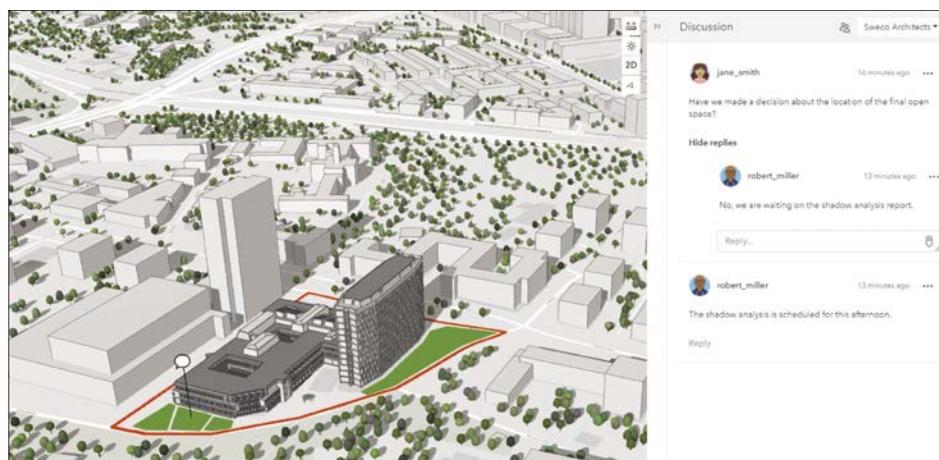
City planners in Uppsala, the fourth-largest and fastest-growing city in Sweden, are using Urban, for example, to design a new district with 33,000 new housing units that will accommodate 50,000 new residents by 2050. The planners wanted to concentrate on sustainability while maintaining the quality of life that current residents of the centuries-old university town already enjoy. With ArcGIS Urban, city planners were able to test different design strategies for the project and run them against sustainability and quality-of-life metrics to ensure that the development wouldn't subtract from the area's existing biodiversity and would still enable the city to meet its goals for reducing carbon emissions.

On the other side of the world, the City of Des Moines, Iowa, is employing ArcGIS Urban to transform its historic East Village into a more walkable, dense, mixed-use neighborhood. When a local property developer floated the idea of building a new 40-acre market district, the city's planning and economic development teams wanted to visualize the prospective space to ensure that views of the gold-domed state capitol would be preserved. They built a digital twin of the area and, using the technology, were able to balance the desire for urban development and renewal with their responsibility to protect historic views, meet housing demands, and ensure livability and climate resilience in the area.

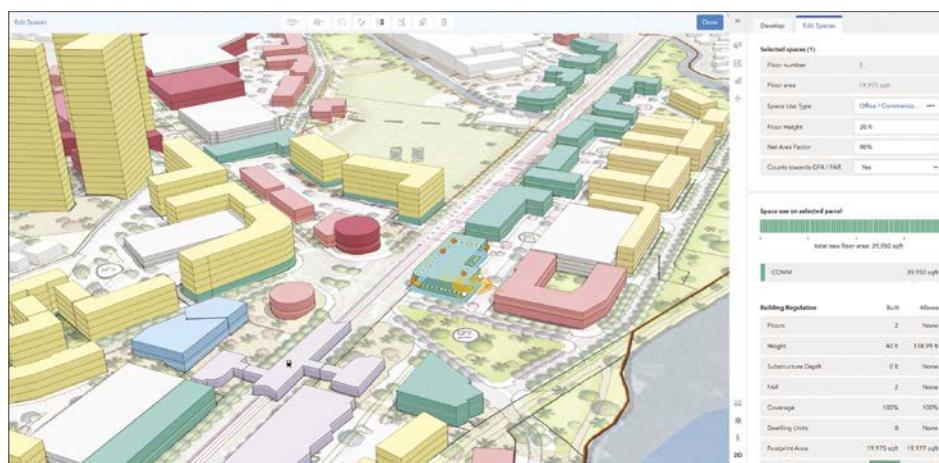
The summer 2021 release of ArcGIS Urban contains an assortment of new tools that can help urban planners meet their challenging design goals while giving them a smooth user experience. Read on to find out more about several of these advancements.



↑ Interactive dashboards enable viewers to visually assess metrics.



↑ Stakeholders can start a new discussion and mark up ideas directly on a design.



↑ Users can sketch out various design scenarios and model buildings.

More Flexibility When Sketching Buildings

Buildings and space use types, which describe the function of a space within a building, are the centerpiece of any design scenario within an urban plan. Now, in ArcGIS Urban, users can modify buildings that have been procedurally generated and sketch buildings from scratch on a selected parcel by drawing a new space use. This opens up a world of possibilities when creating detailed site concepts. For instance, when drawing from scratch, users can demolish specific buildings, if desired, and then draw one or more buildings on the site, starting with the first floor. They can then easily add floors and incorporate other space uses into the building.

This new sketching capability also allows users to edit individual vertices of building floors, push

and pull building walls, rotate building parts, and adjust the elevation of the entire structure. And support for snapping has been added throughout Urban, so users can snap new details to existing elements, making editing easier. In addition, it is now possible to adjust various attributes—such as the space use type, the height, and the net area of an individual building floor—on the fly. This means that for complex buildings, each floor can have unique parameters without requiring users to make a bunch of new space use types.

Metrics for Real-Time Feedback on Goals

Previously, there was often a lag between the time designers created new urban scenarios and analysts evaluated them. But now, ArcGIS

Urban makes the design formulation and evaluation processes seamless. As planners create new scenarios, they can use the technology to analyze the effects of their designs, including things like the financial performance of the plan; the overall distribution of housing units by type; and sustainability forecasts, such as how much the plan will reduce carbon emissions.

This is possible, thanks to a new capability in Urban: custom metrics. Users can now create their own metrics to report on objectives such as the total number of jobs a project will generate, how affordable a residential development will be, and parking supply and demand. Metrics can also be configured based on other metrics. For example, designers can simultaneously evaluate how many affordable housing units a residential development will contain and how many market-rate units it will have by dividing the total square footage of the development accordingly.

As users create their designs, they can always keep track of how their metrics relate to one another by using a dependency graph. A metrics dashboard allows users to report and visualize metric values in an easy-to-understand way across all planning scenarios. And the dashboard is interactive, giving users the ability to visually assess things like how much a building floor or surface will contribute to a particular metric. By clicking on charts related to parking, for instance, planners can see where demand is highest throughout the proposal and compare that to where available parking will be located.

Collaboration Gets a Boost

To make it easier for collaborators to exchange ideas about various planning scenarios, ArcGIS Urban has a new sharing and discussion functionality. Users can decide whom they want to share their designs with and then set up individual discussion channels in Urban for each group of stakeholders. People can make comments about the scenarios either by writing general notes or by annotating specific parts of the designs.

Of course, Urban users can still email their colleagues links to their design plans, and discussions can certainly happen outside the software. But this new commenting capability makes it easy to add fresh ideas to a plan, reply directly to comments made on a design, and evaluate various scenarios in detail and in context.

How to Get Started

This is just a sample of the new features available in ArcGIS Urban. To learn more about how to sketch new buildings, create metrics, conduct interactive shadow analyses, and more, go to [ow.ly/FXhn50GedEr](https://www.esri.com/arcnews/urban).

How to Choose the Right Web App in ArcGIS Online

As maps have evolved from being largely paper prints to existing much more commonly in interactive web apps, the way users experience maps—and the data within them—has changed. While static maps can provide very good information, interactive web apps allow audiences to really connect with and explore the data in a map.

Apps are the user experience for digital maps and data. The tools and visualizations in apps guide users through the data and help them answer questions. That's why when building an interactive web app, it's important to consider how users should experience the data. What interactions should the app permit? And which app builder will support them?

If you are thinking of adding to the six million web apps that already exist in the ArcGIS Online system, take a look at some important factors to consider before building an app. Then check out some of Esri's most popular app builders.

Four Questions to Ask

The ArcGIS Online ecosystem has a wealth of app builders that each support different purposes. Some are intended to gather data and analyze what's nearby, while others communicate status and tell spatial stories.

Before selecting which app builder to use, creators should think about the purpose of the app; who's going to use it; and what the design, in general, should look like. They should also bear in mind their own app-building skill levels and their knowledge of the data they're working with. Depending on the project, some considerations might outweigh others, and at times, multiple apps might meet users' needs. Of course, these choices also depend on personal preference.

What's the purpose?

To help define the purpose of a web app, answer the following questions:

- What is the goal of the web app? Is there one goal, or are there many?
- What functions do users need to perform with the app?
- Is the data available and ready to use, or does it need to be collected or transformed?

Different data types, such as dates, attachments, and imagery, can unlock specific capabilities in different apps. So the data alone can determine the potential purpose of the app.

When an app is intended for multiple workflows and audiences, it usually works best to create more than one app. To ensure a streamlined user experience, it's advisable to create one app for each purpose and audience type.

Who's the audience?

Who will be using the app? Is it intended for the general public or seasoned GIS experts? Maybe it's for senior citizens or residents under evacuation orders.

App creators need to identify who the core users are going to be and understand their technical abilities because each audience calls for different designs. For example, people who have grown up using technology are typically comfortable clicking or tapping buttons and figuring out what to do at each step, while people who adopted technology later in life need a guided workflow to gain confidence in interacting with an app.

Additionally, when creating apps for the general public, accessibility is a basic requirement. Specific colors and levels of contrast, for instance, make it easier for some users to see different components and buttons, and it is often necessary to ensure that apps work with assistive technology such as screen readers. If the audience is multilingual, it is critical that the app support multiple languages.

How should the design look and function?

Choosing an app builder depends in large part on how much control the creator wants over the app's design. Key design choices include the following:

- How the audience uses the app—Choices such as how the scrolling works, what can be zoomed in on, and how to navigate through the app affect how users engage with the content.
- How much branding the app displays—For organizations with strict branding guidelines, app creators may need to select an app builder that supports custom Cascading Style Sheet (CSS), symbology, and styling.
- Whether different types of devices need unique experiences—Certain app builders have the option to create distinctive user experiences for audiences accessing the app on mobile browsers, on desktop browsers, or natively.
- The tools that come with the app—App creators need to figure out how users will interact with the data and maps in the app and where those tools should reside.

How tech savvy is the app creator?

Some app creators like to add customized details, while others stick to the template. Some people enjoy selecting each color and symbol, while others are content running with the defaults. These app-building skills and preferences greatly influence which app builder creators choose.

Also crucial is how much time they have to build the app. While anyone with enough time and interest can certainly learn new technology, in some cases, it is easiest for people to leverage their already existing skills and knowledge.

It is also important for app creators to consider how knowledgeable they are of the data they're working with. The more familiar they are with it, the simpler it is to figure out what capabilities the app needs to have.

Four App Builders to Consider

After app creators consider the purpose of the app, its intended audience, general design specifications, and their own abilities, it's time to choose an app—or several—for the project at hand.

ArcGIS Online users with a Creator or GIS Professional user type can author apps, and they have access to a variety of app builders. Four popular ones, highlighted below, are all built with ArcGIS API 4.x for JavaScript, which means they support the latest web mapping capabilities in the new Map Viewer.

ArcGIS Instant Apps

ArcGIS Instant Apps offers single-purpose apps that fulfill specific workflows. For example, the Nearby app shows people what's around them, the Attachment Viewer app displays images and videos clearly, and the 3D Viewer app showcases 3D scenes. Selecting an app from Instant Apps is the fastest way to provide an intuitive user experience for the general public. Every Instant Apps template has a common set of tools, including search, navigation, and integration with web analytics. The apps are also optimized for use across devices and with assistive technologies.

ArcGIS Dashboards

Dashboards are some of the most viewed GIS apps ever, and it's no surprise why: they make it easy to understand data at a glance. The maps, lists, charts, and gauges that constitute a dashboard summarize information in visually appealing ways. These elements can be interactive as well, so when a user selects a map, list, chart, or gauge, the corresponding data populates the item. ArcGIS Dashboards makes for smooth configuration, too. All app creators have to do is drag the components to where they want them on the screen. Dashboards can be single- or multipurpose, and their design and customization options range from simple to complex.

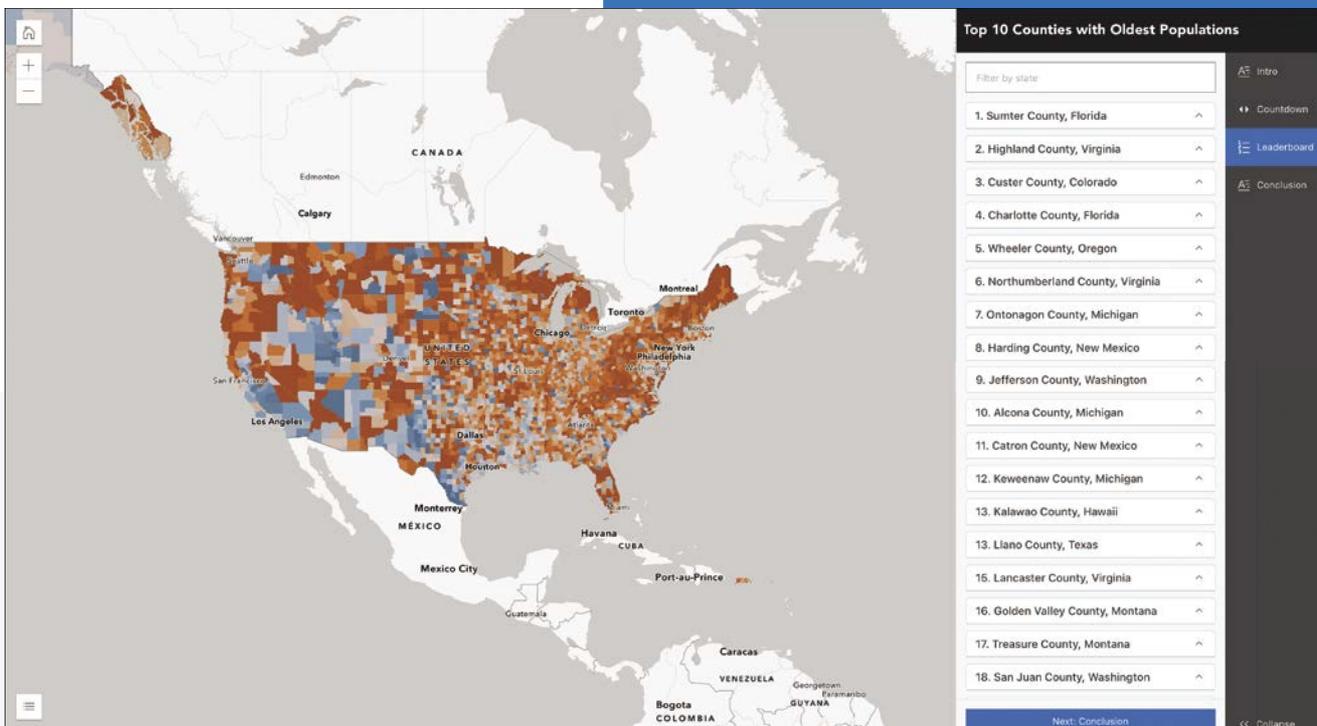
ArcGIS StoryMaps

ArcGIS StoryMaps offers an innovative way to tell stories using GIS. These interactive apps guide viewers through a story using components such as videos, photos, maps, and narrative text blocks. The ArcGIS StoryMaps builder includes express maps, which provide a simplified map authoring experience. App creators can also incorporate existing web maps and apps from the ArcGIS Online ecosystem into their stories. The defaults in ArcGIS StoryMaps are stylish and modern, making it easy for anyone to create great-looking stories. Additional customization is available, and StoryMaps is optimized for use across devices.

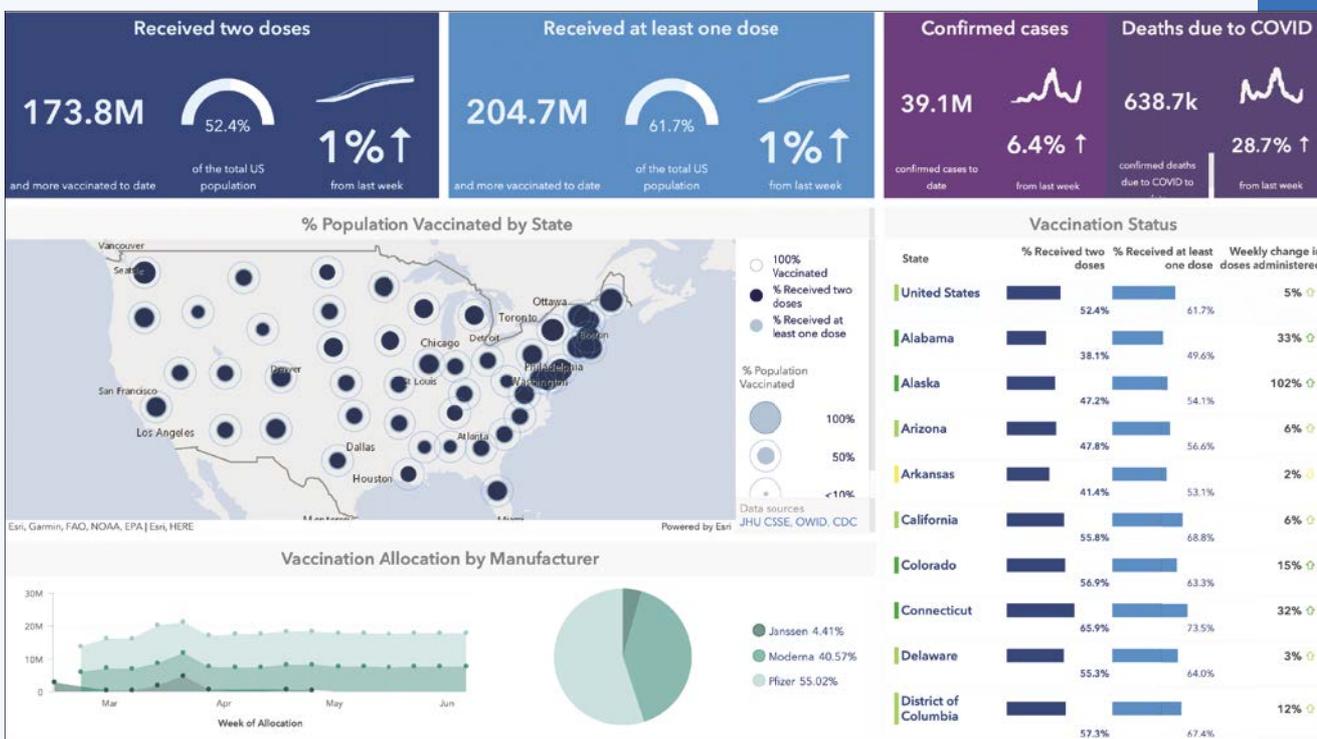
ArcGIS Experience Builder

With ArcGIS Experience Builder, app creators can transform their data into compelling web apps by building the apps themselves, either using a template or by starting from scratch. There are plenty of widgets to choose from—including maps, images, text, and lists—that drive an integrated user experience and can be incorporated across one or multiple pages. Experience Builder can also showcase both 2D and 3D data in a cohesive view. The flexible builder allows app creators who have more experience and training to perform deep customization to support detailed branding; an assortment of more complicated audience interactions, such as scrolling and zooming; and unique experiences for mobile and desktop browsing.

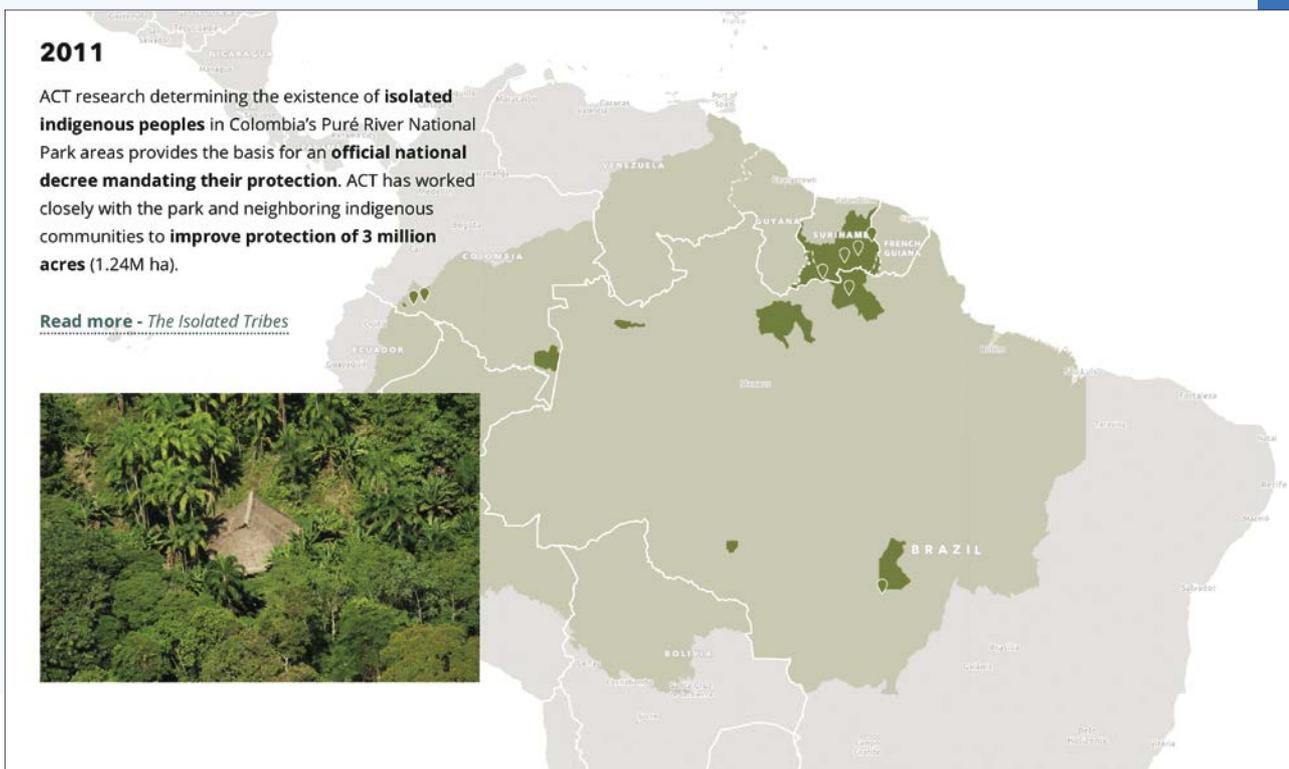
ArcGIS Online contains many interactive web app builders that users can choose from. After determining the purpose of the app, who the audience is, what the design requirements are, and their own technical abilities, users who want to create apps can find the right app builder for their project.



↑ The Countdown app from ArcGIS Instant Apps displays a list of locations in a map that are ranked by value.



↑ Dashboards present a lot of information—like COVID-19 vaccination rates across the United States—in a simple and easy-to-understand way.



↑ Interactive ArcGIS StoryMaps apps guide viewers through a narrative using videos, photos, maps, and text blocks.

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A GIS Innovator Pursues Her “Mappiness”

Annette Ginocchetti has boundless enthusiasm for GIS. She is also always one step ahead with the technology.

Ginocchetti helped build a 3D dataset of major US cities long before digital twins were a thing. She used GPS to map and classify roads all over the United States, which laid the groundwork for the ubiquitous mobile navigation systems of today. She advocated for open data well in advance of many organizations making it a priority. And she’s now implementing hub-based GIS solutions that integrate all sorts of technology—including payment systems—with GIS.

“GIS is a fantastic field, and it’s super special to be in it,” said Ginocchetti, the GIS services manager at the Northeastern Pennsylvania Alliance (NEPA), a nonprofit community and economic development agency. “I’m so proud and thankful and feel very blessed to be part of this world.”

A lover of the outdoors, Ginocchetti recognized early on that she wanted a career that got her out into nature.

“I was working for my family’s shoe store and knew I didn’t want to be in retail,” she said. “I wasn’t sure what I wanted to do in life, but I figured environmental science sounded good.”

That’s the major she chose as a sophomore at a Pennsylvania State University branch campus. Around the same time, a friend of her mom’s encouraged her to apply for an internship at the Pennsylvania Department of Environmental Protection. She got it.

“They handed me a GPS receiver and asked me to go out and locate all the abandoned landfills in northeastern Pennsylvania. I thought, what a great job this would be, working with satellites and working outside,” she said. “I fell in love with GPS and GIS technology.”

Ginocchetti soon transferred to the main Penn State campus, where her major fell under the College of Agricultural Sciences.

“*[There were]* a lot of farmers,” she said. “It just wasn’t what I thought it was going to be.”

She went to her guidance counselor and asked where all the GPS and GIS classes were.

“She asked, ‘Like space?’ And I was like, ‘I guess so.’ So she said to check out the College of Earth and Mineral Sciences,” Ginocchetti recalled. “When I went there, I discovered that that’s where all my people were!”

Ginocchetti dropped her environmental science classes and picked up a bunch of geography classes. She was told that she could study the history of geography and become a teacher or focus on digital geography.

“By default, I chose the latter, and I’ve never looked back,” she said. “It was one of the greatest decisions of my life.”

Annette Ginocchetti



Despite not having much of a mapping background—she once drove through the Mojave Desert to attend a Grateful Dead concert and had difficulty figuring out where she was while using a paper map—Ginocchetti’s first professional ventures in the industry were foundational to modern mapping technology.

After college, she was hired as a GIS analyst for a mapping company called Urban Data Solutions. Her primary responsibility was to attach spatial attributes to photographs of buildings in major US cities. The company then pitched the 3D photos and datasets to gaming companies, real estate agencies, government organizations, and more.

“We built the first 3D dataset of all the major cities in the United States,” she said.

Soon, however, Ginocchetti noticed that her coworkers were being laid off, so she started sending out her résumé. Sure enough, Urban Data Solutions shut down.

Within a week, a digital mapping navigation company called Etak recruited Ginocchetti for a data collector position. While she was at a six-week training course on how to map and classify roads based on their function, Etak was bought out by Tele Atlas, whose parent organization is now Esri partner TomTom.

“At the time, Tele Atlas and NAVTEQ *[now owned by Esri partner HERE]* were two companies going head-to-head to map the United States for in-car navigation. So there was a rush to map the functional road classification in the United States,” Ginocchetti explained. “Tele Atlas sent me

home with a company car, a pentop computer, and a dataset. I was responsible for mapping all the roads in northern New Jersey.”

Ginocchetti was told that one day she’d be able to stand on a street corner and see all the streets appear in a map on her cell phone. At the time, that seemed a little futuristic, she thought.

“I had no idea back then how big this was going to be,” she said. “But I loved my job. I loved being on the road. I loved mapping reality.”

She won awards for the quality of her data and even got to map rural areas in Ohio, Kentucky, and Indiana. But she saw that Tele Atlas was starting to sell its cars and lay people off, so once again, Ginocchetti began circulating her résumé. This time, she wanted to work closer to home, ideally in Philadelphia. A GIS analyst opportunity arose at the Delaware Valley Regional Planning Commission (DVRPC), and she jumped at the chance to work there.

“When I interviewed for the job in Philly, I didn’t know how to explain to them what I did, so I streamed my drive to the interview,” she said. “I mapped the whole ride down, and they could see the GPS tracks—which I called Nettie’s Spaghetti—all the way to the parkade.”

Ginocchetti landed the job, which allowed her to bridge all the mobile work she’d been doing with her education in GIS. She made maps for the planning commission using ArcGIS 8.x—which was new technology for her—and credits her colleagues at DVRPC with teaching her a great deal about GIS.

From there, Ginocchetti moved even closer to home and got a management-level job at



↑ Ginocchetti built a dashboard showing COVID-19 cases in northeastern Pennsylvania, broken down by county.

GIS Hero

Luzerne County, Pennsylvania, as its shared GIS resource. While there, she advocated for open data and led projects that included making flood maps and doing 911 readdressing.

After seven years, Ginocchetti's increasingly comprehensive experience made her a shoo-in for a GIS transportation specialist role at NEPA, the position she held before being promoted to GIS services manager. The alliance represents seven counties in northeastern Pennsylvania, and that has allowed Ginocchetti to work on a range of projects that champion open data. NEPA also supported Ginocchetti in getting her geographic information system professional (GISP) certification and empowers her to be a GeoMentor to young students in a local after-school program.

"I am thankful to NEPA for trusting my geospatial capabilities and embracing my desire for open data," she said.

One of her standout undertakings at NEPA was creating its COVID-19 response hub. In addition to posting COVID-19 case and lost loved ones numbers, the site provides local businesses with information regarding economic assistance.

"When COVID-19 hit, our CEO said, 'We need to get something on our web page.' But our IT manager said we couldn't do that because our website was so out-of-date," Ginocchetti recalled. "And I was like, 'Wait, I can do it.'"

It was the first time Ginocchetti had worked with ArcGIS Hub. She used the COVID-19 template to create a localized version of Johns Hopkins University's now-famous dashboard. She then added some pages with information about all the state- and federally funded loans that were becoming available for small businesses. When Ginocchetti heard that Spanish speakers in northeastern Pennsylvania were

having a hard time figuring out what was going on with the pandemic, she reached out to Esri's ArcGIS Hub team to see if a Spanish-language version was available. There wasn't one, but the team started working on it right away. In the meantime, Ginocchetti put her whole hub site, paragraph by paragraph, into Google Translate to at least get some Spanish-language information out.

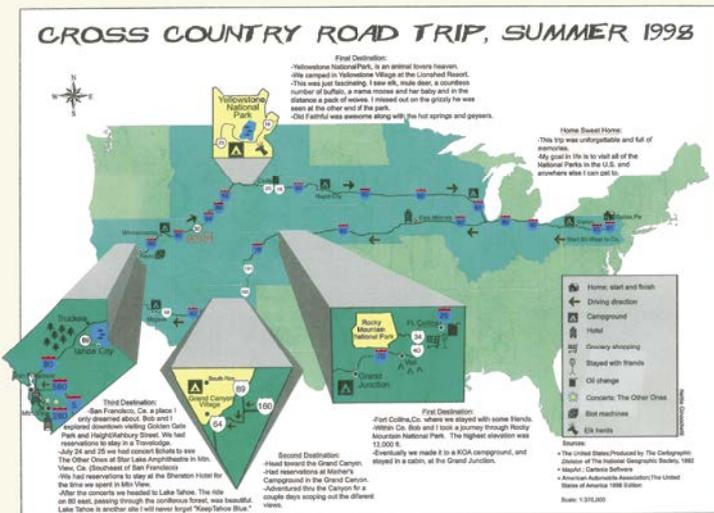
"The day Esri released a translator tool was the day I finished my Spanish-language page," she recalled with a laugh. She promptly replaced her version with the Esri tool.

Since then, Ginocchetti has continued to innovate with ArcGIS Hub. For example, NEPA's CEO wanted members to be able to sign up for the organization online. But Ginocchetti didn't want to just give members a receipt; she wanted to collect their information and put them on a

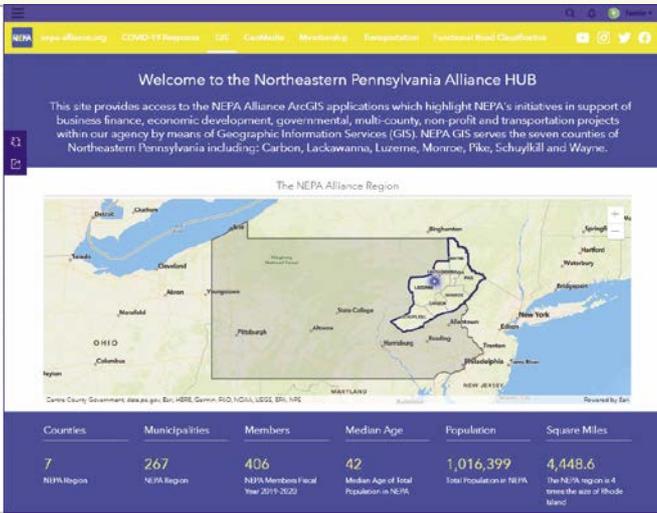
map. So she added a Membership page to her hub site that employs ArcGIS Survey123 to gather members' data and uses PayPal to allow them to pay their dues.

"Nettie is a creative thinker who is always willing to try new things," said Brenda Wolfe, Esri's lead product manager for ArcGIS Hub. "When she faces a challenge—like needing to translate a website or bring together ArcGIS apps with other technology—she finds novel ways to get the job done. And in the course of doing that, her enthusiasm for GIS inspires others."

"I'm just motivated to pursue my mappiness," said Ginocchetti—something she encourages others to do in her emails, social media posts, and other correspondence. "Where in the world would I be without GIS? I honestly don't know."



↑ The first map Ginocchetti made, with ArcView 3.2, was of her road trip to see a Grateful Dead concert in California in 1998.



↑ Ginocchetti is an advocate of open data and uses ArcGIS Hub in all sorts of innovative ways.



↑ Ginocchetti put a Spanish-language page on NEPA's COVID-19 hub site.



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Water Utility Brings Engineering In-House with Enterprise Asset Management

Erie Water Works Saves Hundreds of Thousands of Dollars with GIS-Based Implementation

By Justin A. Stangl, Amanda L. Donegan, Michael Dzurko, and Jeffrey Granger, Erie Water Works

Like most areas in the northeastern United States, Erie, Pennsylvania, is no stranger to aging infrastructure. The city's water utility, Erie Water Works (EWW), regularly contends with harsh seasonal conditions along with varied pipe materials and inconsistent installations that have accumulated over decades.

EWW maintains 771 miles of pipe and replaces an average of approximately 2.5 miles of it per year, so keeping up with capital construction projects to repair and improve regional assets is already overwhelming. Add to that new construction and the need to accelerate pipe replacement so the infrastructure doesn't exceed its useful life-span, and the utility needed to develop some new, more streamlined workflows.

After almost 15 years of GIS use, EWW evolved its technology suite into a dynamic enterprise asset management system that correctly represents—at four-inch accuracy—all the water utility's assets in GIS and recognizes various asset installations. The system has hundreds of related datasets, thousands of subfoot-accuracy features, and millions of attributes. EWW's engineering department also implemented proper construction documentation to prepare preliminary digital surveys for construction projects, wherein all assets, landmarks, and other utilities need to be represented.

It took a lot to build this system, but the payoff has been immense. Combining ArcGIS software with the latest GPS and CAD technologies has saved EWW thousands of hours per year in

unnecessary manual work and generated hundreds of thousands of dollars in total returns on investment.

Data Collection Processes Needed Updating

Since 2007, EWW staff members have digitized a century-and-a-half's worth of water utility asset information using ArcGIS Desktop and ArcGIS Enterprise. To build a functional enterprise asset management system, though, the utility also needed to update its data collection methods. They were outdated and unnecessarily convoluted—especially when it came to recording assets at new construction projects.

Because EWW's in-house engineering department was small and limited in scope, the utility typically hired consulting engineers to do most of the preliminary survey and postconstruction work for capital improvement projects. However, this resulted in disconnected workflows and lengthy, expensive business practices. For example, EWW's own engineers were only able to extrapolate certain GIS layers to support the CAD basemapping and surveying that the consulting engineers did. If EWW inspectors collected any GPS data, it just supplemented the utility's existing GIS data instead of being used to produce timely engineering drawings. What's more, even though EWW staff members had to add any newly installed assets to the utility's versioned geodatabase, they couldn't do that until they had received the consulting

engineers' as-built drawings—and the wait time to obtain those often stretched to a year.

Given increasing demands for data, plus EWW's growing use of real-time GIS apps, these workflows and timelines were unsuitable. To streamline productivity, EWW began piecing together the components to build a more functional asset management system.

Gaining Full, GIS-Based Coverage of Assets

After conducting a lot of research, EWW's GIS staff decided to buy into the KeyNetGPS Virtual Reference Station (VRS) Network in Pennsylvania. Based on Esri partner Trimble's VRS[®]Net app, this network of base stations provides continuous real-time kinematic (RTK) corrections and postprocessed data to all users in a particular coverage area. EWW installed a base station on top of one of its central pump stations, and that made the utility eligible to receive 5 percent of all subsequent subscriber proceeds, which is a substantial return on investment.

Having access to this VRS equipment allowed EWW to collect GPS data of its existing assets and newly installed infrastructure with four-inch accuracy. Additionally, the VRS provides GPS corrections and postprocessing in real time. That, coupled with the cloud-based GPS software that EWW implemented to load data directly into ArcMap, means that inspectors no longer have to offload the data from each GPS receiver. This turned a

30-minute process into one that staff members can do in under 5 minutes, saving the utility about 150–200 hours per year for this task alone.

Putting this more precise and expedient data collection process into practice demonstrated to the utility's board members that using GIS and GPS technology is critical for keeping up with asset maintenance and expansion. The board approved EWW's purchase of 10 additional Global Navigation Satellite System (GNSS) receivers, up from 1. Once the utility trained all its inspectors—both in-house and contract—to use the new technology, they were able to capture the exact location of installed assets, including water main joints, fittings, valves, fire hydrants, and service lines. Finally, EWW was getting full, GIS-based coverage of new and existing assets.

Engineering Work Gets Streamlined and Moves In-House

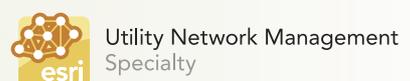
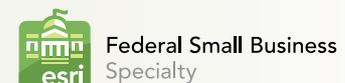
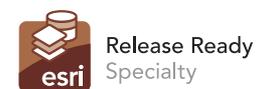
Now that EWW's inspectors could provide consulting engineers with shapefiles that contained the asset information they collected during installation projects, the engineers could put together as-built drawings much more quickly. But this raised new questions: Why were consulting engineers still involved in producing preliminary surveys for EWW? And what would it take to complete postconstruction documentation in-house?

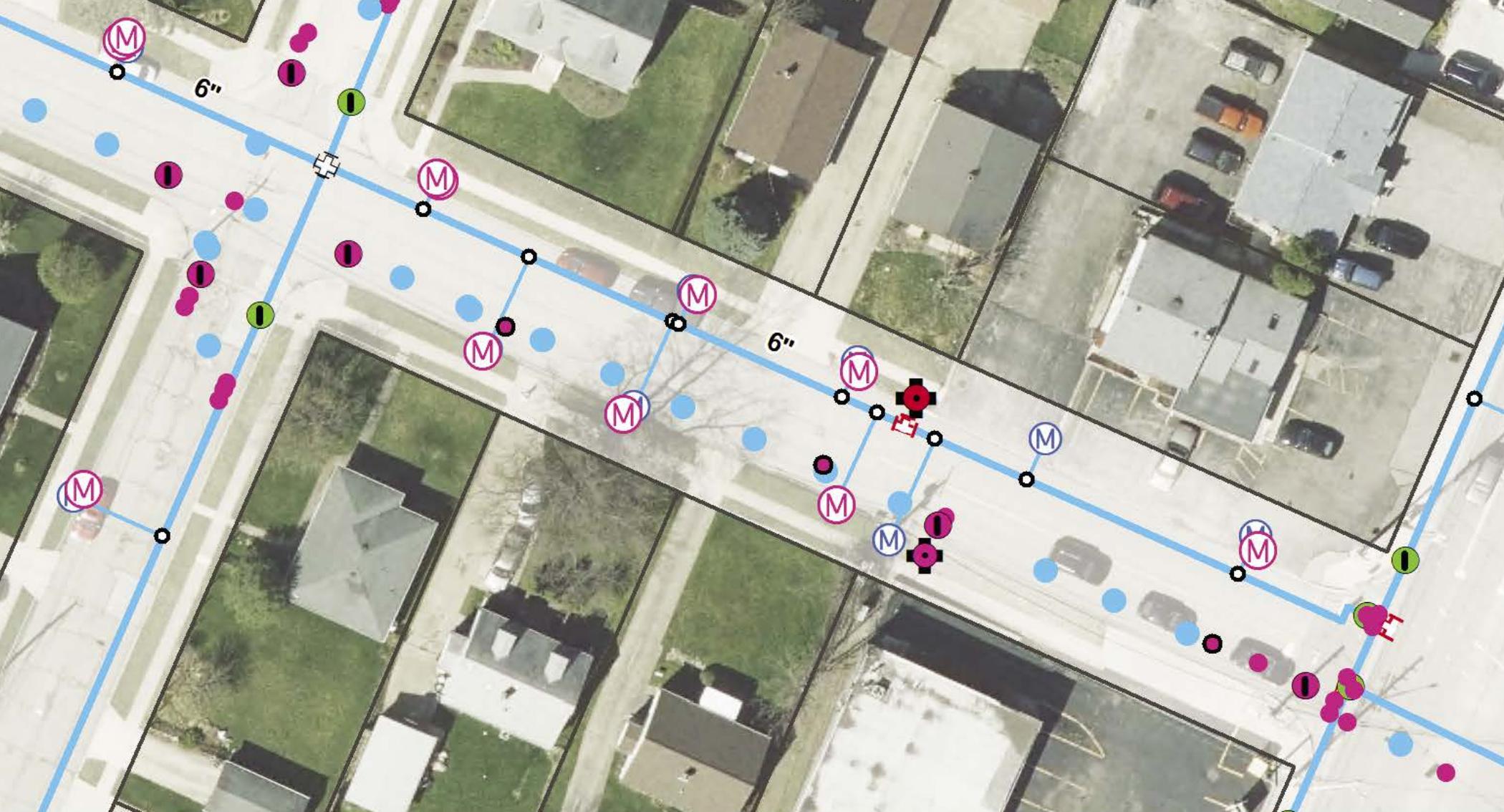
To allow EWW's own engineering department to conduct preliminary surveys, GIS staff would need to be able to contextualize the utility's assets.

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↑ During construction, Erie Water Works (EWW) now collects GPS data of all assets—including pipe segments—in real time, as they are installed, with four-inch accuracy.

But the imagery that EWW had of its jurisdiction was 10 years old, and it didn't include lidar data. So the utility paid for an aerial flyover of its service area to obtain survey-grade orthorectified imagery.

Upon completion of the flyover, GIS staff members used ArcGIS 3D Analyst to classify the LAS dataset by return elevation so the point cloud would render in 3D. This enabled EWW's engineers to visualize project areas and digitally represent the interpolated features, such as buildings and vegetation, as layers in CAD base-map drawings. Incorporating these layers with cadastral information and the precisely located water utility data that EWW was now able to capture made it possible for in-house engineers to complete survey-grade as-built drawings as soon as installation was complete.

In addition, GIS staff members implemented ArcGIS for AutoCAD, which, for smaller projects, lets EWW engineers retrieve published map service data directly within the CAD interface they already use. This new, streamlined workflow saves each GIS staff member from having to manually export 14–20 layers per project.

At last, EWW was able to produce its own as-built drawings in a timely manner. This ensured that the utility could keep its asset data

up-to-date. It also eliminated the fees that EWW was paying regularly to bring in outside engineers, saving tens of thousands of dollars per project.

● New Goals That Were Previously Unfathomable

Staff members at EWW tested, improved on, and accepted the new workflows, which have now been in use at the utility for more than a year. As efficiency increased and staff members gained more confidence in the results, organizational buy-in for the enterprise asset management system improved.

Each step of the implementation process justified the next. The accuracy of the VRS equipment enabled EWW to obtain more GNSS units. This new workflow encouraged EWW to acquire lidar data of its coverage area to ensure survey-grade accuracy for reliable basemapping. And that made it possible to put together preliminary surveys and final as-built drawings in-house.

Now EWW's goal is to replace 5–7.5 miles of pipe per year. This would have been unfathomable before implementing the GIS-centric enterprise asset management system and its accompanying workflows.

About the Authors

Justin A. Stangl, GISP, is the GIS coordinator at EWW. He has 12 years of experience integrating and leveraging spatial workflows throughout the organization, with a primary focus on enterprise asset management and automation. Amanda L. Donegan, GISP, is a GIS analyst/developer at EWW. She has 9 years of experience overseeing GIS utility network, schema structure, and server administration, with an emphasis on mobile data collection and reporting. Michael Dzurko is a GIS technician at EWW with 6 years of experience in digitizing data and designing workflows that make it easier to create digital survey project basemaps. Jeffrey Granger is also a GIS technician at EWW who has 5 years of experience maintaining the utility's water system GIS feature datasets and improving GPS accuracy.

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An Elephant Never Forgets

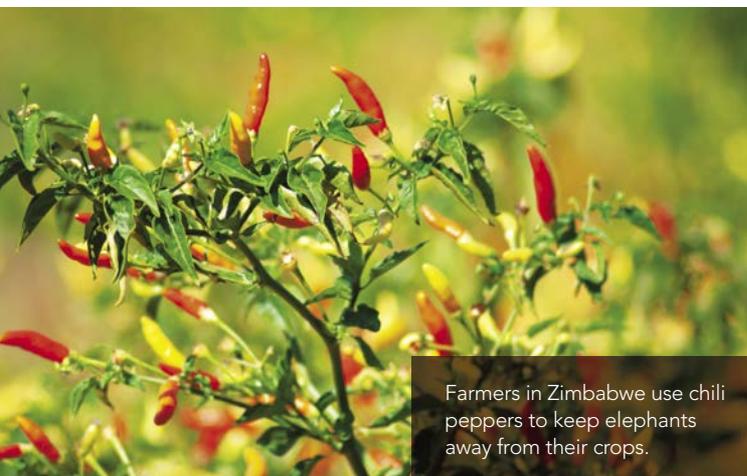
How GIS Helped Save a Playground Pachyderm

If there is one thing that elementary school students around the world can agree on, it's the wonderful feeling of hearing the recess bell. After quietly sitting and learning in class, it signals freedom to run, laugh, and play with friends, usually outside in the fresh air.

But in Victoria Falls, Zimbabwe, Baobab Primary School had a 10,000-pound problem that prevented students from leaving their classrooms in June 2018. It seemed that a male African elephant wanted to share snack break by enjoying some baobab fruit from a schoolyard tree.

"The students' safety was an absolute priority for the school," said Andrea Presotto, an animal cognitive geographer and assistant professor in the Geography and Geosciences department at Salisbury University in Maryland. "Though largely docile, male African elephants are protective of their space and will become aggressive if threatened by humans."

Luckily, the elephant was one that Presotto and her team at the Victoria Falls Elephant Project had been tracking using GIS. Knowing how African elephants move through space and, especially, how this elephant had been behaving in the community, they were able to execute a plan that would clear the schoolyard and save the elephant's life. Presotto also used ArcGIS StoryMaps to clearly record her findings should the team ever need to use this method again.



Farmers in Zimbabwe use chili peppers to keep elephants away from their crops.

A Familiar Visitor Becomes a Nuisance

Presotto has been using ArcGIS technology for cognitive geography studies for about 17 years. Normally, this discipline seeks to understand how humans perceive and interact with their environment. That's how Presotto started out, using a handheld GPS device to follow people around their small community and then analyzing the data points in ArcMap. About 15 years ago, though, Presotto adapted the methodology to study animals. She initially received support to apply her geospatial approach to capuchin monkeys in Brazil, which eventually led her to this opportunity to work with elephants.

Presotto now collaborates with Connected Conservation, an organization that tracks 15 male elephants in southern Africa by using collars that provide their locations every 15 minutes. Her team—the Victoria Falls Elephant Project—had been tracking the elephant that visited the schoolyard since July 2017. According to the data points visualized and analyzed in ArcGIS Pro, the elephant had made the town his home and was familiar to the community. But a year into the study, his daily schoolyard visits were putting children in danger.

Typically, people's first response to a recurring incident like this is to euthanize the animal. Although that eliminates the imminent threat, it is inhumane and removes the elephant from important and costly research. It is extremely expensive to collar an elephant, and in this case, a whole year of data collection

would have ended abruptly. Additionally, Presotto and her team never would have learned how to mitigate the problem.

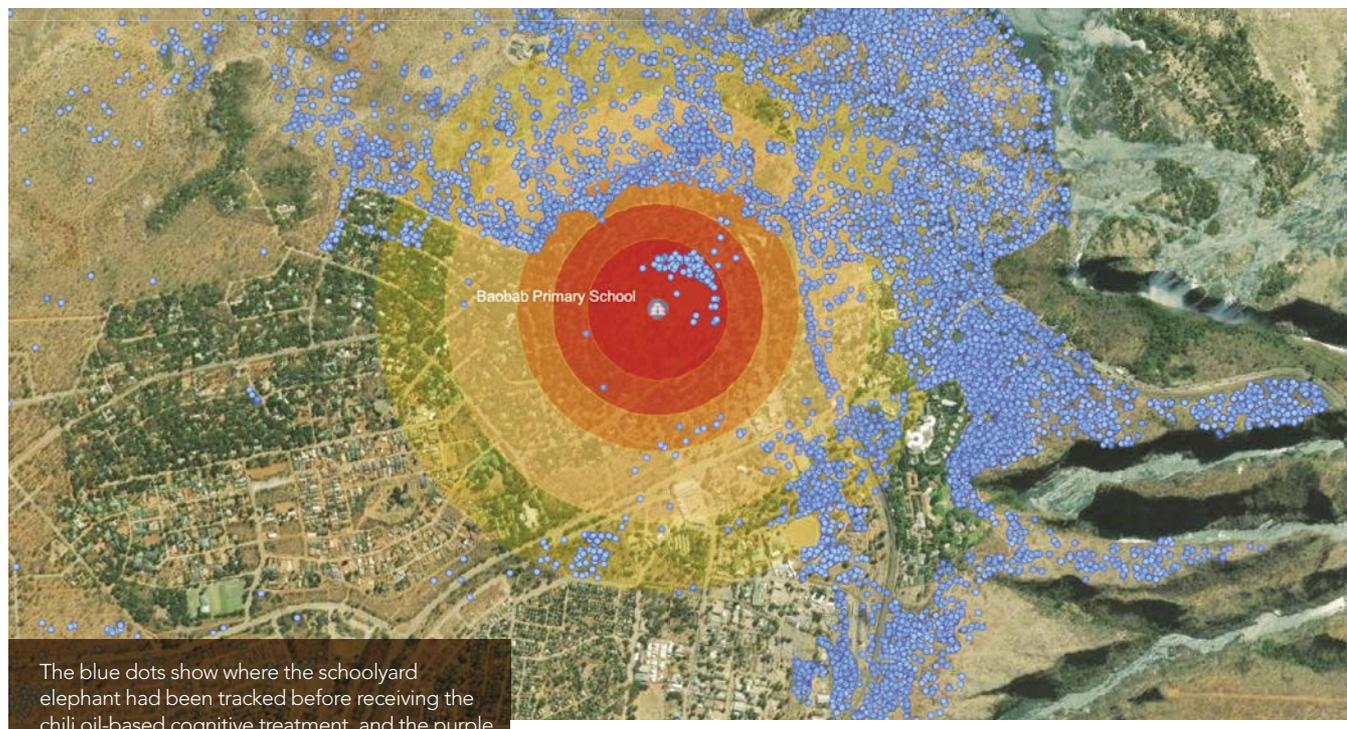
Fortunately, when the school called the Zimbabwe Parks and Wildlife Management Authority (ZimParks) to remove the elephant, the rangers noticed the collar. They were able to contact Presotto's local project collaborator, Malvern Karidozo, to see about finding a solution that was at once compassionate for the elephant and safe for the children.

Cognitive Geography Turns Up the Heat

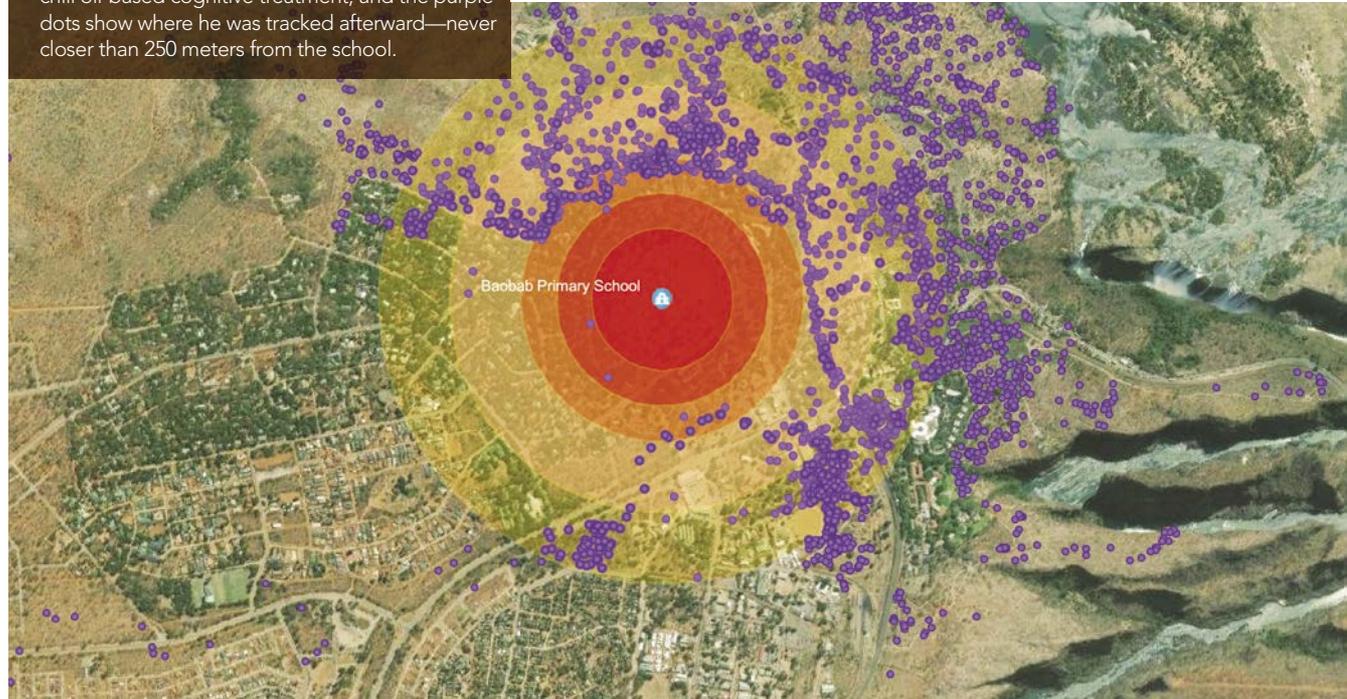
Having grown up on her grandmother's farm, Presotto explored Brazilian forests with her father and has since lived a life committed to saving and protecting animals.

"One of our main goals is to demonstrate that there are alternative ways of dealing with elephant encounters," she said. "The elephant was around the school for three days. On the third day, the children got too close to the elephant and, feeling threatened, it chased the kids."

Rather than euthanize the elephant, ZimParks allowed Presotto and her team to try a cognitive treatment. The creative cure, referred to as "disruptive darting," involved tranquilizing the elephant and applying a chili oil-infused wax to his trunk. In Zimbabwe, farmers have long used chili peppers to keep elephants far from their crops. Until Presotto and her collaborators from the Victoria Falls Elephant Project



The blue dots show where the schoolyard elephant had been tracked before receiving the chili oil-based cognitive treatment, and the purple dots show where he was tracked afterward—never closer than 250 meters from the school.



employed it in this situation, however, authorities at ZimParks had never used the treatment for animal control purposes.

It worked. When the elephant woke up, he associated the schoolyard with the trauma triggered by the chili wax and left immediately. Continuing to track the animal via his collar, Presotto saw in ArcGIS Pro that he avoided the schoolyard for more than two years—likely to prevent getting chili oil wax on his trunk again. And when he eventually did return, he only went within 250 meters of the schoolyard very early in the morning when the property was vacated due to COVID-19.

So the chili wax experiment was a success. It kept the town's children safe and saved the elephant from an untimely death.

A New Kind of Success Story—With Lasting Results

With help from her research students at Salisbury University, Presotto wrote a story using ArcGIS StoryMaps to visually communicate the success of the experiment to ZimParks authorities and Connected Conservation, the project's funder. Presotto likes how, unlike typical slideshows, StoryMaps allows readers to interact with the data on maps and zoom in closely to see more details.

"People question images much more than they challenge data," said Presotto. "We find that our work is transparent to others when we use ArcGIS StoryMaps because they can visualize and interact with the data and gain confidence in the cognitive solution we're proposing."

In Presotto's story, viewable at [arcgis.com/1qayPm](https://arcgis.com/storymaps/viewer/1qayPm), the data on the map clearly shows the elephant on school grounds prior to the experiment and at least 250 meters away afterward. The results were so effective that ZimParks allowed the Victoria Falls Elephant Project team to use this disruptive darting method of cognitive animal control again when another elephant was causing problems at the local airport.

And there is more to come. Thanks to years of tracking these animals' movements, Presotto and her team now have evidence that elephants travel through spaces they deem to be safe, mostly to avoid hunting activities. So she and the team are currently investigating how changes in human movement due to the COVID-19 pandemic have affected elephants' cognition.

"People say an elephant never forgets because elephants have well-developed memories," said Presotto. "Our hypothesis is that an elephant's spatial memory is also well developed and that associations between certain spaces and emotional memories would prevent them from returning to traumatic event locations."

The team already knows that when hunting activities are present, elephants stay away from those areas. But Presotto and

her colleagues are looking into whether, during COVID-19—when Zimbabweans were under stay-at-home orders and there were no tourists or hunters in game reserves—elephants traveled equally over both protected areas and hunting-friendly game reserves.

"We talk about coexistence, but we rarely talk about how we're going to do it," said Presotto. "Technology illustrates how humans and animals can share this space."



→ Andrea Presotto (in the Salisbury University T-shirt) and Malvern Karidozo (in the brown-, black-, and white-striped shirt) wait to measure the elephant that was snacking on fruit at Baobab Primary School.

↓ The Victoria Falls Elephant Project team had been tracking the elephant that visited Baobab Primary School, pictured here, for almost a year. (Photo courtesy of Andrea Presotto.)



GIS Is the Secret to Keeping a Town Tidy

By Anna Smith, Town of Emerald Isle, North Carolina

→ Drivers collect yard debris and then upload information about the pickup into ArcGIS Survey123. (Photo courtesy of Anna Smith/Town of Emerald Isle.)

In Emerald Isle, North Carolina, residents now have a real-time, bird's-eye view of where yard debris trucks are traveling along their route at any given time.

The Emerald Isle Yard Waste Tracker displays the location of the town's two yard waste trucks on a map as the vehicles make their way through the community. It also shows the tracks of where the trucks have traveled since the start of the crews' shift.

This app provides government transparency, helping Emerald Isle residents gauge when their yard waste may be picked up by public works staff. Yard debris is collected from 8:00 a.m. to 3:00 p.m. Monday through Friday, but exact pickup times for residents vary on a weekly basis depending on factors such as distance traveled and the size of yard debris piles.

The public-facing app, available on the town's website at ow.ly/MAsB50FnU9c, was rolled out in May 2021. It is part of the coastal community's wider data-driven solution to better monitor and manage yard waste pickup—the process of collecting, transporting, and disposing of yard debris such as leaves, grass clippings, tree trimmings, and other plant material.

"This new system will improve our level of customer service and will aid our staff when filing yard debris pickup reports," said Artie Dunn, public works director for the Town of Emerald Isle.

The Emerald Isle Yard Waste Tracker was developed using ArcGIS Web AppBuilder and ArcGIS Tracker and is hosted in ArcGIS Online. A separate dashboard that Dunn uses to monitor yard waste pickup and gather data for reports was created using ArcGIS Dashboards, with the information populating that app coming from data collected using ArcGIS Survey123 and ArcGIS Tracker.

Where's the Yard Debris Truck?

For years, the town's Public Works Department tracked its waste debris operations using pen and paper. Crews had to fill out spreadsheets with information such as the number of debris pickups they made each day, where they traveled, the daily mileage, and how many trips they made to the landfill.

The workers filed their reports with Dunn at the end of their shifts. Dunn then spent about 45 minutes compiling that information into his own report, which he emailed to town staff at the end of each day. It was a time-consuming process.

In recent years, the town has received calls from residents who want to know why their yard debris hasn't been picked up on time. Like many coastal communities that rely on tourism as the main industry, the Town of Emerald Isle experiences an influx of second homeowners and visitors during the summer and fall, which elevates its population from less than 4,000 people to roughly 50,000 people. This places a great demand on services like yard waste pickup, which the town offers at no additional cost.

The Emerald Isle Public Works Department has two trucks with two drivers that pick up yard waste. There are approximately 6,500 land parcels in the 5.6-square-mile town, and the trucks typically make 60 to 100 or more stops per day, according to Dunn. Once the vehicles are full, they leave the island to drop off the yard waste at a nearby landfill, then return to repeat the process. Crews take an average of two or three loads a day to the landfill.

During the off-season, this workload is manageable for the two public works employees and their trucks. However, during peak times in the spring and fall, particularly after a severe weather event,

the drivers may make just 25 stops to pick up large debris piles, and they may take up to four truckloads to the landfill in a single day.

That's when property owners start to wonder why their yard debris piles have been sitting by the curb for an extended amount of time.

"Our residents in Emerald Isle—especially those that live on the island full-time—are used to our public works team easily managing yard waste pickup and providing them a service they expect will occur without interruption," Dunn said. "However, with more and more people visiting the island in the summer months and an increase in severe storms along our coast, we can't always keep up, no matter how hard we try. We knew we needed a better solution to meet the needs of our town."

The End of the Pen and Paper Era

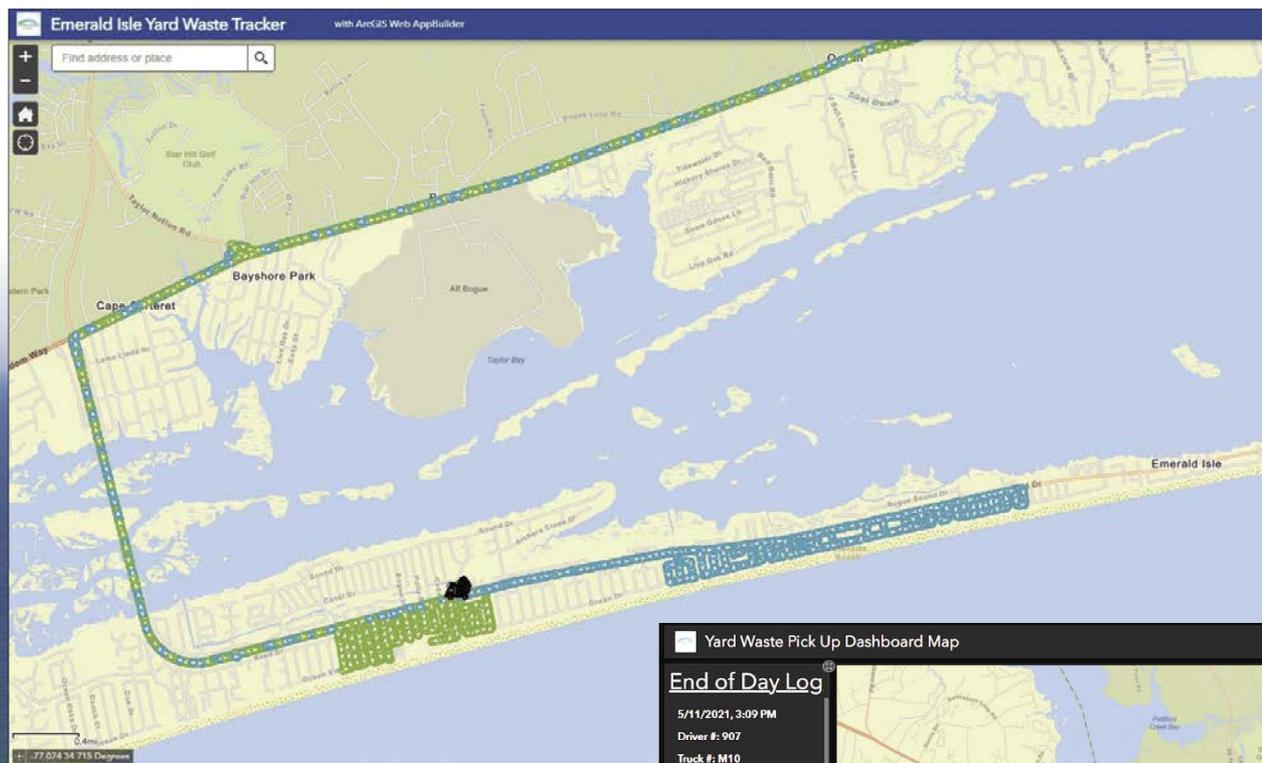
As of early 2021, the Public Works Department was still tracking its operations with pens, paper, and spreadsheets. While effective, it took up a lot of time and made it difficult to quickly analyze information and trends. And when residents called the town's administrative offices to find out why the trucks hadn't picked up their yard debris yet, it was difficult to track down those details.

"I needed people to see that we are running eight hours a day, and there is really nothing more we can do," Dunn noted.

For a solution, Dunn and town manager Matt Zapp turned to Greg Flinn, an independent GIS consultant and licensed small unmanned aircraft systems (sUAS) pilot. Flinn provides support to local municipalities and governments using GIS solutions and aerial imagery, including for crisis response during natural disasters. Due to its geographic location, Emerald Isle is prone to tropical storms and hurricanes.

After brainstorming with Dunn and conducting extensive research, Flinn thought that a digital solution based on Esri technology would work best. Town leaders agreed.

Flinn decided to use Dashboards, Survey123, and Tracker to provide Dunn, town staff, and residents with the information they need about yard waste removal.



← The Emerald Isle Yard Waste Tracker displays the location of the town's yard waste trucks on a map and also shows where they've been that day.

↓ By glancing at his internal dashboard, public works director Artie Dunn can see where the trucks are in real time and where they have traveled.

The image shows a screenshot of the 'Yard Waste Pick Up Dashboard Map'. It features a map of Emerald Isle with truck routes and a data panel on the left. The data panel includes an 'End of Day Log' with entries for various dates and times, listing driver names, truck numbers, mileage, and drop-off counts. Below the log, there are two large, prominent numbers: '72' for 'M10 Pickups' and '51' for 'M6 Pickups'. To the right, there are sections for 'Newest Pickups' with details like date, time, truck number, address, and size.

Date	Time	Driver	Truck	Mileage	Drop offs
5/11/2021	3:09 PM	907	M10	52	2
5/11/2021	2:56 PM	908B	M6	99	2
5/10/2021	4:09 PM	907	M10	53	1
5/10/2021	2:47 PM	908	M6	79	1
5/7/2021	3:10 PM	907	M10	73	-



First, Flinn did a deep dive to understand the yard waste pick-up process, riding along with the drivers and talking to Dunn about the information he needed for his reports.

“I needed to understand every data point along the route that had to be captured electronically,” Flinn said.

Flinn designed two forms in Survey123 for the truck drivers to fill out. One includes information that needs to be collected at each stop: the address coordinates (captured via GPS on the tablet), the load size (small, medium, or large), and a photograph of the yard waste (if there is a pickup that violates a town ordinance).

The second Survey123 form Flinn created is an end-of-day report for the drivers to fill out that includes their truck’s daily mileage and how many trips they made to the landfill. The drivers access both surveys on their location-enabled Samsung Galaxy tablets.

The information gathered on the forms is added to a layer in ArcGIS Online and can be viewed in real time using Dashboards. This enables Dunn to see the drivers’ daily mileage, number of pickups, and number of drop-offs at the landfill—information that he can now easily share with the town’s administrative staff as needed.

In the future, staff will be able to do analysis on the collected data to see trends and answer questions such as, Where is the greatest demand on the island for yard waste pickups?, according to Flinn.

Flinn also made the real-time location of truck crews easy for Dunn, town staff, and the public to access and view. He used Dashboards and Tracker to display the data captured by Survey123.

Dunn can see the location of the trucks in real time and where they have traveled each day—and over time—by glancing at

Emerald Isle Yard Waste Pick up Log

Description content for the survey

Truck Number*

M10 M6

Location*
GPS location of pickup

Find address or place

Let: 34.66670 Lon: -77.02929

Address of Pickup

Date and Time?*

Size of Pick up?*

Take Picture if pick up is problematic
Capture Image if needed.

1 Take a photo (number of photos allowed: 1 - 5)

↑ A Survey123 form lets drivers record the address coordinates, load size, and date and time of each yard debris pickup they make.

his dashboard. The public can see the same information in the Emerald Isle Yard Waste Tracker web app, which Flinn developed using Web AppBuilder.

Now, instead of calling the Public Works Department to ask when their debris will be picked up, residents can go online and see the trucks’ locations for themselves. Staff at the town’s administrative offices are commending Emerald Isle’s Yard Waste Tracker app, which they also use to quickly answer people’s calls about yard waste pickup times.

“Transparency between the Town of Emerald Isle employees and our residents is one of our top priorities,” said Dunn. “Now, we not only have the ability to perform annual and seasonal analysis, but we can give our residents visibility into how hard we work, along with real-time updates, and make decisions based on data. It’s a win-win for everyone.”

Zapp agreed, noting that the solution will not only help during regular pickups but will also be useful following severe storms, when the town needs to provide information on the extent of damage to the Federal Emergency Management Agency (FEMA) to receive assistance.

“By utilizing the [solution] Greg has created for us, this will allow us to quickly analyze information following severe weather and collect data that will then be released to FEMA,” he said. “Greg has gone above and beyond in his work. We are thrilled to have him working with the Town of Emerald Isle so he can help us improve our services and communication with our property owners and residents.”

About the Author

Anna Smith is the public information and media director for the Town of Emerald Isle, North Carolina. She holds a degree in print journalism with a minor in Spanish from Pennsylvania State University. In her spare time, she enjoys baking and spending time on the beach.

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Machine Learning Streamlines Graffiti Removal in Tempe

The cost of monitoring, detecting, removing, and repairing graffiti damage in the United States is estimated to be between \$15 and \$18 billion per year. And the problem is ubiquitous. Tagging is found on public and private property in small towns, large cities, urban centers, and rural areas alike.

Several years ago, the City of Tempe, Arizona, assembled a Graffiti Abatement Team to drive the city's streets, looking for and removing graffiti. This helped city staff members identify graffiti hot spots so they could pay greater attention to those areas. In addition, a 311 call center was made available so members of the public could report incidents of graffiti, as well as other city-related issues.

"Graffiti affects city residents socially, environmentally, and financially," said Seth Lewis, Tempe's lead programmer analyst for enterprise GIS and data analytics. "Neighborhoods that are spray-painted by taggers can experience a reduced sense of community pride. We also see an adverse effect on housing prices in heavily tagged areas."

In 2015, members of the Graffiti Abatement Team met with Lewis to determine how they could use GIS to help facilitate their work. Using ArcGIS Collector, ArcGIS Online, ArcGIS Enterprise, and an enterprise geodatabase, he provided them with an editable web map interface.

This was a significant enhancement to their work. But team members still had to drive the roads of Tempe looking for graffiti. They wanted more out of their GIS.

A Graffiti Abatement Service Platform

A breakthrough came in late 2019 when the City of Tempe announced its graffiti abatement service platform. The platform

leverages machine learning, image recognition, event messaging, and ArcGIS technology to optimize the city's graffiti abatement operations. It was developed with Arizona State University's (ASU) Center for Smart Cities and Regions (CSCR) and the ASU Smart City Cloud Innovation Center (CIC), which is sponsored by Amazon.

Essentially, city vehicles are fitted with cameras that capture imagery of possible graffiti and stream that to the cloud. The imagery is then run against object recognition models, and if graffiti is detected, staff are notified of current incidents via event messaging.

"For this project, we made extensive use of [ArcGIS] GeoEvent Server and ArcGIS Online," said Lewis.

He employed an Esri connector to integrate RabbitMQ, an open-source message-broker platform, with GeoEvent Server. The graffiti data is obtained via a program written in Python that runs on a high-performance Karbon 700 computer. The program captures images from the vehicle-mounted cameras, and the imagery is assessed using a machine learning object detection model.

"The model determines whether or not the image contains graffiti," Lewis explained. "If an image is deemed to be graffiti with suitable confidence, then two events take place. First, the image is copied to an Amazon Web Services (AWS) Simple Storage Service (S3). This stores the data and its descriptive metadata. Next, a message is published to the RabbitMQ message queue. That message contains the URL of the graffiti photo in S3 and the GPS coordinates of where the image was captured. ... GeoEvent Server is a consumer of RabbitMQ. Each time GeoEvent [Server] receives a new message from RabbitMQ, it transforms the message into a point feature and then publishes that event to a feature service in ArcGIS Online."

Graffiti abatement staff, who are using Collector, see those features that have been identified by the model as probable graffiti in a separate layer on their displayed maps. They can then decide whether the area needs immediate attention or if they can wait until later in the workday to check it out.

"To date, city analysis shows that approximately 80–85 percent of abated graffiti is discovered and logged by staff on a proactive basis," said Lewis, meaning that they go out and search for it.

But if staff members receive data in advance, they can use it to optimize their workflows and plan better inspection routes. For example, if a vehicle with a mounted camera begins driving at 2:30 a.m. while graffiti staff start their day at 5:30 a.m., those staff members benefit from three additional hours of autonomous data collection.

The city's Graffiti Management Team also has access to a dashboard built with ArcGIS Dashboards that shows, by default, a given day's graffiti abatement activity and is updated every five minutes. Managers can filter the data by date, date range, and location type to analyze graffiti incidents more closely.

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A Model with Proven Performance

Staff and students at ASU's CIC created the machine learning model used by the City of Tempe to detect graffiti. A team of managers and a solutions architect ran the project, and ASU computer science graduate students, who were completing internships at the CIC, were tasked with developing the model.

They began by using an existing object detection model from California Polytechnic State University, San Luis Obispo. The City of Tempe provided CIC and AWS staff with approximately 15,000 photos that had been captured as part of its abatement efforts. These images were then classified by hand and identified as graffiti.

As part of training and validating the model, students adjusted various parameters and let the model run for one to two hours each time. Students also trained the model using imagery from outside sources, such as search engines and photos captured by phones, that may or may not have been considered graffiti in their original context.

"The overarching performance management goals of the city when it comes to graffiti abatement are to reduce the number of graffiti incidents and proactively abate [and] track emerging hot spots," said Lewis. "Tempe's performance measure goal is to achieve one occurrence of graffiti, on average, per four miles, as measured in an annual audit conducted by city staff. The 2013 annual audit showed the average number of incidents was 15.17 per four miles, while in 2019 the average number had dropped to 1.3 [for the same area]."

GIS-based machine learning is not only making graffiti abatement in Tempe more efficient, but it is also contributing to increased success.



↑ A dashboard shows where probable graffiti is and monitors abatement operations.

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A BIM/GIS Workflow Benefits Key Railway Construction Project in Italy

In July 1996, the European Commission adopted a resolution to implement the Trans-European Transport Network (TEN-T). The intent of this multiphased project is to provide coordinated improvements to primary roads, railways, inland waterways, airports, seaports, inland ports, and traffic management systems throughout Europe.

When complete, the Scandinavian-Mediterranean Corridor of the TEN-T project will stretch from Helsinki, Finland, to Valletta, Malta. The Napoli-Bari high-speed railway project in southern Italy is part of this corridor. Initiated in 2015 by the Ferrovie dello Stato (FS) Italiane Group, the government agency responsible for Italy's railway network, the project now benefits from the use of a GIS-based building information modeling (BIM) workflow.

"We are using it to monitor construction progress and the resources necessary for the project, as well as its impact on the surrounding environment," said Marcella Faraone, department head of the BIM GIS Competence Center at FSTechnology, part of the FS Italiane Group. "Our plan is to implement the BIM/GIS workflow for all projects in which BIM methodology is used."

Integrating BIM Models with ArcGIS Technology

At the end of 2018, the FS Italiane Group began constructing two viaducts on the Napoli-Bari railway project to carry the tracks across low ground in two built-up areas. One viaduct is 2,625 feet (800 meters) in length, and the other one measures 1,312.5 feet (400 meters).

To help monitor the construction of the viaducts, as well as the resources going into them, the agency began incrementally implementing BIM 360 from Autodesk. This allows stakeholders to see information about the dimensions of the structures and the details about how long it takes to do planning and development, the costs associated with the projects, the viaducts' sustainability, their operational lifetimes, and asset management.

An important part of the project, according to Faraone, was testing

the proof of concept of FSTechnology's BIM/GIS workflow. ArcGIS Pro integrates the geometry and parameters, as well as the other construction information contained in the BIM files, and facilitates the geodesign capabilities of the BIM/GIS workflow. It also allows the project design and work status to be published via ArcGIS Online.

"We have determined several advantages in integrating our BIM models with ArcGIS during the construction phase of the project," said Faraone. "The surveyed and mapped 3D data of the utilities can be used to more efficiently plan the work. During the infrastructure construction, the utility pipes that intersect the infrastructure may need to be encased to avoid structural damage. In order to involve all the stakeholders responsible for the maintenance of the utilities, the 3D buffer tool can help determine the type of utility service that intersects the infrastructure and calculate the length of the pipe to be reinforced. The same data can help find the best place for the construction site that needs to be connected to public water, sewer, and...lighting systems."

Faraone also noted that the team can come up with a construction plan more effectively by using other types of analysis programs, such as ArcGIS Network Analyst. This helps the FS Italiane Group find alternative routes for things like waste management and goods transport that need to go around the construction. Additionally, because work on the construction site intermittently stops the flow of traffic, the team can use Network Analyst to schedule roadblocks when construction moves across traffic lanes.

Drone Imagery Helps Monitor Construction Progress

Fundamental to FSTechnology's new BIM/GIS workflow is the use of drone-captured imagery.

"The drone uses a 3D laser scanner to provide high-resolution and geoaccurate imagery of the site and the surrounding environment," explained Faraone.

The dataset that's collected can then be used to assess the site's progress over time and

better manage resources such as vehicles and equipment. It is also used to measure cut and fill volumes (when the earth gets moved from one location to another) and record poor waste management practices.

"Surveying a project in this manner also provides an efficient method to inspect the execution of the work without the safety challenges involved in physically inspecting it," Faraone added.

The drone collects data in a LAS file, the industry-standard binary format for storing airborne lidar point cloud data. The file contains large collections of 3D elevation points, which include x-, y-, and z-values along with additional attributes such as GPS time stamps. This data is integrated into ArcGIS.

"The 3D point cloud surveys collected with the drones are compared with our BIM models so that we can monitor construction progress," said Faraone. "We use Autodesk's Navisworks to compare the point cloud with the BIM model. With its clash detection functionality, we can compare the difference between the planned construction and the actual work in progress."

To process the point cloud so it can be compared with the BIM model, the team reduces the size of the point clouds to contain only the necessary points and data and then combines different point clouds to obtain the entire model of the project. Sometimes the team has to transform point clouds into surface models or 3D objects,

and staff often create digital elevation model (DEM), digital surface model (DSM), or raster RGB (red, green, blue) files as part of this process. Then details, like color, are added. The team can also make digital skins of the construction and add that to the 3D model created from the point cloud to make it look more realistic.

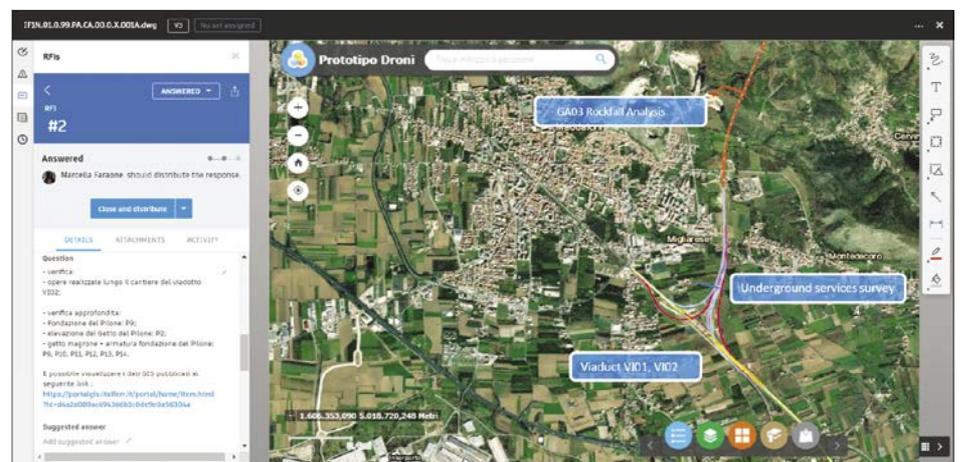
FSTechnology has also used artificial intelligence (AI) to set up a system that automatically detects some key parts of the project within the point clouds to allow for a better comparison with the BIM model. In addition, the team is developing an application to automatically identify workers and construction equipment on the work site for logistical purposes.

Completely Interoperable Data

The advantages of using a BIM/GIS workflow—from reducing errors to mitigating risk—has been demonstrated for vertical construction projects. For FSTechnology, this viaduct project helped determine how it can achieve the same benefits for linear infrastructure projects.

The team developed a workflow that allowed for the complete interoperability of data between BIM and GIS for project life cycle management.

"The key difference is that, for linear infrastructure, it is essential to automate the modeling of the project elements along its alignment to avoid manually reworking some of the construction elements due to project variations," Faraone concluded.



↑ The team uses Autodesk and ArcGIS technology to plan drone flights.

↓ FSTechnology compares 3D point cloud surveys taken by drones with its building information models to monitor construction progress. The pillars in green have already been built, while everything else is from the model.



Esri Partners Model Development and Increase Sustainability

In striving for smarter, more equitable development, communities all over the world are turning to GIS, and Esri partners are helping them streamline their ideas and implement solutions. Find out how four Esri partners have worked with cities in the United States, construction companies in Europe, and a water supply agency in Rwanda to build new housing, improve road paving, and fix water supply issues—all with an eye toward enhancing sustainability.



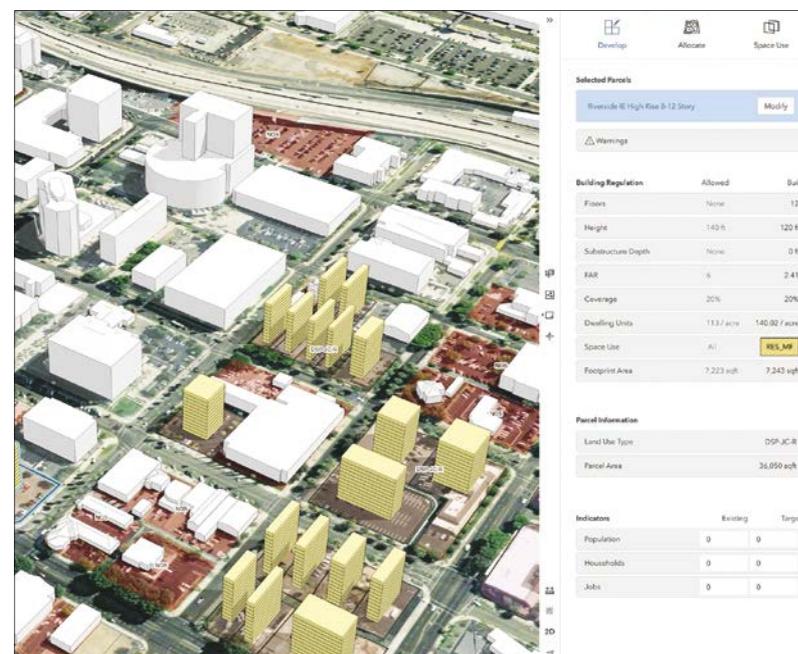
Building Fair and Equitable Housing in California

Since 1969, all California communities have been required to plan to meet everyone's housing needs, regardless of income. The state's housing-element law notes that to do this, local governments have to adopt plans and regulatory systems that foster opportunities for housing development rather than impede them.

When the City of Riverside recently updated its housing-element policies, it was required to find sites that could accommodate approximately 24,000 new residential housing units by 2029. This mandate, part of a Regional Housing Needs Assessment (RHNA), is what helps every municipality in California strive to meet statewide housing needs. At the same time, the city must ensure that the housing units are Affirmatively Furthering Fair Housing, a rule from the US Department of Housing and Urban Development (HUD) that encourages communities to create real and fair housing choices. The developments must also heed environmental justice issues.

To help Riverside meet its RHNA allocation, [Houseal Lavigne](http://housealavigne.com) (hlplanning.com) developed a GIS-based solution and workflow using ArcGIS Urban called the RHNA Opportunity Finder. Planners employed Urban at the outset of the project to work with staff at the City of Riverside to identify the most favorable locations for future residential development. Based on stakeholders' feedback, the planners used RHNA Opportunity Finder to zero in on specific parcels that are well suited to accommodate a variety of housing types within these preferred locations. To further fair housing and support positive economic, educational, and health outcomes for economically disadvantaged families, the RHNA Opportunity Finder evaluated several benefits and constraints that affect each parcel, including access to amenities and proximity to sources of pollution, protected natural areas, and natural hazards.

With the resultant group of sites that take into consideration affordable housing, environmental justice, and access to community resources, planners at Houseal Lavigne employed Urban again to complete the planning process, testing potential policy changes and development scenarios. Now, the city is using the comprehensive plan to interactively engage with residents, letting them explore 3D web maps and an ArcGIS StoryMaps story, to get their input. Already, the 24,000 new homes that need to be built in Riverside by 2029 are becoming part of the fabric of the community.



↑ Houseal Lavigne used ArcGIS Urban to help the City of Riverside come up with a fair and equitable housing plan that meets the State of California's requirements.

3D Models of Road Construction Increase Sustainability

Designing smart construction processes requires organizations to connect a wide variety of data sources. In a nutshell, that's what VIA IMC, a digital construction company based in Berlin, Germany, does in partnership with its parent company Eurovia, a global leader in transport infrastructure and industrial, commercial, and urban development.

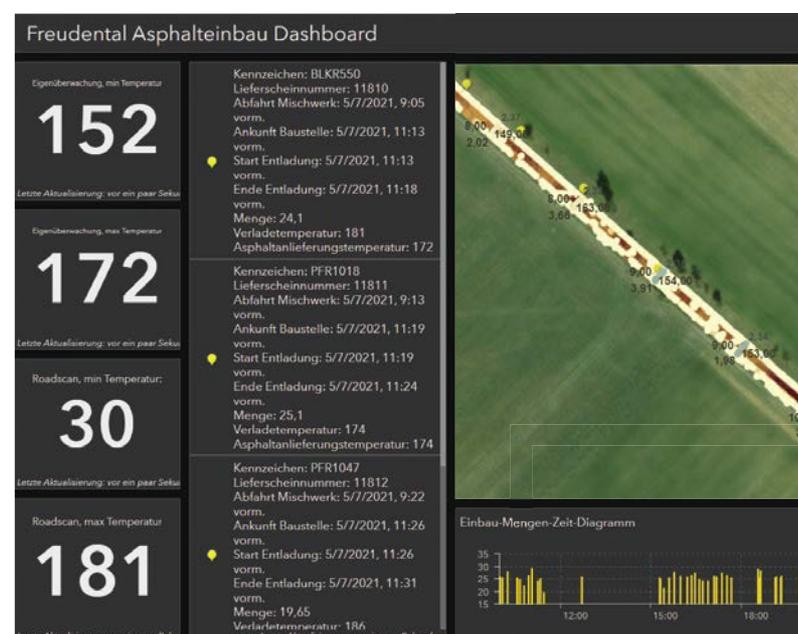
To increase sustainability at road construction sites, the two companies want to eventually establish digital twins of their projects. But first, this requires generating 3D models of road construction. So VIA IMC brought in [ARC-GREENLAB](http://arc-greenlab.de) to help develop an online platform to use for this, called AVUS.Online.

One of the main goals of the solution is to increase sustainability during asphalt-based road construction. By lowering the temperature of the asphalt by only 5 degrees Celsius (41 degrees Fahrenheit) as it is being laid, CO₂ emissions can be reduced by up to 20 percent. This requires working faster and in closer coordination, so it is necessary to precisely document the locations of—and asphalt temperatures in—both heated transport trucks and paver machines.

ARC-GREENLAB helped VIA IMC by designing the system architecture and operational processes for AVUS.Online in Microsoft Azure. Project staff also ensured that the construction data that VIA IMC and Eurovia employees collect can be merged with the ArcGIS system and evaluated there.

ARC-GREENLAB staff built data models and structures; converted data using a feature manipulation engine (FME); and developed interfaces for integrating several types of data—including building information modeling (BIM) data, imagery collected using unmanned aerial vehicles (UAVs), and construction data—into a geodatabase. Using ArcGIS Enterprise, ArcGIS Dashboards, and ArcGIS Web AppBuilder, the team made it possible for VIA IMC and Eurovia staff to access and visualize the data online. Employees on construction sites can also evaluate a project's implementation status, the quality of the asphalt, and other tasks from the field. And ARC-GREENLAB developed components like interfaces, tools, and widgets that make it possible for staff at VIA IMC to implement new apps on their own.

All this amounts to taking the first step toward setting up digital twins for construction sites. Employees at VIA IMC and Eurovia now record data in real time, combine that data with existing data, and analyze it and visualize the results on the web. This not only makes it possible for construction employees to closely monitor asphalt temperatures while it is being laid, but it also helps them optimize other logistics and processes that can further reduce CO₂ emissions. Additionally, the solution is easily scalable, so VIA IMC and Eurovia can use it for construction sites across their portfolios.



↑ ARC-GREENLAB built a dashboard using ArcGIS Dashboards to display key information about asphalt construction sites.

A Novel Way to Visualize Infill Development

For city officials in Rocky Mount, North Carolina, the rapid pace of growth and the increasing need to develop affordable housing have strained the limits of the city's existing land development and zoning codes.

To analyze and communicate how a potential code change or new development affects existing neighborhoods, officials didn't just want to present stakeholders and community members with paper-based site plans. They wanted to let people see how site plans fit in with existing and other planned projects. So the city turned to **ViewPro** (viewprogis.com) to start the iterative process of creating a digital twin.

"The deployment of an interactive tool that enables us to engage stakeholders by visually representing the development potential for properties is revolutionary," said Rocky Mount planning administrator William Deaton.

To begin the process, officials filled out ViewPro's needs assessment, available at viewprogis.com/urban-solutions, to identify specific problems they wanted to solve. The next step was for ViewPro to produce an ArcGIS Urban model. This required converting traditional 2D data, such as land-use designations, floor-to-area ratios, building heights, and street orientation, into 3D data—a workable data input for building out a digital twin. Staff at ViewPro then used other Esri software, including ArcGIS Pro, ArcGIS CityEngine, and the ArcGIS 3D Analyst extension, to achieve the desired output.

To maintain cost-effective and efficient infrastructure networks amid tremendous pressure to grow, city officials want to do more infill development, which entails building on vacant or underused land that exists within a community's current development patterns. With ArcGIS Urban, ViewPro staff are able to simulate code changes that allow city officials to demonstrate how infill developments will impact the surrounding neighborhoods. For example, stakeholders and residents can see how a multistory unit with four apartments in it will look in a predominantly single-family home neighborhood.

The interactive digital tools that ViewPro created have enabled Rocky Mount city officials to improve communication with the community, better coordinate across city departments, and save both time and money through seamless data sharing. Critically, efforts are building toward developing a full-scale digital twin of Rocky Mount, which will allow officials to use more 3D data analytics for decision-making.

"Rocky Mount leverages the ViewPro team to better position the city en route to becoming a smarter city by using cutting-edge technology like the Esri visualization toolset," said Gregory Cotten, the city's chief technology officer.

Rocky Mount is far from being alone in having to come up with creative ways to grow and develop more housing choices. Its use of next generation technology can be an example for other communities facing similar challenges.



↑ City officials in Rocky Mount can visualize how new infill developments will look within existing neighborhoods.

Ensuring a More Stable Water Supply in Rwanda

Kigali, the capital of Rwanda, is home to more than 1.2 million people. As in other urban areas of the country, residents in Kigali frequently face water shortages. While water demand in the city is 290,038 cubic meters per day, the supply is estimated at 187,293 cubic meters per day, resulting in a gap of 102,746 cubic meters. This means that some areas of Kigali are regularly subjected to water rationing.

Rwanda's Water and Sanitation Corporation (WASAC) wanted to ensure that a stable supply could reach more residents, so it commissioned Esri Rwanda and **DHI** (dhigroup.com) to establish a geodatabase of its assets and develop hydraulic models of the water distribution network in the city and in 14 up-country regional WASAC branches.

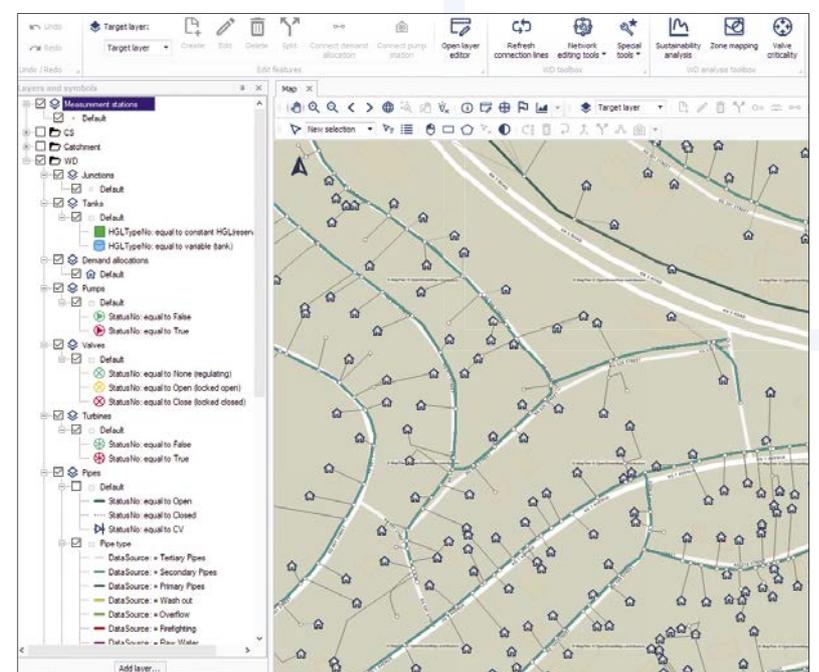
To begin, staff at Esri Rwanda collected and mapped water network data throughout the country using ArcGIS mobile apps. Esri Rwanda ensured the quality of the data and loaded it into a central ArcGIS Enterprise geodatabase.

Esri Rwanda staff then built a geometric network with specific connectivity rules to represent and model the flow of water within WASAC's network. The geometric network allows engineers at WASAC to perform network analysis to determine things like the direction of water flow, what customers are supplied from a specific reservoir, and which valve should be closed when a pipe bursts.

With all the data in place, DHI developed hydraulic models using its MIKE+ suite of software integrated with ArcGIS Pro. The team chose MIKE+ due to its fast SQL database, user-friendly interface, and hydraulic modeling tools designed to handle large city networks. The DHI team made 16 models in total of key water networks in Rwanda. Now, WASAC's engineers can use these detailed representations to optimize daily operations, ensure that adequate water pressure is available to the most people, build networks to new urban areas, perform water quality analyses, and investigate many other what-if scenarios.

MIKE+ has a web interface that gives regional branch employees and section managers web-based access to the main models located on a server at WASAC headquarters in Kigali. They can use this to run hydraulic simulations and visualize the results via mobile devices while out in the field, often in remote areas. Additionally, Esri Rwanda developed a supervisory control and data acquisition (SCADA) system to allow supervisors at WASAC to automatically and remotely control some water management and distribution operations. Once fully implemented, the SCADA system will be a state-of-the-art technology in Rwanda and enable WASAC to take its water supply services to the next level. Finally, the team integrated WASAC's billing system with ArcGIS technology and made this information available to all WASAC departments and branches so they can more easily monitor the billing process across all water distribution zones.

With all this centralized data and new ways to monitor, analyze, and model network distribution, staff at WASAC have so far accurately mapped and identified water supply issues for around 200,000 households and begun instituting network configuration solutions to ensure a more reliable and sustainable water supply for everyone.



↑ DHI developed hydraulic models of the Water and Sanitation Corporation's (WASAC) water distribution network in Rwanda.

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

CLOSING INFORMATION GAPS IN EMERGENCY RESPONSE

When natural hazards strike, emergency service providers must be prepared to act quickly and decisively to respond to people in need. Whether dealing with hurricanes, wildfires, tornadoes, or earthquakes, these crises require fast, informed action.

But that's easier said than done when the data that first responders use comes from scores of disparate sources. Even though more information than ever before is available to today's emergency personnel, the data is often stored in disconnected systems that make use of many different tools. This makes it tough to combine all the necessary information into a single source of truth. It also makes it hard to share critically needed information with people on the front line.

Esri partner First Due—a graduate of the Esri Startup program—offers a cloud-based, end-to-end software suite that brings together much-needed data for fire and emergency medical services (EMS)

operations, prevention, and administration. With First Due, emergency service providers can run their entire operation in one place using tools for pre-incident planning, community engagement, mobile response, inspections, and asset and personnel management, as well as the National Fire Incident Reporting System (NFIRS) and electronic patient care reports (ePCR). First Due also works on any computer or mobile device.

A key feature of First Due is that it allows fire department and EMS staff to operate directly on top of crucial data layers from Esri, such as floodplain and elevation maps or live fire data, while out in the field. First Due's solution employs ArcGIS technology throughout, including in tools for pre-incident planning, inspections, and community risk reduction.

"By partnering with Esri, we're able to give our customers across the country the critical geospatial information they need—at their fingertips and at a moment's notice," said First Due cofounder and CEO Andreas Huber. "Our customers are using this data to tackle incredibly complex and quickly moving natural disasters."

Out of the box, First Due's pre-incident planning functionality automatically aggregates public and private sources of critical information within an agency's response area to provide a profile of every

structure, including single-family homes. Additionally, First Due's Community Connect solution enriches automatically sourced data by enabling residents to submit their own life-safety information. This gives responders and emergency planners access to details like people's contact information, mobility concerns, language preferences, and building features that only occupants would know.

Real-Time Incident Management for the Bobcat Fire

During the devastating 2020 California wildfire season, the Bobcat Fire burned more than 115,000 acres in September in and around the Angeles National Forest. As one of the largest fires on record for Los Angeles County, the Bobcat Fire resulted in large-scale natural and structural damage, caused residents to evacuate, and contributed to hazardous air pollution across the region. For the first responders fighting the blaze, the Bobcat Fire was a dangerous, hard-to-contain, quickly moving challenge.

Using First Due's Pre-Incident Planning function, the nearby City of Arcadia had collected comprehensive community data before the fire broke out. As the wildfire progressed, city officials were able to see this data in First Due in the same operating picture as real-time data layers from Esri to help first responders monitor and battle the blaze.

"MODIS [Moderate-Resolution Imaging Spectroradiometer] and VIIRS [Visible Infrared Imaging Radiometer Suite] layers in GIS are up-to-date information made available by the folks at NASA [the National Aeronautics and Space Administration] to understand, through high-tech thermal imaging, what areas are showing spikes in abnormal heat and where the fire has most likely spread," Arcadia fire chief Barry Spriggs said. "In conjunction with fire perimeter data from other sources, we were able to gain an accurate, real-time picture of what we were dealing with."

Spriggs said that First Due and ArcGIS helped all the agencies responding to the disaster set priorities and drive a consistent, organized response.

"Having an accurate map was huge when deciding how and where to place resources for all agencies involved in response to the event—our personnel, local [police departments], and city officials in the EOC [emergency operations center]," he said. "Early on, it was determined that we needed to take advantage of Arcadia-specific GIS layers and wildfire-specific GIS layers to make sure we could utilize our computers and tablets in the command post and emergency operations center so that we could stay current with the fire perimeter and best understand how it can impact our city."

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

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→ Offshore weather buoys delivered real-time data to First Due users during Hurricane Sally.

Sharing Data in Real Time to Combat Hurricane Sally

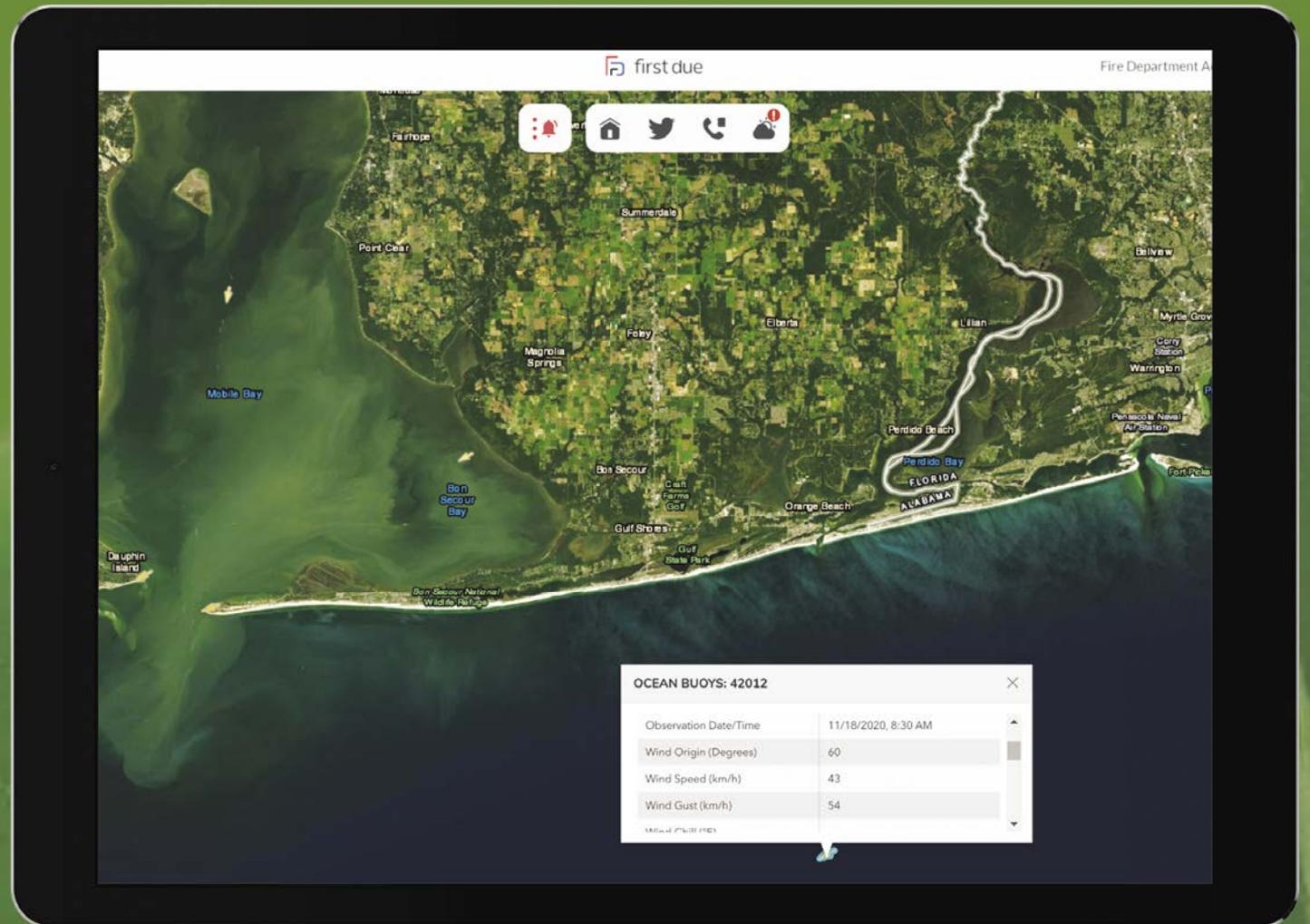
Like the Bobcat Fire, Alabama's Hurricane Sally—also in September 2020—brought fast-moving destruction to a region that had already been battered by storms during last year's active hurricane season. Hurricanes can swiftly change direction, intensity, and speed, making for a hazardous set of circumstances. This intensifies the need for accurate, readily available data.

For the Orange Beach Fire Department in Orange Beach, Alabama, prehurricane preparation was key.

"First and foremost, we had to get on the same playbook and act quickly to provide our task force partners with our incident alerting, mapping data, and all of our pre-incident plans—including details on our residential structures," said Jeff Smith, Orange Beach deputy fire chief. "We took it a big step further by just as quickly enabling our crews to track outside task force apparatus locations, just as we do ours, so we could make sure the closest unit to any emergency was the one responding."

But the team realized that more external data would be needed to accurately plan for and track Sally's path.

"With the way we were already using data in the First Due platform, there were no big changes that needed to be made, even for a situation like a major storm," said Smith.



"However, when we developed strategies to incorporate data from outside sources to understand how our preparations would hold up against projected storm tracks, we needed to bring in platform expertise to make these things a reality."

Live data from weather buoys, the National Hurricane Center, floodplain elevation markers, and more was brought

into First Due, where it could be viewed alongside other data layers. This enabled responders from all agencies to access and use the same information in real time.

Delivering Data and Getting Results

For the agencies responding to the Bobcat Fire, Hurricane Sally, and other natural

hazards, First Due—together with ArcGIS technology—gives emergency personnel the tools they need to deliver better, more accurate, and more comprehensive services to people in peril. The seamless, up-to-date data and simple user experience improve crisis response for those who need it most.

For more information, contact the First Due team at firstdue.com.



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From the Meridian

By Mark Revell
American Association of Geographers



Community Colleges Are Changing the Landscape of Geography Education

It's only fitting that studying geography—a discipline that contemplates place and space—enables students to take their careers in so many directions. What other field of study can count among its graduates urban planners who assess the costs and benefits of proposed transit systems, state climatologists who monitor the impacts of rising sea levels, consultants who advise firms about moving into new markets, and human rights advocates who work with refugees?

The Bureau of Labor Statistics database lists hundreds of occupations that require knowledge of geospatial technologies. It's clear that opportunities for geographers and GIS practitioners will only continue to grow in the foreseeable future. Yet because of its interdisciplinary nature and a relative lack of understanding of how versatile it is, geography is facing some major challenges at institutions of higher education, especially in the United States. Core among them are declining

enrollments and a lack of diversity that threaten to derail the geospatial workforce.

In the United States, bachelor's degrees awarded in geography and cartography have declined for seven years running, even though the number of bachelor's degrees earned overall has risen steadily, according to the National Center for Education Statistics. From a peak of 5,128 geography and cartography bachelor's degrees conferred in 2012, the numbers have since decreased to just 4,234 in 2019—the lowest they've been since 2003. While the percentage of Black, Indigenous, and People of Color (BIPOC) students earning bachelor's degrees in geography and cartography has grown over the same period, this group remains significantly underrepresented compared with all graduates of four-year institutions. What's more, the discipline has performed especially poorly among Black and African American students. In 2019, just 3.5 percent of geography and cartography bachelor's degrees

conferred went to Black or African American students, compared with 9.4 percent of bachelor's degrees across all disciplines.

So here we are. Geographers—with their cross-disciplinary perspectives that bridge the physical sciences, social sciences, and humanities—are among the most qualified professionals to address the complex problems facing our world. The demand for geography and GIS skills has perhaps never been greater, and the intellectual approaches and conceptual tools of the discipline are more relevant than ever. Yet the number of graduates in this field is not only failing to keep pace with workforce demand but is also going in the wrong direction.

But it is not all doom and gloom. The American Association of Geographers (AAG) will soon release its new, comprehensive *Guide to Geography Programs in the Americas*. This interactive directory will show all the geography, GIS, and closely related programs available in the United States, Canada, and Latin America, at all levels of higher education. And one thing stands out in the data: the growth of geography and GIS at the community college level. The AAG's annual review of programs found that there are now 210 community colleges in the United States that grant associate's degrees in geography and GIS, compared with an estimated 158 in 2018. Many more two-year programs offer stand-alone courses in geography, GIS, or related subject areas as well.

According to the National Center for Education Statistics, community colleges accounted for roughly 34 percent of all degree-granting institutions in the United States in 2018 and educated more than 42 percent of all US undergraduates that year. Decades of state-level funding cuts for higher education have contributed to significant tuition increases and pushed more of the costs of college onto students. This has made it harder for many people to afford four-year programs. Recent findings from the American Association of Community Colleges show that average annual tuition and fees at community colleges in the United States were \$3,730 compared to \$10,440 for four-year public institutions.

Community college geography programs are generally much more diverse than their four-year counterparts. Fact-finding conducted by the AAG earlier this year showed that 46 percent of two-year colleges with geography, GIS, or related programs serve communities of color compared to 18 percent of bachelor's degree-granting programs and 19 percent of master's and PhD programs. According to Jacqueline Housel and Patrick Shabram, members of the AAG's Community College Affinity Group, geography at two-year colleges is more agile and adaptable at the local level to students with varying educational and life experiences. Community colleges may also serve as places where students discover geography as a field of study.

Moreover, for students who have historically faced greater economic barriers to gaining higher education, community colleges offer attractive, affordable alternatives to four-year degree programs. That's because, although many students attend community college with the intent of transferring to four-year geography programs, two-year colleges can provide pathways for direct entry into the workforce—for example, as GIS technicians in fields such as planning, transportation, and resources management. Indeed, it is likely that much of the growth of geography at the community college level is driven by the demand for GIS certifications and technical skill sets that can be acquired at two-year colleges.

At a time when the relevance of geography is being challenged within universities, the growth of geography and GIS at the community college level provides a unique opportunity to turn the tables. It's a promising indicator of a diverse and growing student body that is, by all indications, eager to learn about geography and gain skills that will enable its members to enter the geospatial workforce.

More must be done to help community college graduates who want to continue their education and gain entry into four-year geography programs. Building these connections may become critical to the viability of the discipline.

Given the strong outlook for career opportunities, the field of geography in higher education should be booming. Let's make it so.

About the Author

Mark Revell is the manager of career programs and disciplinary research for the AAG. He coordinates a wide range of projects related to careers, professional development, and geography education and serves as editor of the AAG's *Guide to Geography Programs in the Americas*. Revell holds a master's degree in geography from George Washington University.

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

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At All Career Levels, Mentoring Drives Success

By Frank Romo, RomoGIS Enterprises; Kevin Mickey, The Polis Center; Steven J. Steinberg, Los Angeles County; and Rachel Layko, Arizona State University

Think back to when you first learned about GIS. Perhaps you encountered GIS in school, on the job, or by asking a friend, “What is GIS?” Maybe you got your start by taking a formal college class, participating in a professional training program, or taking an online course.

Those experiences are all incredibly important, but they typically focus on the technical aspects of GIS and how to apply it. How many of those experiences included practical discussions about how to best develop your GIS career?

As in any profession, those who are further along in their GIS careers can offer people who are just starting out valuable insight into how to keep progressing. Mentors often share with their mentees tips on gaining executive support for GIS within an organization, how to effectively plan and budget for GIS projects, and ways to incorporate spatial thinking and location analytics into organizational workflows. These topics are rarely covered in standard GIS courses, but they are essential to thriving in the field of GIS.

Mentorship is one of the most powerful ways to expand one’s professional network, develop a rapport with others in the GIS field, and stay on top of the latest industry trends—gains that both mentors and mentees realize. Finding the right mentoring relationship, however, can be challenging. That is why the Urban and Regional Information Systems Association (URISA) launched the URISA Mentoring Network in 2020. Led by the URISA Vanguard Cabinet, this new mentoring network aims to foster strong connections between geospatial professionals at all stages of their careers.

Mentors Contribute While Building Their Own Skills

For mentors, it is important to realize that mentoring is not just about giving. Serving as a mentor builds skills that are important for current or future GIS managers and other leaders to have, including listening carefully, communicating clearly, and recognizing opportunities that others might not see. The mentor-mentee relationship also enables both participants to learn about new technologies, fresh ways to apply GIS, and emerging research that can inform their decision-making.

One of the most valuable characteristics a leader can have is a passion for helping others reach their potential. When advising a

mentee, this might involve helping the person explore employment opportunities, find professional training programs, and join professional organizations. Having regular conversations and sharing advice with mentees can influence their immediate circumstances as well as their longer-term outcomes.

It is so rewarding to witness someone grow professionally and personally, knowing that you have had a role in informing, shaping, and supporting that person’s decision-making. Every mentoring experience is unique and tailored to the needs and abilities of the individuals involved, and each mentorship goes as far as the participants choose to take it. The more a mentor and mentee engage with each other, the more both will get out of the relationship.

How Mentees Can Make the Most of Mentorships

Anyone can benefit from having a mentor, no matter what stage of their career they’re in. Most GIS practitioners hold a variety of roles throughout their professional lives, often at various organizations. Working with a mentor yields countless occasions to learn about and plan for new opportunities.

Seeking a mentor who is at a different level in your chosen field or who works in a different sector altogether can provide valuable perspective for career transitions, whether you want to move up the ladder or switch industries. A mentor may know which skills you should highlight on your résumé, be able to identify shortfalls in your experience, and want to share lessons learned.

Topics that a mentee might want to discuss with a mentor while trying to progress from a GIS technician to a GIS analyst would be very different from topics that are helpful to explore when considering a move into management. Mentees who are at the early stages of their careers may want to focus on how to improve their résumés or enhance their GIS portfolios, while people in the middle of their careers may be interested in learning more about hiring, managing, and evaluating GIS staff or planning, budgeting, and overseeing projects.

Getting perspectives from people who work in various environments can be helpful as well. Mentors can include college or university professors and advisers, coworkers, and other members of professional organizations. Academic

Managing GIS

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



mentors can provide recommendations on coursework and internship opportunities that serve as good preparation for entering the workforce. Colleagues can give great advice about navigating company culture and how to get promoted. And mentorship from outside sources like professional organizations can offer insight into what it’s like to work in other sectors or locations.

Drawing on people’s diverse opinions about various work environments, the tools and skills required to succeed, and ways to approach problem-solving can give mentees a broad perspective on the GIS industry. For students transitioning out of the classroom and into the workplace, hearing from a variety of real-world professionals can guide them to great first jobs as GIS practitioners. And for those undergoing career transitions, forming professional relationships with people in other jobs and industries can help inform the decisions they make about their own jobs.

Get Involved in Mentoring Through URISA

URISA’s new mentoring network aims to support mentors and mentees as they work together to accomplish their professional and academic goals, improve each other’s self-esteem, and advance their technical capabilities.

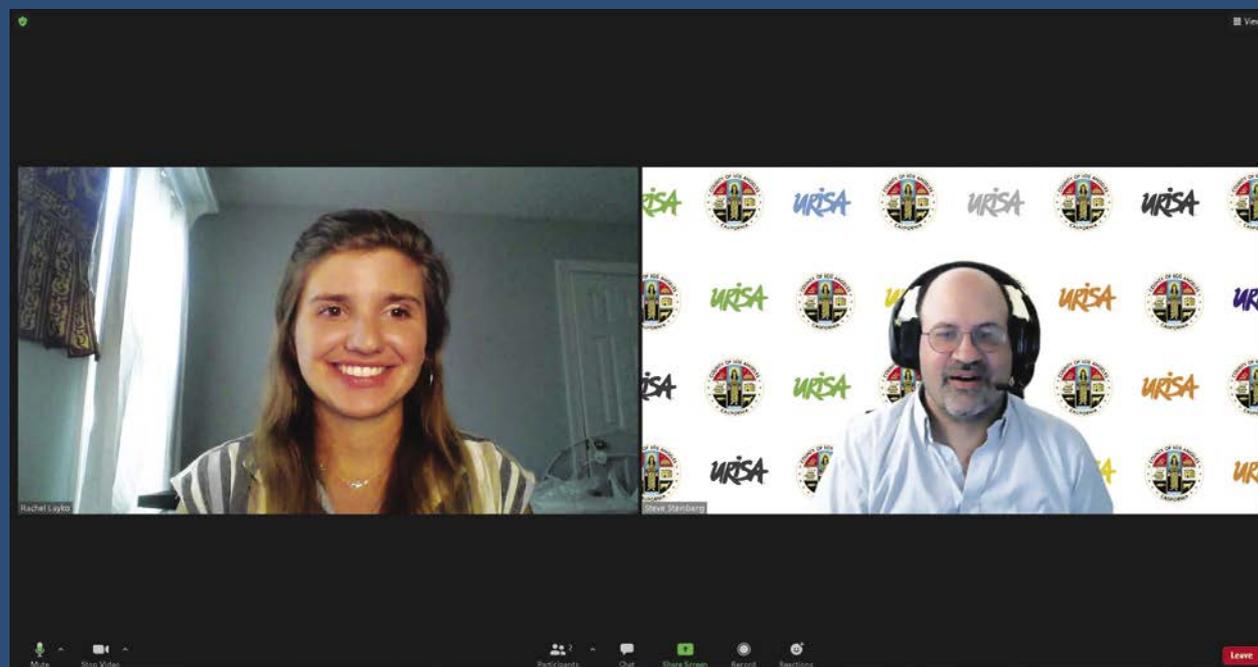
The URISA Mentoring Network offers three, six-month mentorship cohorts each year—two that begin in the spring and one that starts in the fall. After volunteers pair up mentors and mentees based on their interests, skills, location, and more, the program begins with a kickoff event in which mentors, mentees, and members of the Vanguard Cabinet discuss the program structure, expectations, and the goal-setting process. In this meeting, each mentor-mentee pair is provided with resources to use to shape their future conversations.

Over the course of their relationship, mentors and mentees can discuss suggested topics, such as interviewing tips and goal setting, or define their own topics that better suit their objectives. At the end of six months, the pair is welcome to continue their relationship in a way that works for both parties. Mentors are also encouraged to take on new mentees if they want to, and mentees are empowered to then serve as mentors themselves.

To learn more about the URISA Mentoring Network or to register as a mentor or mentee, visit ow.ly/phN450FXMGp. For more information about getting involved, email Rachel Layko, cochair of URISA’s mentoring subcommittee, at layko.rachel@gmail.com.

About the Authors

Frank Romo is the founder of RomoGIS Enterprises, a data, design, and research collaborative that harnesses the power of maps, data, and technology to improve the quality of life for underserved communities. Kevin Mickey, the current president of URISA, is the director of professional development and geospatial technologies education at The Polis Center, an applied research center in the School of Informatics and Computing at Indiana University-Purdue University Indianapolis (IUPUI). Steven J. Steinberg, PhD, MPA, GISP, is the geographic information officer for Los Angeles County, California. He is a member of the board of directors for URISA. Rachel Layko is a graduate student in the Center for Global Discovery and Conservation Science at Arizona State University. She is a member of the URISA Vanguard Cabinet and serves as cochair of the mentoring subcommittee.



↑ By having regular conversations, mentors and mentees—like mentor Steven J. Steinberg, right, and mentee Rachel Layko, left—can develop a rapport that helps them hone skills that are key to having a successful career in GIS.

Giving Students a Dynamic, Shareable Work Space with ArcGIS Notebooks

With so many changes having happened right before the summer 2020 semester at the College of William & Mary in Williamsburg, Virginia, lecturer Dr. Tyler Davis decided to lean into his calling as a solver of complex problems. Just days before teaching was to begin, he completely redesigned the structure of his Advanced GIS Analysis and Programming class.

Davis's class is part of the Center for Geospatial Analysis (CGA) at William & Mary and functions as a campus resource, rather than a major or a department, for all things related to geospatial

analysis. The center plays an educational role at the undergraduate and graduate levels and offers technology and GIS support to faculty, staff, and the greater community.

"What drew me to the CGA was that we help solve other people's problems," Davis said. "That resonated with me because that's essentially who I am. As an engineer by training, I like to solve problems."

Students with different skill levels, career paths, and intentions enroll in Davis's class to increase their understanding of program-

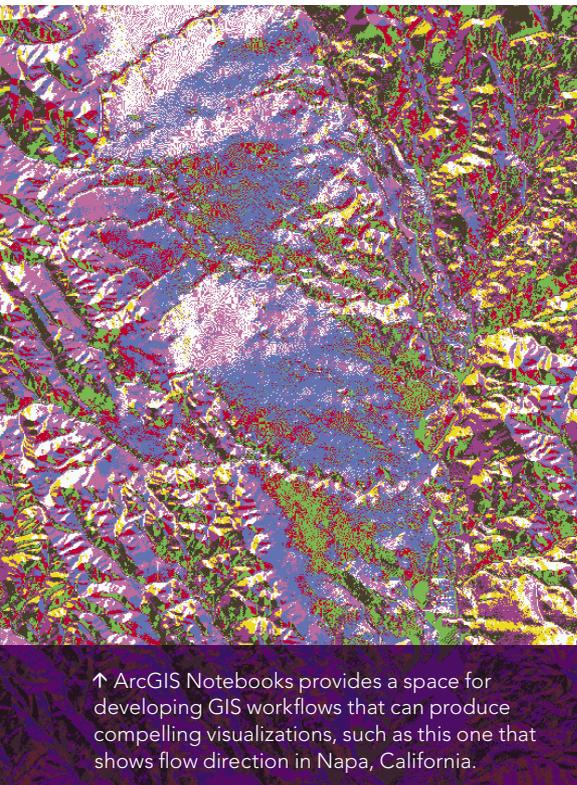
matic approaches to spatial data and analysis. Consequently, Davis needed to structure his class to accommodate every student's unique needs. What's more, he had to overcome these hurdles amid uncertain times, equitably and in a completely digital setting.

When Davis learned about ArcGIS Notebooks, he realized he had found a key piece of the framework for showing GIS as a workflow.

"A lot of problems can't be solved just by clicking a button," he said. "We have to put different pieces together."

His overarching goal was to help his students understand that solving complex problems—like those they will eventually confront in their workplaces—requires a lot of data, analysis, collaboration, and hard work.

Notebooks is designed to help users better collaborate with other analysts and data scientists, a concept that Davis wanted to carry into the foundation of his class. ArcGIS Notebooks is built on top of the Jupyter Notebook, an open-source web application that allows users to create and share documents that contain live Python code,



↑ ArcGIS Notebooks provides a space for developing GIS workflows that can produce compelling visualizations, such as this one that shows flow direction in Napa, California.

Finding Landsat Data

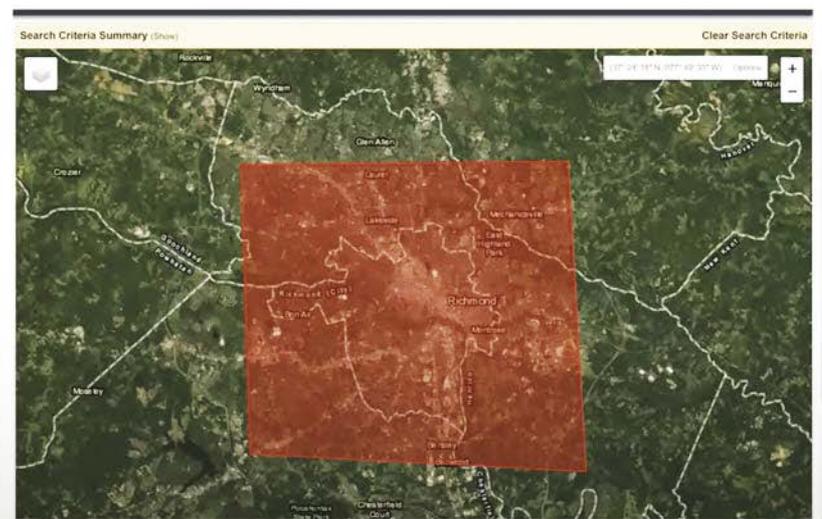
Step 1: Selecting a polygon/circle, can be preset coordinates or drawn

Polygon Circle Predefined Area

Degree/Minute/Second Decimal

1. Lat: 37° 38' 44" N, Lon: 077° 37' 28" W	✓	✗
2. Lat: 37° 38' 51" N, Lon: 077° 19' 21" W	✓	✗
3. Lat: 37° 25' 08" N, Lon: 077° 18' 22" W	✓	✗
4. Lat: 37° 25' 55" N, Lon: 077° 36' 59" W	✓	✗

Use Map Add Coordinate Clear Coordinates



↓ Students work together to outline problem-solving processes in a reproducible manner. This often begins with finding the right data.

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visualizations, and text. As a result, students can share their work and build on work that has already been created by others.

Adapting to Asynchronous Remote Learning

One of the biggest problems Davis had planned to overcome was the students' diverse schedules and the potential need to quarantine due to COVID-19 at unpredictable times. With not much time to prepare, the class adopted an asynchronous remote learning approach. The schedule proved to be a challenge to navigate, given the complex nature of the class subject matter. "We tried to fix that with a virtual desktop, where they would log in to computers remotely, [but there was] internet lag, and just the software itself was really slow," Davis said. "When you're teaching something that's already frustrating, adding another layer of frustration is not really what you want because students [may] give up."

When Davis's class moved completely online, he wanted to provide students with equitable computing resources to run GIS software.

"The ability to put everything in the cloud meant that there was more equity in terms of students having access to all the tools that I felt we needed," Davis said. "Opening up both ArcGIS and ArcPy in one platform in the cloud, I think, really rang a lot of bells for me."

The Value of Teaching Reproducibility

Given increased public skepticism of science as of late, Davis realized that his students should focus

“There’s a lot more stress and emphasis on how we communicate science to the general public. The philosophy I’m trying to show students is to become better communicators of their process and to become a part of the reproducible-science movement.”

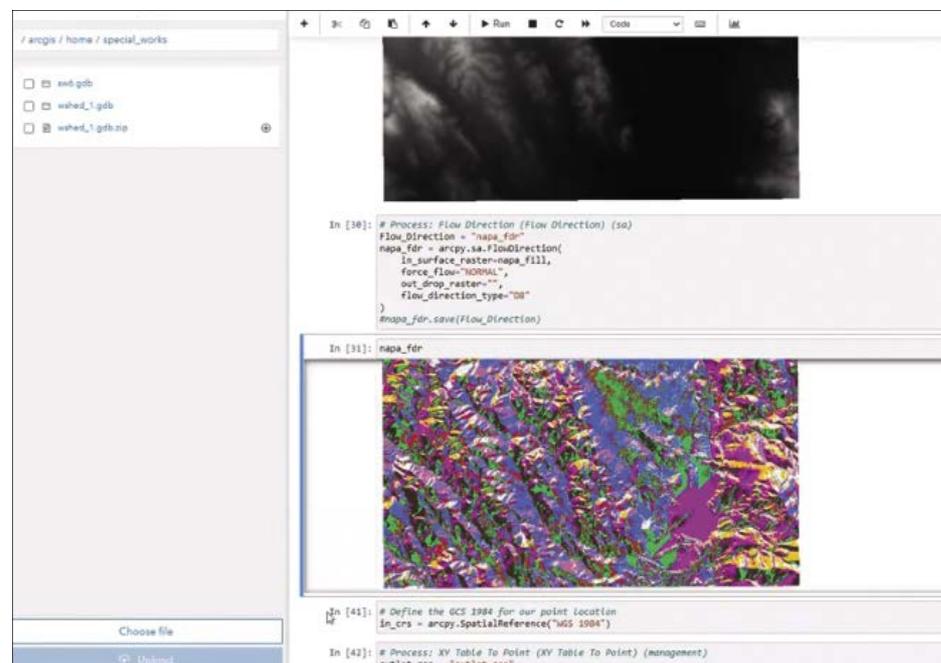
Dr. Tyler Davis
College of William & Mary

on careful processes that could easily be reproduced for testing and verification. By combining Python scripting with interactive visuals and descriptions, Notebooks allows students, researchers, and educators to explain their analyses in a dynamic, shareable work space.

"There's a lot more stress and emphasis on how we communicate science to the general public," Davis noted. "The philosophy I'm trying to show students is to become better communicators of their process and to become a part of the reproducible-science movement."

Part of the class requires students to choose a published paper and grade it on the project's reproducibility. In doing so, they see how others have

put together projects and gain an understanding of advanced geospatial techniques. Students are encouraged to work together so they can evaluate how others approach problem-solving with varying levels of knowledge and experience.



↑ Using Python in Notebooks, students can link together a series of geoprocesses to create a reproducible workflow for watershed delineation.

put together projects and gain an understanding of advanced geospatial techniques. Students are encouraged to work together so they can evaluate how others approach problem-solving with varying levels of knowledge and experience.

Creating a Workflow Conducive to Problem-Solving

Notebooks is designed to ensure that users can better collaborate with other analysts and data scientists. With this software implemented in Davis's classroom, students gained relevant experience with sharing their work and building on work that others have already created.

"Notebooks can be a part of the production line for communicating science through Esri's ecosystem of applications," Davis said. "All of these apps work well together."

Of all the benefits that Notebooks brought to Davis's class, perhaps the most useful is that the

software enables students to show their transferable skills to a potential employer. Davis provides students with nine different Notebooks tutorials on foundational topics, including programming basics. Students finish the class with an understanding of how and why programming is used, as well as the ability to visually show their work, which can help them acquire an internship or a job.

"If you're solving problems where you have scale and time considerations...you can start to show students how to take advantage of programming to meet those challenges," Davis said.

For the future of the Center for Geospatial Analysis, Davis envisions a community where mapping and spatial analysis are essentially ubiquitous in teaching and learning, research, and campus support. His multifaceted class, backed by supportive tools, has proved to be a significant step forward in this.

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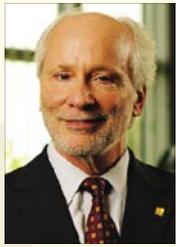
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A University That Speaks the Language of Spatial Data

By Gary Brahm and Dr. Sheila Lakshmi Steinberg, University of Massachusetts Global



Gary Brahm



Dr. Sheila Lakshmi

Data is the language of the 21st century—the way professionals in the nonprofit, public, and private sectors communicate with each other to make intelligent, evidence-based decisions. An analyst who can translate raw data into comprehensible information is an invaluable asset to any organization.

As critical as data literacy is in the modern workplace, however, data is never anyone's first language. People who thrive with numbers may

even seem to live in a different realm than those who do better with words. But the boundaries between science, technology, engineering, and mathematics (STEM) fields and liberal arts spheres are not impassable. Virtually anyone can learn the language of data.

To acquire fluency in any language, immersion is the best method. Those learning how to work with data need to be able to engage in hands-on learning activities that teach them how to find the patterns within datasets that reveal insights about human societies and the natural world. They also need guidance from instructors who can share their technological expertise and facilitate participation in applied activities.

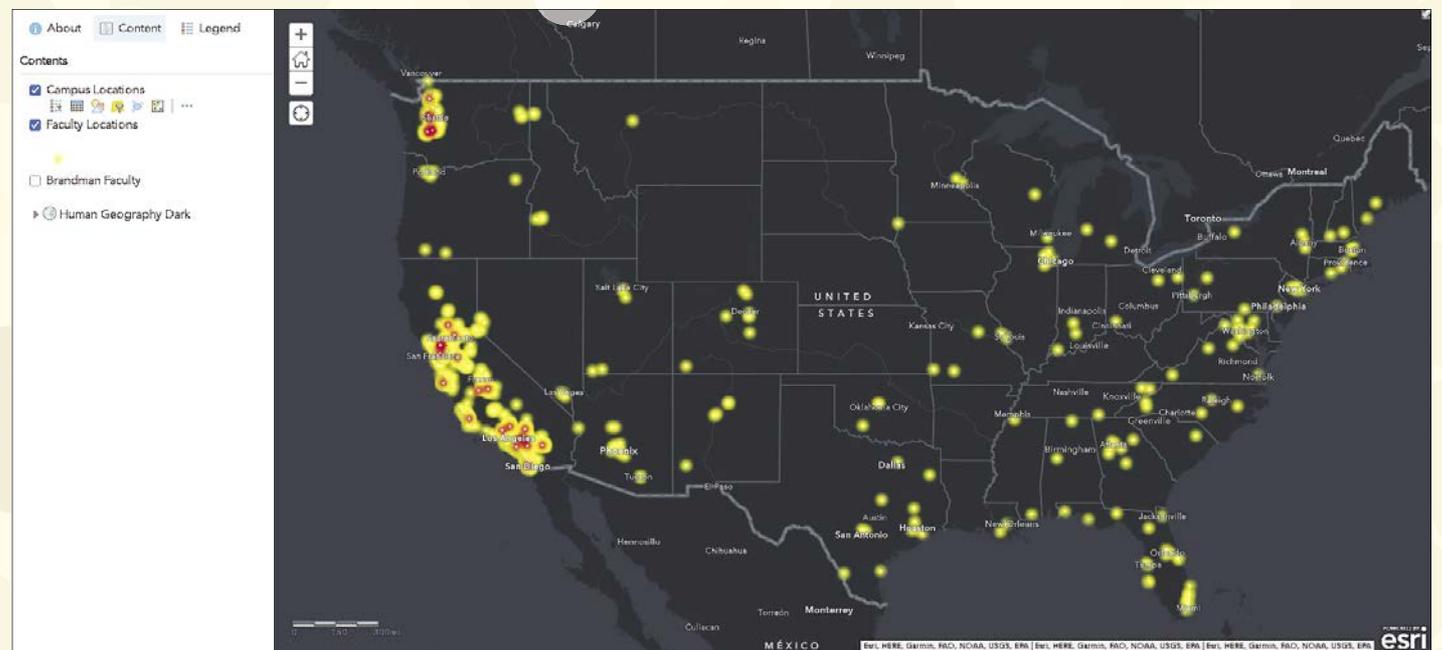
In an effort to increase the number of analytically fluent professionals, the University of Massachusetts Global (UMass Global), formerly Brandman University, has built a spatially literate university, in partnership with Esri, to educate students from diverse professional backgrounds in data and geospatial literacy. The university's distinct academic programs and student support services are designed to help working adults complete degrees and certificates that match increasingly datacentric labor market needs.

A Dearth of Data Literacy

For all the talk about data, the reality is that a vast majority of professionals in several technologically advanced countries are not yet analytically fluent.

Just 21 percent of surveyed professionals from select countries in North America, Europe, Asia, and the Pacific are fully confident that they can use data proficiently, according to *The Human Impact of Data Literacy*, a 2020 report from analytics software company Qlik and professional services company Accenture. Both companies are members of the Data Literacy Project, which aims to enhance data literacy around the world. Alarming, the report also shows that 36 percent of respondents admitted to wasting time to avoid having to work with data, and 61 percent claimed that having to work with data was a source of on-the-job stress.

These deficiencies are striking when one considers how advantageous data literacy can be. In *The Data Literacy Index* report from 2018, Qlik-commissioned researchers looked at businesses



↑ The University of Massachusetts Global (UMass Global) has campuses and faculty members located across the United States.

worth an average of \$10.7 billion to see how well they used data. The researchers, who included faculty members from the Wharton School of the University of Pennsylvania, found that the firms they observed as having the highest data literacy rates had enterprise values \$320 to \$534 million greater than those of comparison firms.

Nevertheless, index researchers also discovered that many executives in the United States do not emphasize data literacy education at their companies. Only 30 percent of US business leaders in the study reported providing their employees with training in data literacy—the smallest number among all countries surveyed. And only 16 percent of US executives said their enterprises significantly encourage data literacy.

Clearly, something needs to change. Students need opportunities to learn about data, and companies need to invest in their employees' data literacy.

Learning in Context

UMass Global offers a variety of degree and certificate programs that do just that, incorporating project-based learning and even Esri trainings into the curriculum.

The university, which has more than a decade of experience developing online and hybrid programs for working adults, has infused GIS into its undergraduate programs in the School of Business and Professional Studies and the School of Arts and Sciences. Students often apply the GIS skills they learn in the classroom one day to their jobs the next.

Additionally, UMass Global's certificate offerings manifest the value of data literacy. One such program, the graduate-level certificate in Business Intelligence and Data Analytics, begins with a course on data fundamentals. Students then go on to gain experience in data visualization, communicating with data, and using data to understand if projects are producing desired results.

The university's newest certificate offerings allow students to take Esri's instructor-led trainings and have them count toward their university credits.

These certificates—which include Emergency Management Using GIS, Economic Development Using Location Intelligence, and Geospatial Marketing Analysis—show students, in context, how to do data analysis and visualization and make data-driven decisions.

Not only that, but certificate programs like these “allow workers of any age to upskill as jobs and skills shift,” according to the recent *Creating the Future Workforce Today* report from professional services firm PwC and the Business-Higher Education Forum. And because certificate programs allow students to obtain stackable credentials—in which they take shorter-term courses that, over time, lead to a degree—they are a means to closing existing equity gaps.

Skilled individuals who are underrepresented among degree holders are often overlooked in the hiring process for positions that match their abilities. Given that UMass Global's student population is 17.99 percent Hispanic or Latino, 10.47 percent Black or African American, and 36.95 percent first-generation American, the university is well-positioned to teach GIS and data analysis skills to groups of students that are traditionally underrepresented in higher education.

Functional Curriculum

At UMass Global, faculty keep practitioners' and employers' needs in mind when designing courses.

Faculty members work in interdisciplinary teams to identify problems that people within a given field will face and try to solve. They then work backward to determine how to teach the spatial data analysis skills that students will need in the workplace. Thus, UMass Global graduates who learn Esri software can help colleagues who

would otherwise share information in functionally different languages—datasets or spreadsheets, for example—to better understand each other by using geospatial technology such as real-time maps and dashboards.

What's more, UMass Global has fostered relationships with several companies that generously invest in their employees' education, as this can significantly enhance employee recruitment and retention while also nurturing internal talent. These partners include the Automobile Club of Southern California and, through Guild Education, such national employers as Chipotle Mexican Grill, Inc.; Discover Financial Services; Walmart; Target; and The Walt Disney Company.

The success of this corporate partnership model rests not only on UMass Global's institutional strengths in serving working adults but also on its consultations with employers to identify programs that best suit their talent needs. When employers carefully select partner universities and education programs, they want to be sure that their resources will be used effectively. More importantly, this enables employees to enter programs that will help them develop skills that are of value not only to themselves and their own professional goals but also their employers.

UMass Global has the intellectual and institutional capacity to help students and organizations across the United States enhance their data literacy, which, ideally, will contribute to increasing analytical fluency around the world. Whether students participate in certificate courses or opt for a full-blown degree program, strengthening their data literacy will help them become more effective communicators with fluency in the language of spatial data.

About the Authors

Gary Brahm is the chancellor of UMass Global. He also served as chancellor of Brandman University and, prior to that, was executive vice president for finance and administration and chief operating officer of Chapman University. Dr. Sheila Lakshmi Steinberg is a professor of GIS, social, and environmental sciences and the faculty president at UMass Global. She is also an Esri Press author.

The Relevance of Cartography

A Cartographer's Perspective

By Tim Trainor

President, International Cartographic Association



The Early Evolution of Cartography

From Individual Craft to Professional Practice

Interest in maps has stood the test of time, from the earliest days of mapmaking to the extensive use of cartography today. Unsurprisingly, the vocation of cartography has evolved throughout the centuries. It was initially a craft in which individual practitioners combined their artistic abilities with design skills that enabled them to present content in a way that others could view, interpret, and understand. Now, cartography is a specialized subject that not only sets itself apart as its own area of practice, study, and research but also contributes to the advancement of related disciplines.

How did cartography transform, and what led to its development as an academic and professional specialty? Let's take a look at how mapmaking changed from pre-Renaissance through the end of the 19th century as new technologies emerged and the practice of making maps advanced. The next installment of this two-part series will focus on the last century through today.

Map Depictions Change from Imaginative to Precise

Early maps made prior to the age of exploration tended to center on *terra incognita*, or what was beyond. Drawings often depicted the universe, the heavens, and imagined distant lands. But this cosmographic view of things eventually gave way to maps that showed the world as it could be observed and, in some cases, approximated.

One reason for this, historians of cartography note, is that as tools, such as latitude and longitude, were developed to measure new discoveries, mapmakers gained greater interest in precision. Cartographic representation and design started to revolve around things like distance, time, and current conditions. Think, for example, of navigational charts and topographic maps, which are themselves instruments used to plot courses of travel and measure distances.

It also helped that, at the end of the 18th century, lithography made it possible to copy maps exactly from the original. This reduced the instance of errors, given that previously, both a map's content and design had to be transcribed manually.

Mathematical cartography, for example, which focuses on how map projections get transformed and distorted when representing the spherical earth on a two-dimensional

plane, has benefited from the accuracy that novel printing techniques, like lithography, made possible. When people use lines on a map to calculate distances, evaluate directions, and assess areas, it is important that those lines be accurate.

Geography Becomes a Proper Field of Study

Prior to the 18th century, mapmaking was generally the domain of individual cartographers. Very early maps, dating back to the prehistoric period, were sketch-like depictions that showed the locations of objects or settlements in reference to where the illustrator was at the time. As with art during the Middle Ages and Renaissance, wealthy people frequently commissioned well-known cartographers to produce maps for them. Other cartographers created works to advance exploration and discovery, as well as to analyze results from those endeavors. And novice mapmakers produced

sketches that portrayed geography that was of interest to them, much like what hobbyists and even children do today.

Mapmaking as an individual pursuit changed in the 19th century, though, when geography became a discipline. By this time, geography was often closely associated with history, meaning it helped people understand the locations of historical events. Over time, however, geography gained recognition for other uses, including figuring out how to connect neighboring settlements and delving into why something was happening in a particular location. Universities were key to establishing geography as an official field of study when they started adding specialties—like the study of different cultures, the history of cartography, or geology—to geography.

Because maps show geography, there is a natural alignment among the many specializations in geography and the different methods for visualizing and constructing representations of geographic phenomena via a map. Think about topics like physical, cultural, economic, regional, and environmental circumstances; biogeography; the climate; coastal geography; geodesy; geomorphology; glaciology; hydrology; oceanography; political, social, historical, and health issues; population density; transportation; tourism; and urban design. Now think about the techniques used to map these things, such as quantitative and qualitative methods, remote sensing, GIS, and cartography. The topics and techniques are inextricably linked.

Geographic Organizations Encourage Collaboration

Once a discipline comes into being, there is a natural tendency to organize people who share an interest in that subject area. The International Cartographic Association (ICA), founded in 1959, is a great example of this. Its establishment followed a boom in the founding of national geographic societies that began in Europe in the early 19th century. These organizations offered outlets for professional cartographers and geographers to share their experiences and publish articles and studies, which often included maps, about various geographic topics.

One increasingly available source of geographic observation was topographic maps that showed settlements, transportation, vegetation, hydrology, and hypsography. While early topographic maps were used primarily for military purposes, their versatility soon became evident for other functions like geographic exploration.

At the same time, geographic societies began storing atlases and maps, which geographers perused and used to complement their own work. These valuable documents also became a subject of research in cartography—that is, designing and constructing maps. Questions to explore included, What's the best way to display new content? What map scale shows the desired level of detail? What mathematical projection meets a measurement need? What's the most suitable way to display

gradients of the landscape? Thus, geographers began using the maps available to them—to national geographic societies—to study the very documents they were employing as tools to further their research.

Connections Emerge Among Disciplines

In 1871, at the first International Geographical Congress in Belgium, national geographic societies coalesced in an international context. Around this time, maps and atlases were being designed, produced, and used at increasing rates.

The Statistical Atlas of the United States, based on the country's ninth census taken in 1870, is a good example of the relationship among disciplines. Francis Amasa Walker, the superintendent of the census at the time, felt that the data collected in past censuses had been underutilized. He traveled to Paris to learn about new techniques for graphically portraying statistics and embarked on creating an atlas out of the 1870 Census results. In 1871, early maps from the census were exhibited at a session of the American Geographical Society, and Congress subsequently authorized a budget appropriation to produce the atlas. The atlas focused mainly on the results of the ninth census but also contained comparisons to all previous censuses, offering historical perspective.

Arguably, this was one of the first national atlases, since it contained maps of geographic information that extended well beyond the data presented in statistical tables. Maps of manufacturing, mining, agriculture, and disease prevalence—along with hypsometric sketches, a temperature and rain chart, and a geological map of the country—were all included in the atlas, as were topics on physical and administrative geography.

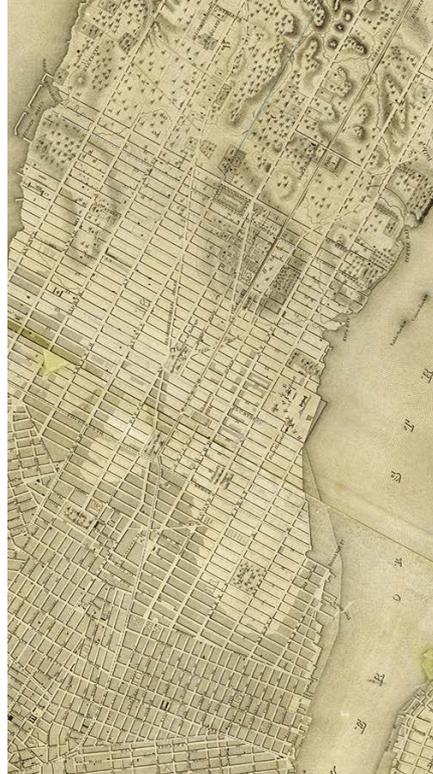
Cartography Comes into Its Own

By the end of the 19th century, then, cartography was no longer an individualistic pursuit. The expansion of technology, the growth of the new discipline of geography, and the founding of geographic societies all cultivated a surge in interest in how to make maps. Thus, cartography became a veritable professional practice and, in time, its own field of study that propelled other disciplines, including geography and mathematics, forward.

About the Author

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

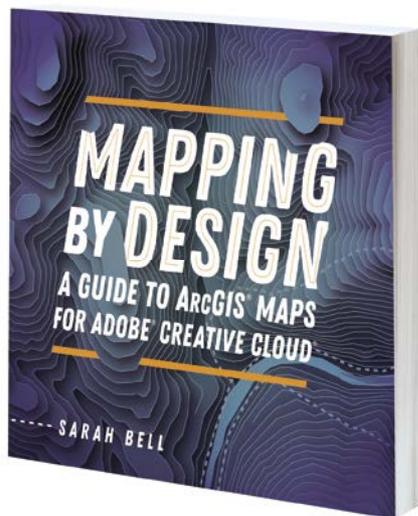
The primary source of information for this article is *The History of Cartography*, Volumes 1, 2, and 3, from the University of Chicago Press. PDFs of the publication are available at press.uchicago.edu/books/HOC.



Mapping By Design: A Guide to ArcGIS Maps for Adobe Creative Cloud

By Sarah Bell

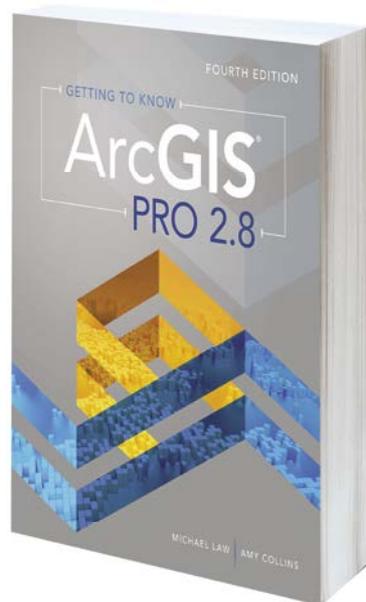
Mapping by Design: A Guide to ArcGIS Maps for Adobe Creative Cloud teaches anyone who wants to create visual and geospatial stories how to use ArcGIS Maps for Adobe Creative Cloud. By following comprehensive tutorials that navigate common mapmaking workflows, readers learn how to blend map science and map design. The book is intended for creatives who seek to make beautiful maps using familiar graphic design apps, as well as GIS professionals who want to learn the integrated workflows. September 2021/January 2022, 225 pp. Ebook ISBN: 9781589486058 and paperback ISBN: 9781589486041.



Getting to Know ArcGIS Pro 2.8, Fourth Edition

By Michael Law and Amy Collins

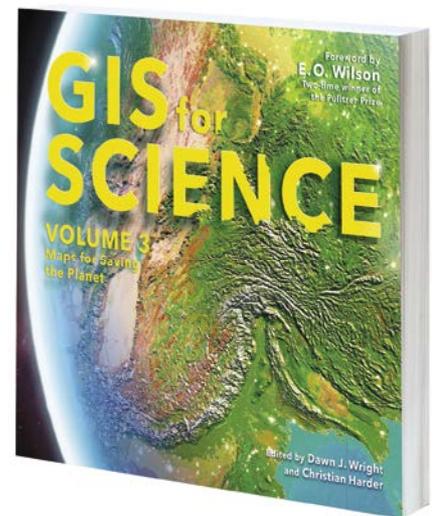
With new chapters on ArcGIS Online and geocoding, *Getting to Know ArcGIS Pro 2.8*, Fourth Edition, introduces new and existing GIS practitioners to tools and functions in the latest release of ArcGIS Pro. Readers explore data visualizations, build a geodatabase, work with 3D GIS, and create maps for print and the web. The book clarifies how to develop a geoprocessing model, use Python to write a script tool, and create space-time cubes for analysis. October/December 2021, 432 pp. Ebook ISBN: 9781589487024 and paperback ISBN: 9781589487017.



GIS for Science, Volume 3: Maps for Saving the Planet

Edited by Dawn J. Wright and Christian Harder

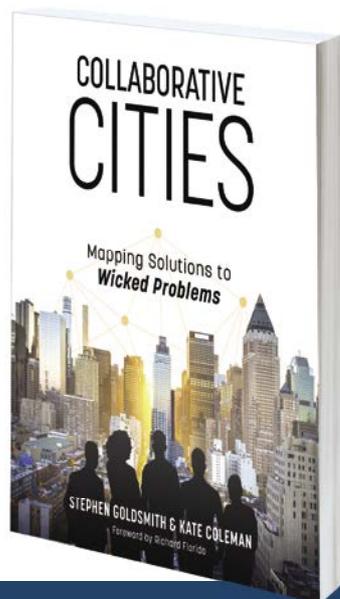
With a foreword by two-time Pulitzer Prize winner E. O. Wilson, *GIS for Science, Volume 3: Maps for Saving the Planet* highlights real-world examples of how scientists are creating maps to save the planet. This volume, which centers on biodiversity, is written for professional scientists and anyone interested in learning about how conservation and technology intersect. The ideas presented in *GIS for Science* can be applied across many disciplines and will hopefully inspire readers to help save Planet Earth while there's still time. September/November 2021, 228 pp. Ebook ISBN: 9781589486720 and paperback ISBN: 9781589486713.



Collaborative Cities: Mapping Solutions to Wicked Problems

By Stephen Goldsmith and Kate Coleman

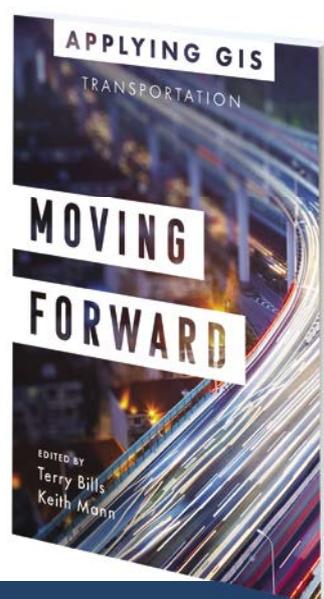
Confronting complicated issues such as climate change, homelessness, and access to health care demands that governments, nonprofits, businesses, and residents work together. While these stakeholders don't always agree on the best approach to take, they can all work from one commonality: place—where problems are happening and where people need assistance. *Collaborative Cities: Mapping Solutions to Wicked Problems* addresses how to form, operate, and adapt cross-sector collaborations that make use of maps, data analytics, visualization, connectivity, and the Internet of Things (IoT). October 2021/January 2022, 250 pp. Ebook ISBN: 9781589485402 and paperback ISBN: 9781589485396.



Moving Forward: GIS for Transportation

Edited by Terry Bills and Keith Mann

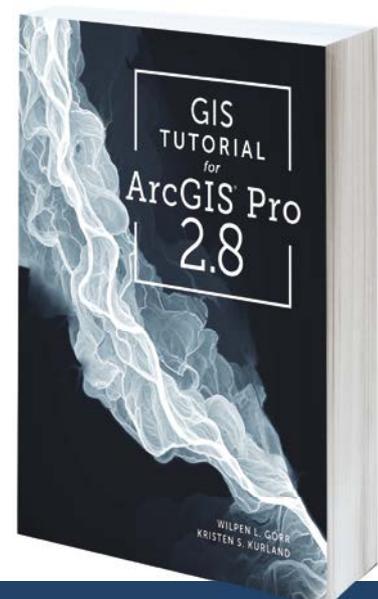
Geospatial analytics, real-time dashboards, and mobile apps are changing how transportation agencies protect and maintain infrastructure and streamline operations. In *Moving Forward: GIS for Transportation*, readers can see how ports, airports, transit authorities, and departments of transportation around the world have implemented GIS to visualize and analyze data for operational efficiency, safety and security, and asset management. September/November 2021, 120 pp. Ebook ISBN: 9781589486935 and paperback ISBN: 9781589486928.



GIS Tutorial for ArcGIS Pro 2.8

By Wilpen L. Gorr and Kristen S. Kurland

Updated for the latest version of ArcGIS Pro, *GIS Tutorial for ArcGIS Pro 2.8* is the book of choice for learning the latest tools and workflows in ArcGIS Pro. Suitable for classroom and self-learning, this edition teaches readers how to make maps; find, create, and analyze data; and manage operational systems using ArcGIS Pro, ArcGIS Online, ArcGIS StoryMaps, ArcGIS Dashboards, and more. The book features newly revised geocoding workflows and simple steps and figures that match the 2.8 interface. Additional resources for instructors are available. July/August 2021, 452 pp. Ebook ISBN: 9781589486812 and paperback ISBN: 9781589486805.

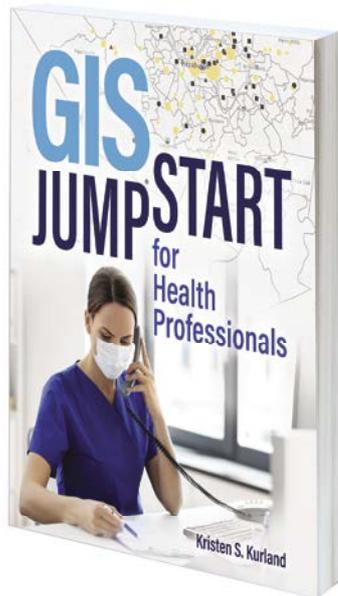


A New Way to Access Esri's e-Learning Resources

GIS Jump Start for Health Professionals

By Kristen S. Kurland

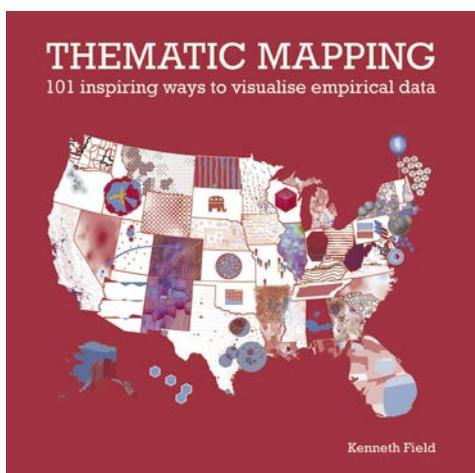
GIS Jump Start for Health Professionals is a concise workbook that introduces location analytics and ArcGIS technology to health professionals; medical students, residents, fellows, and researchers; nursing students; and others interested in health IT and informatics, health-care administration, and health policy. Tutorials demonstrate how to use web-based data and storytelling apps, while short video lectures included with the book improve learning outcomes. September 2021/January 2022, 196 pp. Ebook ISBN: 9781589486546 and paperback ISBN: 9781589486539.



Thematic Mapping: 101 Inspiring Ways to Visualise Empirical Data

By Kenneth Field

Maps are rarely right or wrong; they are simply different versions of the truth. The meaning people find in a map can reinforce or challenge their understanding, and people are much more likely to trust a map if it presents a version of the truth that they already believe in. Using 101 maps, graphs, charts, and plots of the 2016 presidential election in the United States, *Thematic Mapping: 101 Inspiring Ways to Visualise Empirical Data* explores the rich diversity of thematic mapping and the visual representation of data. Each map illustrates a different approach to the same data, and all lead to different maps and different ways of seeing different shades of truth. August 2021. Ebook ISBN: 9781589485587.



Organizations that are set up for long-term success make continual learning an essential part of their workplace culture. It's a great way to encourage employees to keep up with rapid changes in technology and cultivate an agile workforce.

Esri has long offered a large collection of e-Learning resources to help organizations build their employees' geospatial capabilities and get comprehensive value out of their investments in ArcGIS technology. Given that every organization has unique workforce training needs, Esri now offers Esri Academy LMS Integration, a subscription-based product that allows organizations to deliver this professional development and training via their own enterprise learning management systems (LMS).

"We've heard from organizations that it can be challenging to make sure that all their GIS users know, first, that they have access to on-demand Esri training and, second, that they know how and where to find it," said Patty McGray, Esri's director of customer education. "Giving their employees one access point for all their training and professional development needs is a really efficient and user-friendly way for these organizations to build in-house GIS skills."

Through Esri Academy LMS Integration, organizations get to use a single learning management system for the high-quality e-Learning resources offered by Esri, which include the following:

- **Web courses:** Interactive, self-paced courses cover conceptual information and are composed of activities, hands-on exercises, and quizzes. For these, learners need their own access to Esri software to complete the exercises. Course durations range from one to four hours.
- **Training seminars:** These recorded technical presentations and demonstrations by Esri experts may include Q&A sessions from live seminars. These usually last about one hour.
- **Videos:** These demonstrations from Esri experts on product capabilities and apps include a curated selection of recorded technical workshops from Esri conferences. Durations range from 5 to 90 minutes.

Esri Academy LMS Integration subscriptions are available at multiple levels to support organizations of various sizes. Levels range from 0 to 50 up to 100,000 users. To purchase a subscription, organizations must have

- An active Esri maintenance subscription.
- A high-speed internet connection.
- An LMS that is compliant with the Sharable Content Object Reference Model (SCORM) e-Learning format. Esri Academy LMS Integration supports SCORM 2004 3rd Edition and SCORM 1.2.
- An LMS administrator who is familiar with the procedures for ingesting SCORM files into a learning management system. (This is a common workflow, and many administrators are familiar with it.)

After an organization purchases the Esri Academy LMS Integration subscription, Esri provides the LMS administrator with SCORM files for all the resources. Once the administrator uploads those to the organization's LMS and enables learner access, individuals within the organization can seamlessly use Esri e-Learning resources at any time to build and reinforce their ArcGIS technology skills.

While access is given from within the LMS, the resources themselves are hosted by Esri Academy. This means that learners experience the live version of all Esri Academy e-Learning resources. Additionally, if a resource is updated on the Esri Academy site, users automatically see the updates through their LMS. New resources are added to Esri Academy regularly, and their SCORM files are provided to organizations each quarter.

With an Esri Academy LMS Integration subscription, managers are able to use one system to assign courses to their team members and track their learning accomplishments. Administrators only have to maintain one e-Learning system, and they can rely on their organization's own standard processes to deliver professional development and workforce training resources to employees.

To learn more about Esri Academy LMS Integration—and to get started using it—visit go.esri.com/esri-academy-lms.





New Training and Certification Offerings

Training

New Instructor-Led Courses

Esri's instructor-led courses are developed in-house by subject matter experts who have a deep understanding of ArcGIS best practices and recommended workflows. All instructors have Esri technical certifications and CompTIA CTT+ certification. Courses are currently offered online, in real time (in multiple time zones), and as private training events.

If you're curious about how other organizations use ArcGIS to streamline operations, need to learn how to build dashboards, or would like to explore how to make data usable in GIS, check out the following courses:

- **ArcGIS: Exploring the Possibilities**—In this two-day class, participants discover how organizations use ArcGIS technology to build efficiency, gain deeper insight from data, and drive collaboration. Intended for business, GIS, and other technical leaders, this course demonstrates what's possible when location intelligence is infused throughout the enterprise.
- **Get Started with ArcGIS Dashboards**—In one day, attendees learn how to present a lot of data simply and effectively using visually engaging dashboards. This course covers how to display various data visualizations on a single screen that supports dynamic data exploration, real-time operations monitoring, and informed decision-making.
- **Preparing Data for GIS Applications**—This two-day class focuses on a key need: ensuring that GIS project data delivers valid results. Participants learn how to find relevant data for their project needs, assess data quality, and apply a variety of techniques to address data inconsistencies and enable disparate datasets to be mapped and analyzed together.

Upcoming Esri MOOCs

Massive open online courses (MOOCs) are free and convenient and offer a great way to build in-demand skills and stay up-to-date with Esri technology. Participants get access to ArcGIS software, and each course includes video lectures by Esri experts, hands-on software exercises, and interactive forums to engage with learners from around the world. Everyone who completes the course content receives a certificate of completion. View all the MOOCs Esri has available at esri.com/mooc. For a closer look at some upcoming courses, check out the following:

- **Spatial Data Science: The New Frontier in Analytics**, October 27–December 8, 2021
Discover how spatial data science can help uncover hidden patterns, gain deeper insight into data, and improve predictive modeling. Attendees work with powerful ArcGIS analytical tools, apply machine learning and deep learning techniques, and learn how to integrate popular open data science packages into analyses. Registration is open through November 10. View course details and register at go.esri.com/sds-mooc.
- **Do-It-Yourself Geo Apps**, January 26–March 2, 2022
Create and share useful apps that feature geospatial capabilities—no coding required. In this four-week course, participants build the skills they need to make apps for crowdsourcing data, telling effective stories, sharing data on dashboards, and much more. Access to a suite of the latest ArcGIS apps is included. Learn more and sign up at go.esri.com/learn-geo-apps.

Certification

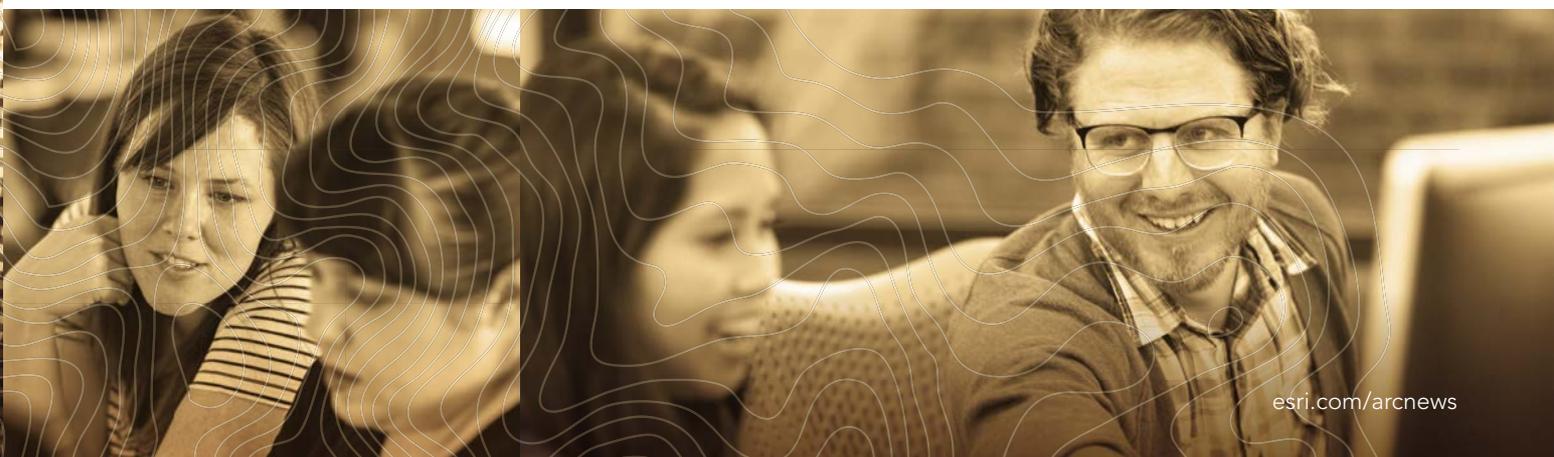
The Esri technical certification team recently celebrated an important milestone: 10,000 certifications have been awarded since the program launched!

"We're excited that the program has reached this milestone. It reflects strong interest in Esri technology and the value that high-stakes certification holds for so many professionals," said Esri certification program manager Jessi Mielke. "My team is proud to support the worldwide community of highly skilled individuals who have achieved one—and in some cases many—Esri technical certifications. We look forward to supporting everyone who aspires to do the same."

With new ArcGIS Pro and other exams in development, the program is poised to award many more certifications in 2022.

If certification is something you're interested in pursuing, get some inspiration for your GIS journey by viewing certification success stories at go.esri.com/certification-success. Also, explore the latest Esri technical certification exams at esri.com/training/certification, and join the Esri Technical Certification groups on LinkedIn and Esri Community.

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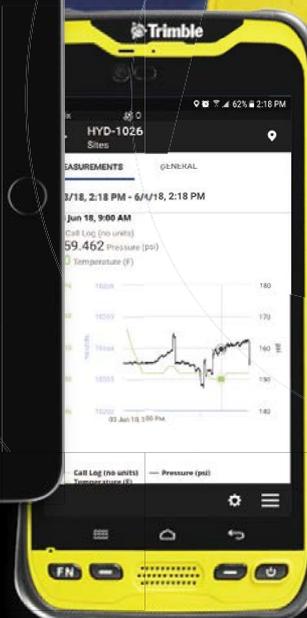
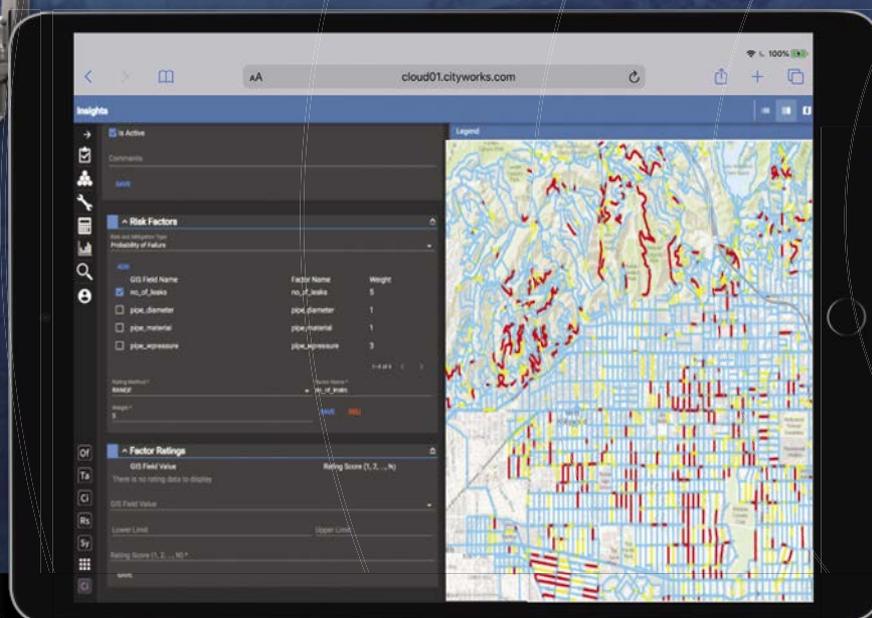
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