

## Briefly Noted

### Esri Acquisition Will Enhance 3D Visualization Capabilities

Esri acquired Zibumi Yazılım Bilişim Tasarım Arge Sanayi Ticaret S.A. (Zibumi), a software development company headquartered in Turkey and known as a developer of innovative visualization, analysis, and simulation capabilities in leveraging game engines. Zibumi will help advance 3D visualization and simulation in Esri software and expand the ongoing integration of game engine technologies into ArcGIS. Esri also announced the creation of the Ankara R&D Center.

### Esri Recognized for Its Work in Mapping COVID-19

Inc. magazine's inaugural Best in Business list has awarded Esri the gold medal in the Government Services category. These awards were created to honor companies that have gone above and beyond to make a positive difference, tackling today's problems to lead to a better future. "This year, more than ever, our mission of helping our customers make an impact through the use of GIS is critical," said Jack Dangermond, Esri founder and president.

### Enforcement of HTTPS Only

ArcGIS Online has been updated to enforce the HTTPS-only standard. Customers with subscriptions still set to allow both HTTP and HTTPS must switch to HTTPS only. See the ArcGIS Online Technical Support site for instructions for updating software for HTTPS only.

## In an Unprecedented Year, US Completes Census Count with Help from GIS

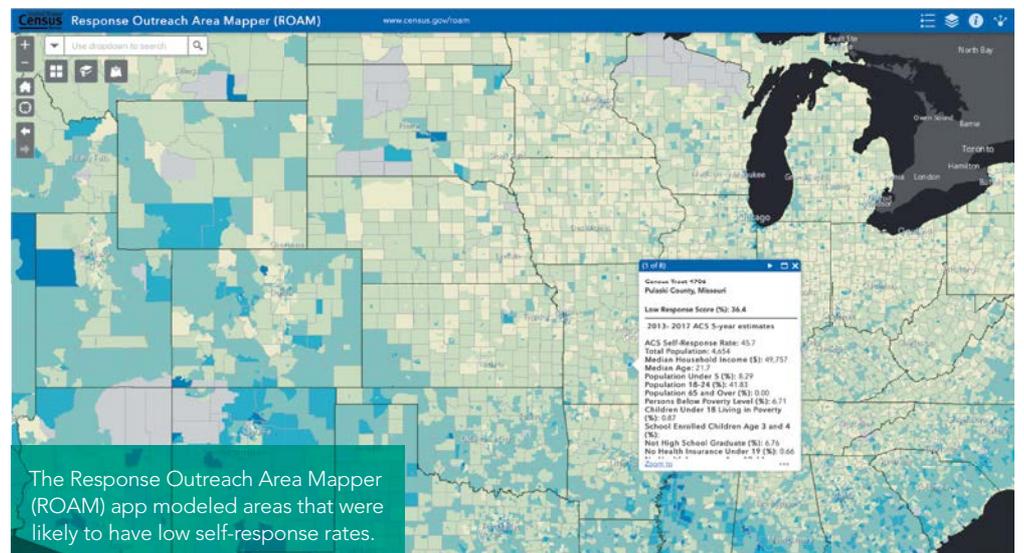
Once per decade, the United States Census Bureau sets out to count every person in the country, just once, and in the right place. The bureau spent 10 years preparing for the 2020 Census by modernizing its systems and building apps. It has successfully replaced paper-based processes with new technologies that have significantly improved data collection and workflows.

Throughout its preparation for the decennial event, the Census Bureau collaborated with Esri, weaving geospatial capabilities into every operational component. The bureau was ready to do the count, but unforeseen challenges lay ahead.

By Census Day on April 1, 2020, most households in the United States had received their invitation to participate in the census. Unfortunately, by this time the first wave of COVID-19 had swept across the nation. While wreaking havoc on public and personal health all over the world, COVID-19 also impacted 2020 Census operations.

The pandemic stalled the launch of the bureau's nonresponse follow-up (NRFU) operations, in which enumerators visit the addresses of people

who did not respond to invitations. Initially, the Census Bureau scheduled NRFU operations to begin May 13, but the risk of infection delayed the launch. On July 16, the bureau resumed follow-up operations in select areas.



When it was deemed safe, thousands of masked enumerators, equipped with iPhones, began knocking on doors. From a safe distance, they asked residents census questions and recorded their answers digitally on their phones. The bureau continued to monitor the impacts of COVID-19 on operations and adapted assignments as needed to keep everyone safe.

"The modernizations that we put into place far exceeded our expectations," explained Deirdre Dalpiaz Bishop, chief of the Census Bureau's Geography Division. "Geographic information and associated technologies played a role in the continued on page 5

## Rapidly Processed Drone Imagery Improves California Wildfire Response



↑ GeoAcuity captured 360-degree panoramic views and aerial videos of the fire-caused devastation.

Over the summer, two devastating wildfires in Northern California burned hundreds of thousands of acres, destroying thousands of structures and endangering countless homes and lives. The North Complex Fire that burned in Butte and Plumas Counties and the CZU August Lightning Complex Fires in San Mateo and Santa Cruz Counties were devastating wildfires that required a prompt and organized emergency response from local teams.

To aid in response and damage assessment efforts, law enforcement needed a better way to view these areas. That's where drones came in. These unmanned aerial systems (UASs) are becoming an increasingly important part of disaster response. They can help with a range of activities, from providing emergency personnel with rapid situational awareness to creating maps of impacted areas.

Law enforcement working on these fires tasked Esri partner and geospatial consulting firm GeoAcuity with obtaining aerial images of the impacted areas by using drones. To furnish multiple agencies and the public with the imagery they needed to conduct fire assessments and boost recovery efforts, the company deployed the cloud-based drone mapping software Site Scan for ArcGIS, along with ArcGIS Online.

continued on page 6



Miami Beach, Florida, is one of the most vulnerable areas for sea level rise in the United States, if not the world. The city has been working with Esri partner Jacobs, a technical consulting engineering firm, to find out where the biggest flooding concerns are and determine how to consolidate public works projects to better prepare for sea level rise while minimizing disruptions to residents.



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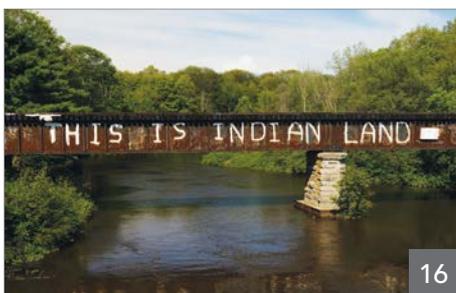
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# How Indoor GIS Can Help Workplaces Reopen Safely

Around the world, the COVID-19 pandemic caught most organizations off guard as it suddenly—and enduringly—upended work culture. For businesses that can support their employees working from home, a remote workforce has become the new normal. But bringing employees back into the workplace is a big challenge—one that employers must prepare for now if they haven't started doing so already.

Indoor spaces, as we came to find out, pose a greater risk of spreading COVID-19 than the outdoors. So hospitals, manufacturing facilities, retail businesses, logistics facilities, and other organizations that either could not let their employees work from home or brought their employees back early on needed effective ways to implement safety measures fast. Now, other businesses that are planning to reopen require the same measures. Even organizations that are offering an ongoing hybrid model, wherein employees work from the office sometimes and home the rest of the time, need to visualize things like how to more efficiently use their real estate.

Fortunately, ArcGIS Indoors, Esri's indoor mapping and location tracking software, is uniquely suited to help with all this.

## Redesigning Communal Spaces

When news of the rapid spread of COVID-19 first started making waves in March 2020, Esri's facility mapping software, which leverages Indoors, enabled employers to use indoor spatial data to better understand their facility operations, steer staff members toward useful resources, apply contact tracing, and comply with safety measures to combat contagion. But a large part of the workforce went remote anyway, with more than 42 percent of employees in the United States alone working from home full-time as of the end of June, according to a study out of Stanford University.

Since the initial outbreak, however, cities, counties, states, and countries around the world have entered various stages of recovery, compelling organizations to look at what it would take to bring their workforces back. The priority is to create a safe communal working environment that employees feel comfortable returning to, which entails honoring social distancing requirements by reducing indoor capacity and regularly sanitizing frequently touched areas.

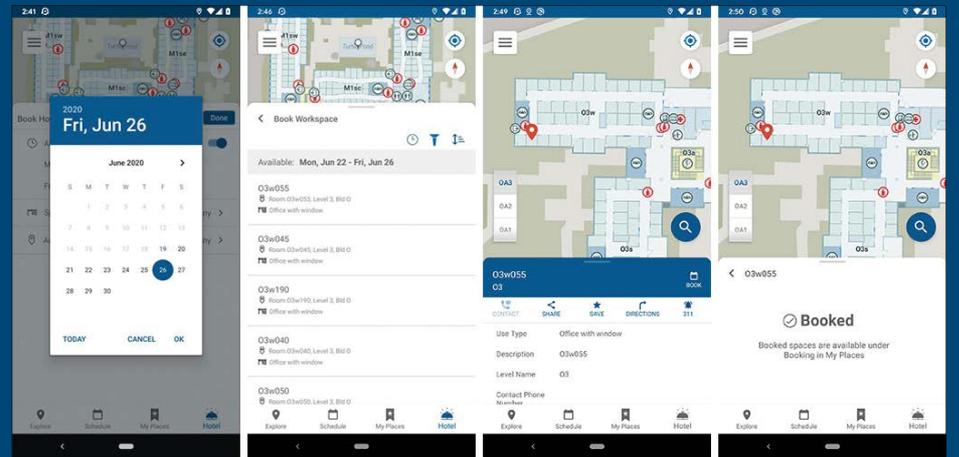
With Indoors, it's possible to use GIS to do this responsibly and accurately. The software allows users to aggregate, visualize, and analyze indoor spatial data on 2D and 3D maps, apps, and dashboards, creating a new level of transparency when it comes to facility operations. For example, operations managers can employ Space Planner, a browser-based app, to better understand employee seating arrangements. They can see where there are social distancing conflicts, such as desks that are grouped too closely together, and reorganize people's work spaces to ensure compliance with safety regulations. Space Planner also allows analysts to model various social distancing parameters so they can visualize areas of concern and map out safe seating assignments.

Indoors enables users to publish space plan changes immediately via its native mobile app and web-based viewer. Having up-to-date indoor maps of office buildings and other work spaces makes it easier for employees to interact confidently with their new workplace arrangements. They can use the mobile app and viewer to reserve conference rooms and navigate to meetings, assets, amenities, and other points of interest.

Building occupants can also use Indoors to report facility issues—for example areas that need cleaning. In the mobile app or viewer, all they need to do is mark the space on a map, upload a photo (though that's optional),



↑ Employees can use ArcGIS Indoors to book office hotels, which are individual workstations that can be used for a certain amount of time.



↑ Using Space Planner, operations managers can easily visualize social distancing conflicts (in red).

and submit a ticket. Once the ticket is submitted, cleaning staff receive a notification telling them exactly what and where the problem is, and then they can use Indoors to navigate directly to the area of concern.

## Leveraging Unused Areas for New Uses

Another key way that organizations can employ Indoors is to build resilience into their operations. As the pandemic has revealed, even successful businesses experience severe disruptions if they lack measures to ensure business continuity—especially when physical spaces and organizational operations have to be adjusted at breakneck speed.

With lots of employees working from home now and some organizations considering making flexible work arrangements

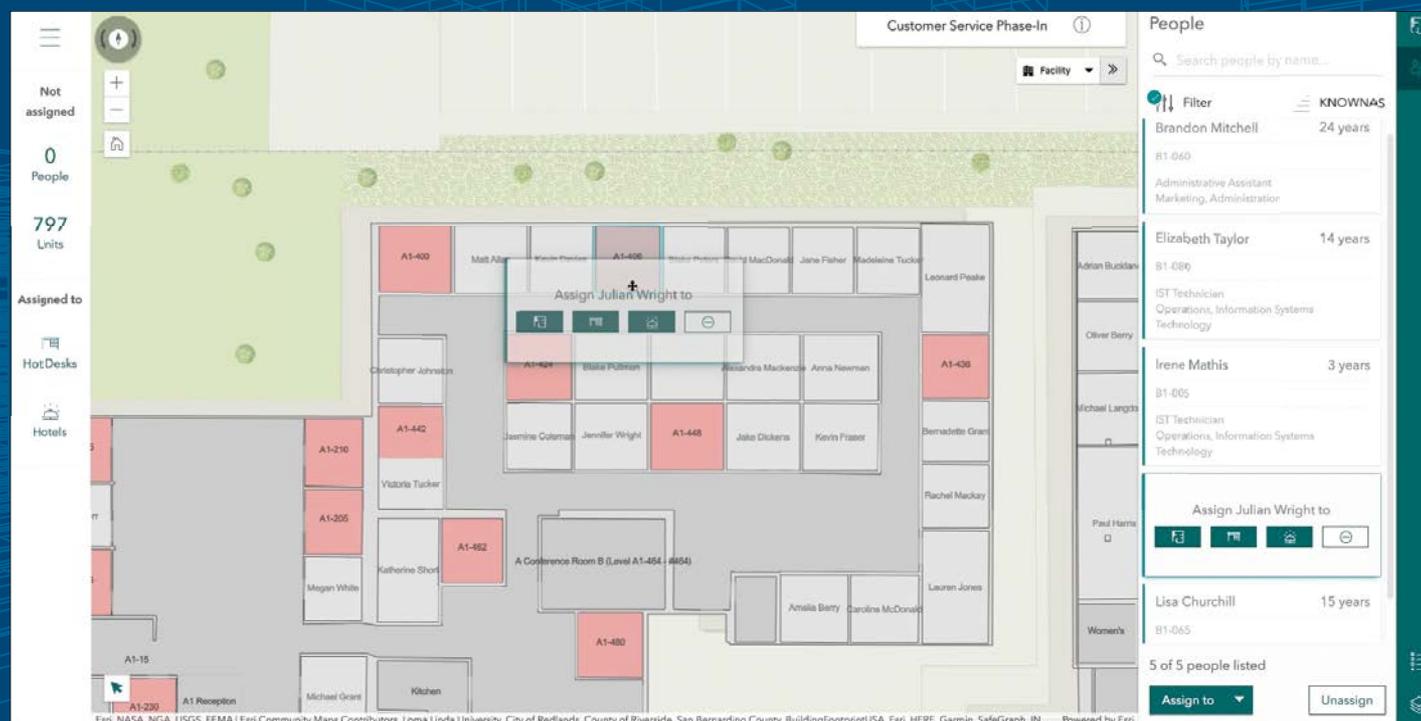
more the norm, ArcGIS Indoors can help businesses gain insight into current space usage and evaluate what they'll need in the future. Not only does this reduce costs, but it can also increase employee happiness, help organizations differentiate themselves from the competition, and better prepare businesses for other potential challenges.

For instance, after the pandemic, every employee may not need a personal work space on every workday. Organizations could turn unoccupied spaces into office hotels—individual workstations that employees can book for a certain amount of time. With office hotels, users could build a list of work space criteria in the Indoors app and viewer. Employees could choose from those amenities when booking an office hotel. What's more, Indoors allows facilities managers to keep track of office hotel reservations so these spaces can be sanitized after use by employees.

## Digitizing Facilities Management

The COVID-19 pandemic has revealed that having a sophisticated digital workplace operations system in place makes it easier to enhance facility safety and respond to unexpected events and disasters. By employing ArcGIS Indoors to envision indoor spaces and make adjustments to how real estate is managed, organizations across a range of industries—from government agencies and nonprofits to private businesses large and small—can increase employees' awareness of their surroundings and provide a much clearer common operating picture to those who manage facilities. Isn't that something we could all use when things seem so uncertain?

For more information on Indoors or to get in touch with an Esri representative, head to [go.esri.com/indoors](http://go.esri.com/indoors).



↑ Space Planner allows analysts to assign employees to new workplaces.

# GIS Day Carries On, and Virtual Events Are a Hit

In spite of all the changes the world has experienced over the past year, one thing has remained steady: GIS is making a difference in so many of the things we do, from managing resources during the COVID-19 pandemic and building smarter, more sustainable cities to conserving wildlife habitats and responding to natural disasters. Some might even argue that GIS is more important now than ever, given how COVID-19 has raised awareness around the globe of how important geospatial technology is for problem solving and decision-making.

GIS Day was officially commemorated on November 18, 2020. Celebrations were not only extra cautious, they were also extra special. Most events were held online, allowing people from all over the world to attend presentations, workshops, interactive meetups, and other virtual functions hosted by government agencies, libraries, schools, universities, nonprofit organizations, and private companies. Events included the following:

- Central Connecticut State University and the Connecticut GIS Network hosted a GIS Day event in which GIS practitioners from a range of professions presented their work to attendees. Other participants submitted map posters, ArcGIS StoryMaps apps, and other geospatial apps to a gallery. The university also held a rousing game of GeJeopardy.
- The National Geospatial Technology Center of Excellence (GeoTech Center), which promotes the use and teaching of

GIS in community and technical colleges, organized six hours of events—in both English and Spanish—that included talks, geogames, mapping activities, and a map contest and gallery.

- At the University of Salzburg in Austria, the geoinformatics program held a GIS Day event to teach people what the technology is and why it matters. Part of the fun for attendees was exploring the nine most beautiful hidden places in Austria, using maps and map narratives built with ArcGIS StoryMaps.

The hosts of each of the events listed above used ArcGIS Hub to organize and present their GIS Day content, which was a new and innovative aspect of the 2020 celebrations. This gave them one, comprehensive online space in which to engage and collaborate with their communities and serve their unique audiences.

GIS enthusiasts registered more than 1,200 additional events at [gisday.com](http://gisday.com), officially putting their functions on the GIS Day map. Most of these were open to the public.

Geospatial Libya Consulting in Misratah, Libya, for example, held a discussion on spatial data infrastructure. The School of Geography at the University of Costa Rica demonstrated what faculty and students are doing with GIS in their instruction and research. Government agency Land Information New Zealand sponsored a virtual, three-day field trip that showed students how to use maps to safely hike the outdoors. The Federation of

Community Forestry led attendees through a demonstration and discussion of its critical forest work. And the Udzungwa Ecological Monitoring Centre in Tanzania taught other GIS Day participants about tropical biodiversity through its GIS Day event.

“You just can’t stop the enthusiasm and quest to share GIS knowledge, even during a pandemic,” said Maria Jordan, Esri’s product marketer for ArcGIS Hub. “Whether celebrating as part of a city, county, university, or private business, GIS Day hosts stepped their creativity up a notch this year to plan virtual events, record YouTube videos, and broadcast radio show programs to reach their audiences.”

In addition to these events hosted around the world, the GIS Day website served up some new, on-demand content to help everyone celebrate the technology from the comfort of their own home. Videos, articles, and podcasts posted on the website spotlighted GIS influencers who are using the technology to do important work such as building inclusive workforces, designing landscapes with climate change in mind, and responding to devastating wildfires. Esri also released a new GIS Day mobile app, available for download from the Google Play and Apple App Store, that was designed to help GIS professionals share the technology with colleagues, students, and community members through games and map exploration activities. The idea was to let people experience GIS using their own personal devices.

Each host that registered an event on the GIS Day website received five ArcGIS for Personal Use licenses. The hosts had full discretion over how to distribute the licenses. Some held contests and lotteries, others gave them out at networking activities, and still others doled them out as gifts to presenters or as donations to nonprofits. The point was to help hosts further the use of GIS within their communities beyond GIS Day.

Around the world, people use GIS Day as a way to help others discover GIS, share their accomplishments, and inspire their peers with the infinite ways that geospatial technology can be used. The next GIS Day will be November 17, 2021, so don’t forget to join in!



↑ GIS enthusiasts registered more than 1,200 events on the GIS Day website.

↑ Several organizations used ArcGIS Hub to organize their GIS Day events.

↑ The GIS Day website served up videos, articles, and podcasts that spotlighted GIS heroes and influencers.

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## In an Unprecedented Year, US Completes Census Count with Help from GIS

transformation of the four main components of conducting the census.”

Those components for the 2020 Census are

- Establishing where to count.
- Motivating people to respond.
- Counting the population.
- Tabulating and disseminating the results.

Since each component is geography based, the Census Bureau deployed GIS apps, which used Esri technology, to streamline every aspect of the count. That made a huge difference in this strange and atypical time.

### Validating Addresses—Mostly Digitally

Well before census operations begin, the Census Bureau updates a national address list. An accurate address list is fundamental to the operational success of the census count. It is essential for mailing invitations and for follow-up efforts. By employing satellite imagery and GIS—and having people walk around certain hard-to-identify areas to verify addresses—staff members built a highly accurate list for the 2020 Census.

Using the Block Assessment, Research and Classification Application (BARCA), which was developed with ArcGIS API for JavaScript and leveraged map and imagery services served in ArcGIS Enterprise, 150 staff members reviewed 11.1 million census blocks. While working in the office, they were able to validate 65 percent of the nation's addresses.

The validated areas were displayed on a map viewer, as were areas that required in-field validation. The Census Bureau shared the map viewer with the public to help people understand which areas census employees would be visiting.

“In 2010, address validation operations involved 150,000 participants, but 10 years later, modernizations—including geospatial technology—enabled us to reduce our address validation workforce to 32,000,” noted Bishop.

States use the decennial census to define congressional districts, state legislative districts, and voting districts, so those boundaries must align with census block boundaries. The Census Bureau's Geographic Area Reconciliation Program (GARP) manages this—the

bureau's largest geospatial quality control effort. GARP brings together and reconciles data from many geographic operations, such as a statistical areas program, voting operations, and ZIP code operations. The bureau also developed an operational dashboard to manage GARP processes to ensure that 14.1 million unique geographic borders aligned.

“Without the dashboard, we may not have successfully completed the process according to schedule,” said Bishop.

### New Techniques to Encourage People to Respond

Getting people to self-respond to the census reaps the greatest results. The Response Outreach Area Mapper (ROAM) app, built with Esri software, streamlined this process.

Using data from the Census Bureau's American Community Survey and the 2010 Census, the bureau modeled areas that were likely to have low self-response rates. The results were displayed on a color-coded range map, so community groups knew where best to target education resources and outreach. Although COVID-19 made it difficult to do community outreach at the levels that the bureau had hoped for, ROAM performed well and will be used to help manage outreach during the Census Bureau's ongoing survey work.

### Making a Massive Follow-Up Operation More Efficient

During the peak of its follow-up operations, the Census Bureau had nearly 240,000 enumerators collecting information. To manage this massive undertaking, the bureau used its Field Operational Control System (FOCS), which securely employed vector tile and dynamic map services hosted in ArcGIS Enterprise, to plan out the workload. Managers used FOCS to assign enumerators to certain geographic locations.

FOCS maps also let managers see where operations were on track and where they needed to boost the number of resources. They could use the system's proximity function as well to ensure that enumerators got assignments that were close to their homes.



In addition, the bureau employed ArcGIS Network Analyst and ArcGIS StreetMap Premium to help optimize the workload for NRFU operations and send enumerators on the most efficient routes possible.

“We have a very strong working relationship with Esri,” said Bishop. “We're continuously collaborating as we enhance the tools we use to get our job done.”

### Delivering Results

The final task for the Census Bureau is to ensure that all responses are associated with their correct geographic locations in the National Address List. The bureau is (as of press time) working to complete this task and fulfill its mission to count every person, just once, and in the right place.

In addition to completing the 2020 Census, the Census Bureau wanted to help businesses and decision-makers understand the social and economic impacts of COVID-19. Working with Esri, the bureau launched the COVID-19 Demographic and Economic Resources page, available at [covid19.census.gov](https://covid19.census.gov). This provides easy access to census data as it relates to the pandemic, and the data ranges from state to local levels.

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# Rapidly Processed Drone Imagery Improves California Wildfire Response



↑ Using Site Scan for ArcGIS, along with ArcGIS Online, GeoAcuity was able to deliver complete imagery products within 24 to 48 hours of beginning drone data collection.

imagery had to be captured and then, once the flights were done, manage the imagery data and metadata that would be uploaded to the cloud for processing.

This was not how things have always been done, though. In past attempts to use drones to capture wildfire imagery, response teams defined areas for imagery capture using paper maps; masking tape; and, in at least one case, a yellow crayon. Unsurprisingly, this wasn't the most efficient method for gathering drone imagery or communicating plans with multiple groups and agencies during an emergency situation.

"There are certainly physical challenges during a wildfire with smoke and visibility, falling trees and power lines, heat, and not [being able to work] together during a global pandemic," said Greg Crutsinger, director of applied research at GeoAcuity, referring to the COVID-19 pandemic that was also spreading while these fires burned. "Those are enough to try to tackle without worrying about what you are going to do with all this imagery."

GeoAcuity wanted a new solution that would make it possible to easily define, capture, and process imagery and then share the

"We can show up on-site; throw up a UAS; and within an hour of the flight, have images rapidly processed and into the hands of the people who need [them] most," said Jason Knowles, CEO and founder of GeoAcuity. "The ability to have current and accurate geospatial information is key to assisting first responders."

## A New Way to Capture, Process, and Share Drone Imagery

Responding to a raging wildfire requires proper planning and efficient management. To make drones a useful part of this process, the team at GeoAcuity needed to first define the areas where

geospatial data with various emergency response teams. So it chose Site Scan to collect, process, and analyze drone imagery, and ArcGIS Online to plan flights and, ultimately, disseminate relevant information to those involved in fighting the fires.

"Our goal [was] also to be able to share the data as broadly as possible to as many stakeholders as possible...in a way that all the agencies [would] understand," said Crutsinger.

## Tried-and-Trusted Technology Speeds Things Up

GeoAcuity staff members have been Esri users for more than 20 years, so they are familiar with and confident in how Esri products work.

"We can build up [new maps and information products] quickly. We're functional in the [Esri] environment," said Knowles.

The first thing the GeoAcuity team did was establish a workflow for capturing data in the field and efficiently communicating it back to the office. For mission planning, the team gave all the drone pilots access to ArcGIS Online to view flight plans and the status of their data capture assignments via their smartphones or tablets. The pilots were also able to use this setup to get instructions on exactly where to fly.

Next, the team used Site Scan to ingest the captured imagery and integrate it into the cloud-based postmission support system.

Site Scan allowed the group to process the orthoimagery faster than ever before and publish it directly to ArcGIS Online. Team members then used other Esri products, such as ArcGIS Dashboards and ArcGIS Web AppBuilder, to create dashboards and apps to monitor the project's status and visualize the resultant data.

According to Crutsinger, GeoAcuity was "processing hundreds of gigabytes [of data] a day and making it public the following day," delivering completed imagery products within 24 to 48 hours of the drones taking off.

→ GeoAcuity's new workflow made it easier to plan where to fly, divide up the drone teams, and then send them out to capture data.

"To be able to pull photos over into ArcGIS Online and just reference [them] to our maps was huge," Knowles added. "That connectivity and interoperability save massive amounts of time."

GeoAcuity collected imagery of the burn areas and stitched that into accurate 2D orthomosaics. It also captured 360-degree panoramic views and aerial videos of the fire areas.

For the North Complex Fire, GeoAcuity and the Butte County Sheriff's Office published high-resolution postfire UAS imagery of about 2,500 acres as 312 individual panoramas and shared them through three public-facing web maps. Deliverables for the CZU August Lightning Complex Fires included high-resolution postfire UAS imagery of 6,000 acres as 650 individual panoramas, shared using two public-facing web maps.

## Myriad Stakeholders Benefit from Rapidly Processed Imagery

Law enforcement agencies, emergency response teams, and civilians all reaped benefits from GeoAcuity's efficient collection and dissemination of geospatially linked drone imagery.

Crucially, GeoAcuity was able to deliver enhanced situational awareness to first responders. More than 30 sheriff's offices across five counties said they were very impressed with the value that the digital, imagery-based maps brought to their



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organizations. This helped all the groups involved in fire response and recovery work together.

“The efficacy and timeliness of the imagery...[enhance] situational awareness when [people] physically cannot get to the disaster area,” said Knowles. “It provides a record of the disaster... and helps decision-makers prioritize where to send help and focus rebuilding efforts.”

According to GeoAcuity, its web apps have been viewed more than 90,000 times—and not just by emergency responders. Residents of the area used the free, public-facing resources—including maps with panoramic views and before-and-after swipe maps—to view their homes online and begin to assess possible damages.

“[The number of views] indicates to me a significant value add to the community and first responders,” said Knowles. “Residents can check on their houses when the fire areas are still closed off to the public. We have citizens use the data to help with insurance claims, as well as to support GoFundMe pages using the pre- and postsite imagery.”

GeoAcuity’s efforts have also given affected counties a historical record of high-resolution imagery that they can reference over

time. And various agencies and insurance companies have been using the imagery to work together to repopulate areas impacted by the fires.

“I’ve had insurance companies tell me they didn’t need to send a team out [to review a site or claim] because the imagery was good enough,” said Crutsinger.

GeoAcuity can also incorporate other GIS data layers, such as property boundaries and topography, to make the imagery more powerful and deliver information in a standard format that all stakeholders can use. Additionally, using Site Scan to process the imagery enabled the GeoAcuity team to rapidly put the images into an easy-to-consume interactive web map and other apps.

“It’s our job as the subject matter experts to make the end product as elegant and visually compelling [as possible] to tell the story of the disaster. That’s what Esri’s products were built for,” said Crutsinger. “Stakeholders are always amazed at what is produced so quickly.”

### An Integrated Workflow Streamlines Response and Recovery

Using Site Scan and other ArcGIS technology, including

Dashboards and Web AppBuilder, has given GeoAcuity a full, end-to-end workflow that shapes its strategy, planning, and operational logistics.

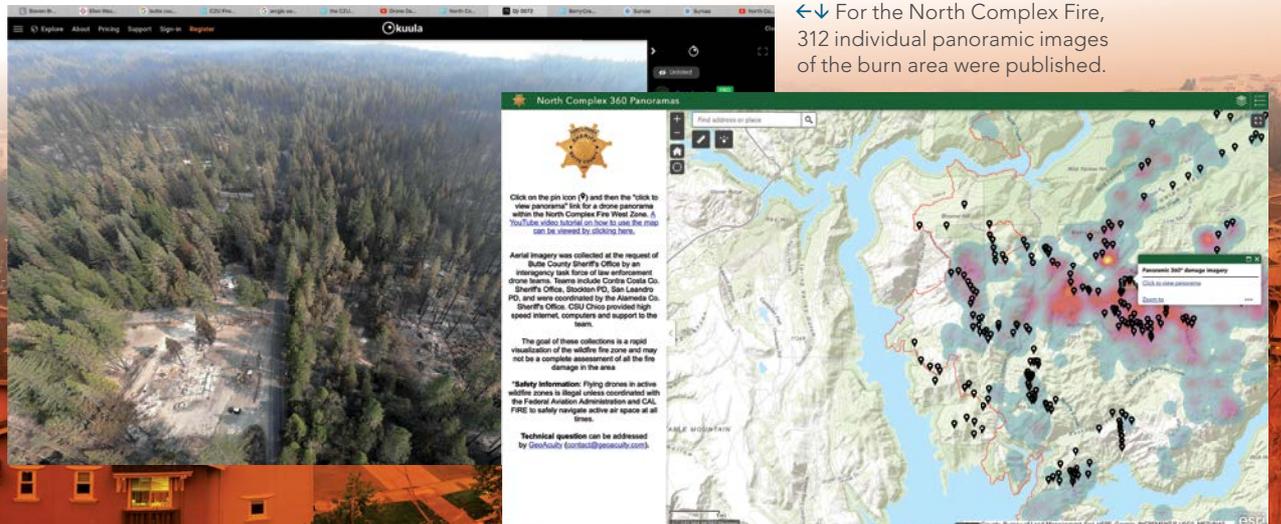
“We can now preplan an area [to fly], divide up drone teams, send them out to capture the data, track all of the SD cards [with the raw drone imagery on them] as they come in, process all the imagery, integrate the layers into web maps, and then release those to the agencies and the public,” said Crutsinger.

Employing this integrated workflow, rather than separate tools, for everything from mission planning to stitching together the imagery, undoubtedly helped streamline response and recovery efforts for the North Complex and CZU August Lightning Complex Fires.

“The less time we spend doing debriefings and planning out the missions, the more time we have to collect data, and the more impactful the response will be,” said Knowles. “[The] human impact and devastation [are tough], but it is rewarding [work] because we see how the data we collect and deliver can help make a big difference.”



↑ GeoAcuity provided law enforcement agencies with the imagery-derived maps they needed to respond to the fires and begin recovery efforts.



↔ For the North Complex Fire, 312 individual panoramic images of the burn area were published.

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# Farmers in India Improve Crop Choices, Boost Income Using Spatial Analytics

By Mukund Kadursrinivas Rao, Centre for Spatial Analytics and Advanced GIS

Over the past 40 years, GIS and remote sensing have gained wide popularity in India, mostly in the government sector. What has been lacking, however, is the use of spatial analytics at the individual level. But a new app, called Agri-GIS, is beginning to bridge that gap in the farming community.

In South Odisha, India, farmers, who mostly own small landholdings, are now using Agri-GIS to make better decisions about their agricultural operations. Starting in June 2018, 150,000 farmers in 532 villages began receiving Agri-GIS advisories that are customized to their plots of land. The advisories, which are transmitted as simple text messages or phone calls, or via a smartphone app, include daily weather forecasts, satellite imagery-based real-time crop and water assessments, crop suitability recommendations based on soil types, market and price analytics, details about agricultural facilities and government programs, and alerts for episodic events such as cyclones. With this, farmers can better figure out which crops work for their land, how to optimize their crop production, best practices for farming, and how to maximize their incomes.

But the unique aspect of Agri-GIS is how it puts the farmer at the center of its analytics. Agri-GIS considers each farmer a virtual economic unit that generates a certain level of sustained economic activity for their family. The app does a 360-degree evaluation of the farmer: their land; social and family characteristics; current and aspirational economic status; noncropping activities such as poultry farming, animal husbandry, beekeeping, and farm labor; and earnings from other endeavors, including dairy and poultry farming or participation in labor trades.

All this is made possible by Agri-GIS's disaggregated approach to spatial analytics. Using various

spatial and nonspatial datasets, the app does a holistic assessment of individual farms, getting at all the direct and indirect variables involved in agriculture rather than focusing strictly on land, soil, and water information. From there, Agri-GIS generates straightforward, personalized messaging that helps farmers get the most out of their efforts, thereby boosting their quality of life.

## Data Distilled to the Hyperlocal Level

A big part of what makes Agri-GIS work is that it is innovatively built on advanced ArcGIS capabilities.

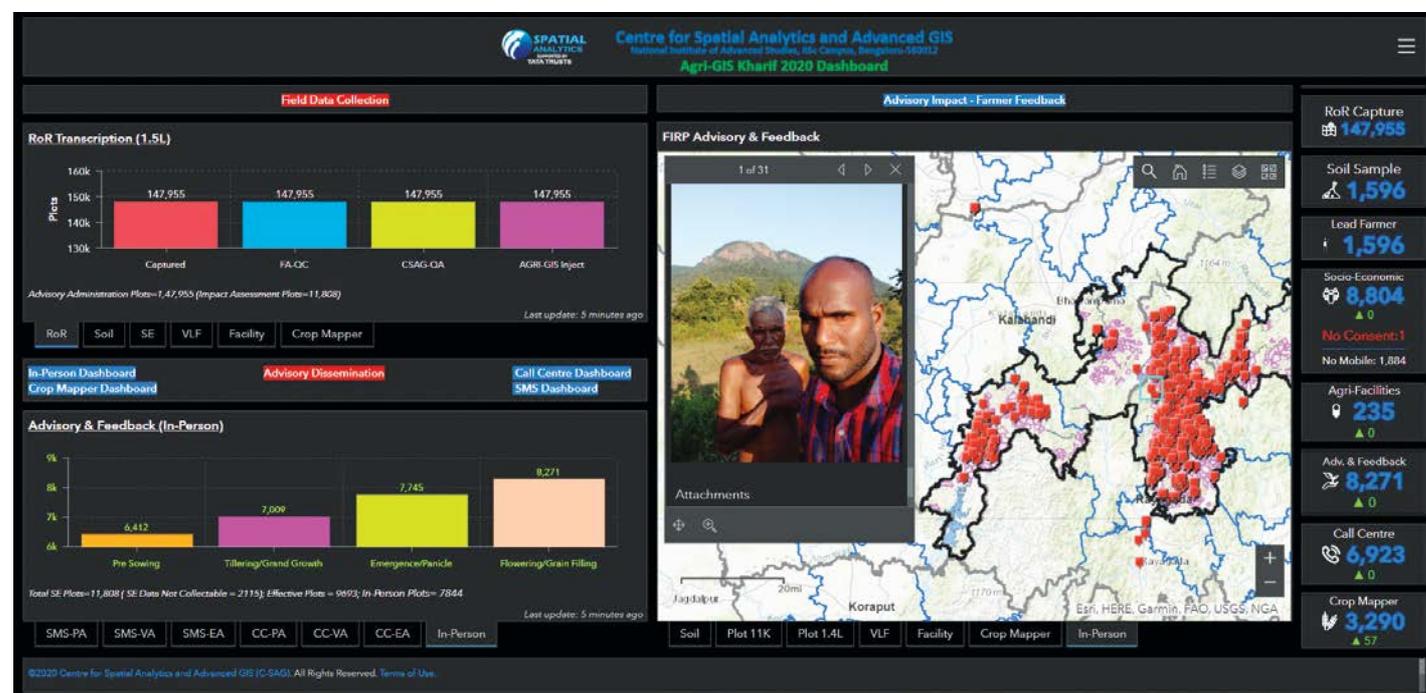
For one, distilling multiple layers of images, maps, and other spatial data at the individual plot level requires tremendous skill in spatial data engineering and data analytics. The geodatabases in ArcGIS Enterprise, plus the software's advanced analytics tools, give Agri-GIS that power.

For example, the imagery the app uses to generate crop status details and land and water information comes from different satellite constellations, including Sentinel-2, Landsat, Planet, and Indian

Remote Sensing (IRS) satellites. Also, daily weather forecasts are assembled from different weather services, and GIS maps come from various GIS data services and internal mapping. All this—and more—needs to be brought together and analyzed so the app can issue advisories that include 15-day, village-level forecasts of rainfall, temperature, and humidity; crop recommendations; suggestions for best practices; and income estimates. The app relies on cadastral records to divvy up land units into individual plots. Data for each plot includes ownership details and household survey data that contains information about each family's demographic makeup, education, social standing, and work status. Each plot's data also provides GIS maps showing soils, land use, and groundwater potential and data on agricultural facilities, markets, and financing opportunities. These datasets are coregistered in a geodatabase that consists of 104 parameters, making it possible to disaggregate everything so it applies to each plot or cadastre unit and then spatially analyze that to generate advisories for each farmer.

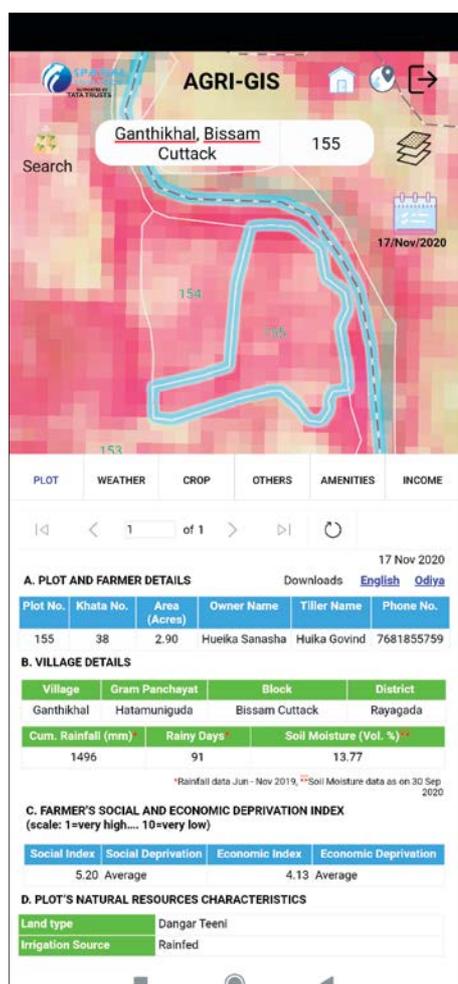
Additionally, every crop season—which, in South Odisha, is split mainly into kharif (June through November or December) and rabi (January through April or May)—the data is updated in Agri-GIS in real time. This means that the app can take all the data it has ever acquired and consistently modify it to apply specifically to each of the 532 villages and 150,000 farmers in the region.

Another way Agri-GIS creatively applies the spatial analytics capabilities in ArcGIS is in reducing complex datasets to simple advisories that are applicable at the hyperlocal level. Employing ArcGIS Spatial Analyst, ModelBuilder, ArcGIS 3D Analyst, ArcGIS Image Analyst, ArcPy, ArcGIS Geostatistical Analyst, and machine learning and artificial intelligence (AI) tools, such as R, Python, and tensors, Agri-GIS performs a profusion of analyses to generate insights about individual plots of land or even a village as a whole. In turn, this becomes part of the intelligence that Agri-GIS employs to do future analysis.



→ Dashboards show the impacts the advisories are having on farmers throughout South Odisha.





↑ Agri-GIS advisories are typically transmitted as simple text messages or via phone calls, but farmers can also access them in a smartphone app.

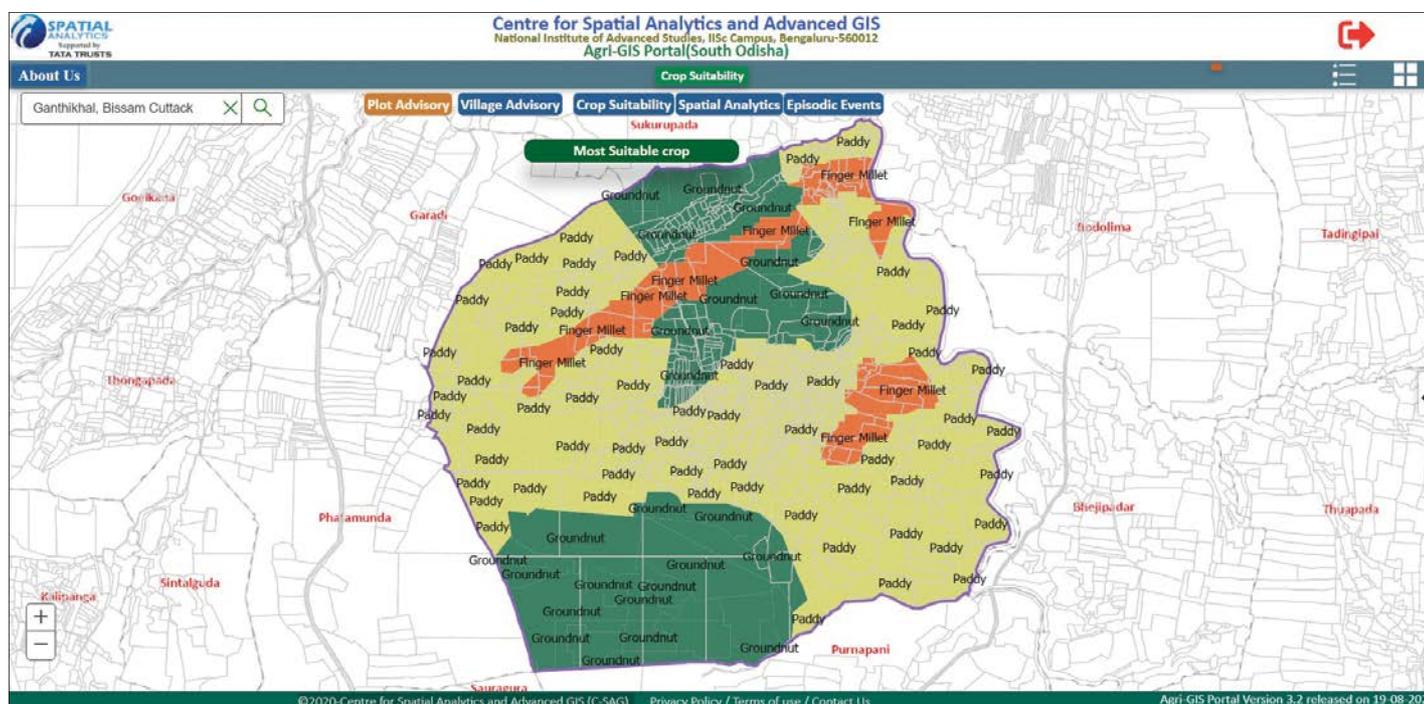
Indexing analytics, for example, determines a farmer's social and economic status, which helps customize the advisories. High-end image analytics supplies weekly water and crop status reports at the plot and/or village level. Advanced meteorological analytics reduces gridded weather forecasts to the village level—a first for this area. Suitability analyses determine the optimal crops for each plot of land, based on its own soil, climate, and social conditions, and comes up with best practices for crops for every stage of the farming season. Beneficiary analytics determines what benefits, such as income or assets, a farmer can expect to receive. And market analyses recommend the best pricing at different markets. All this is then integrated into



↑ Farmers can use Crop Mapper to update their crop data and send in feedback from the field.

up-to-date advisories that farmers receive on a daily basis.

Finally, the Centre for Spatial Analytics and Advanced GIS (C-SAG) has developed 16 different apps that farmers, local researchers, and government officials have access to. Built with ArcGIS Enterprise, ArcGIS Survey123, ArcGIS Collector, and native web app builders, each app serves different Agri-GIS requirements. For instance, farmers can use the Soil Sample Analysis app, the Facilities Mapper app, the Crop Mapper app, and various dashboards to not only see their customized advisories but also update critical crop data and send feedback from the field. Additionally, government officials and agricultural experts have access to an Agri-GIS portal



↑ Government officials and agricultural experts use an Agri-GIS portal to see where plot advisories are being sent, as well as the details of the advisories.

that provides detailed advisory information and other GIS functions, such as crop suitability analyses and seasonable crop maps, that they can use to make high-level decisions.

### Farmers Feel the Effects

In 2019, C-SAG began to assess whether the advisories were actually getting farmers to heed crop recommendations, adopt more scientific agricultural practices, increase their yields, earn larger incomes, and experience any other social advancements. Using ArcGIS Dashboards, C-SAG developed the Agri-GIS Dashboard to track, in real time, advisory dissemination alongside farmer feedback.

For the 2020 kharif season, C-SAG released four formal crop-stage advisories: a pre-sowing advisory on June 2, a tillering advisory on August 19, a plant emergence advisory on September 21, and a flowering advisory on October 19. Based on a sample of 8,804 farmers, as of November 2, C-SAG had recorded the following impacts:

- Forty percent of farmers adopted crop recommendations from Agri-GIS.
- Ninety-eight percent of farmers rated the village weather advisory as uniquely relevant, meaning they adjusted their activities according to the advisories.
- Eighty-four percent of farmers embraced the agricultural practices recommended by Agri-GIS and sought additional details about them.
- Seventy-eight percent of farmers concurred that their incomes would likely increase to the levels Agri-GIS indicated.

In a separate assessment, C-SAG determined that in the 2020 kharif season, the incomes of the 8,804 farmers who participated in this survey would increase by up to 60 percent against their 2019 incomes. Projecting that out to the remaining 110,000 farmers who have their

C-SAG developed Agri-GIS with support from Tata Trusts and the Bill & Melinda Gates Foundation's India Office, as well as in association with the State of Odisha's Department of Agriculture and Farmers' Empowerment. The advisories available through Agri-GIS were designed with guidance from the Odisha University of Agriculture and Technology and various agricultural experts.

own plots of land (the rest are government owned), the cumulative income for farmers in South Odisha is likely to increase from 1.38 billion Indian rupees (US\$18.6 million) in 2019 to 2.31 billion Indian rupees (US\$31 million) in 2020.

C-SAG plans on continuing the assessment through the next two years to make Agri-GIS a more robust product for farmers and, more broadly, bring spatial analytics solidly into India's agricultural spheres.

### App Charts Two New Courses

Looking ahead, C-SAG is planning to take Agri-GIS in two new directions. First, it will work with state governments in India to start implementing Agri-GIS as a public good for small and marginal farmers in rural areas. Second, it will promote Agri-GIS to farmer cooperatives and large agricultural businesses as a pioneering way to support the agricultural supply chain in India.

To find out more about C-SAG and Agri-GIS, take a look at the "International Workshop on Advanced Spatial Analytics and Deep Learning for Geospatial Applications," presented by C-SAG in January 2020. Video recordings from the event can be found at [ow.ly/emnz50CqNpN](https://ow.ly/emnz50CqNpN).

### About the Author

Mukund Kadursrinivas Rao is chief executive of C-SAG, which is established under India's National Institute of Advanced Studies (NIAS) Council of Management. Rao has a PhD in remote sensing and GIS and was the first president of the Global Spatial Data Infrastructure (GSDI) Association. He has more than 40 years of experience that includes working with India's national space agency, leading several GIS-based businesses, conceptualizing India's national spatial data infrastructure and national GIS programs, and defining robust remote sensing and GIS standards and policies. He can be reached at [mukund@csag.res.in](mailto:mukund@csag.res.in).

# Reports Give ArcGIS Online Administrators More Control

Among many enhancements in the December update of ArcGIS Online are a series of reports that give every administrator the information needed to more effectively manage organizational accounts by monitoring members, content, and subscriptions.

ArcGIS Online is enterprise ready. It meets the needs of large organizations for managing content and members and effectively handling security, authentication, and privacy. Although member management is important for organizations of any size, for organizations with thousands of members, efficient and detailed reporting becomes paramount. Recent ArcGIS Online updates have improved and expanded report capabilities and improved dashboards. This enables administrators to more easily monitor members' activities and identify the resources available to each of them.

→ New and enhanced reporting capabilities let administrators more effectively monitor members and manage resources. This item report includes the amount of feature data storage used.

## Organization Status Reports

Administrators can generate four types of asynchronous reports on their organization's members, content, credits, and items. The activity, credit, member, and item reports are generated on the status tab within the organization overview page. The reports are saved as administrative report items in the ArcGIS Online organization that can be downloaded as comma-separated values (CSV) files for additional analysis.

The activity report lists all events within a specified day, week, or month. Events are the changes made to an organization's members, groups, credit allocations, and content. With this report, administrators can see everything that is going on within their organizations.

The credit report provides a detailed breakdown of weekly or monthly credit usage per member. The rows display records for each member that provide credit-consuming activities such as geocoding, routing, analysis, and the creation of notebooks. Credits consumed for file and feature storage are charged based on the total organization values, not by member, and those charges can be found in the organization's status dashboard.

The member report lists current details about each member such as role, available and assigned credits, number of

items and groups, and last login date. With this report, administrators can query the status of members, monitor them, and determine if they should be removed from the organizational account.

The item report includes a comprehensive list of items in the organization and the attributes of each item: type, share level, file size or feature storage size, owner, view count, and date modified. With this report, administrators can understand what their members are creating and storing and quickly identify popular items or items that need to be updated or removed.

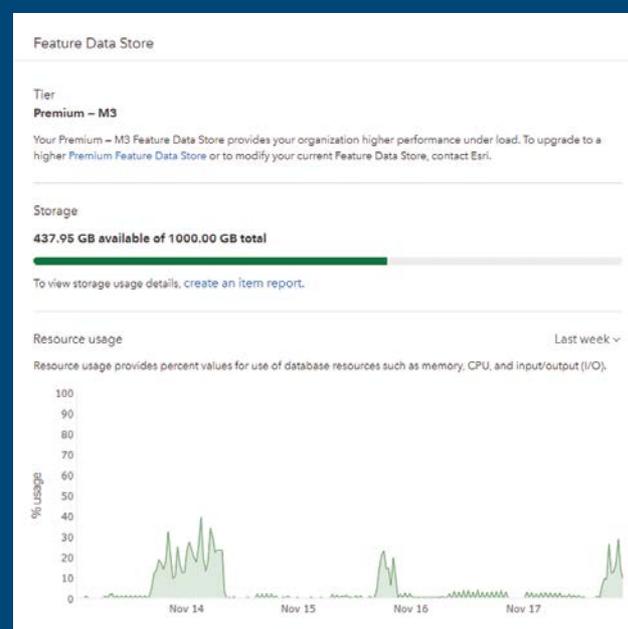
## Organization Overview Page

The organization overview page provides administrators with a quick reference to key information including the subscription ID, system health status, subscription renewal date, and feature data store usage. By viewing the details of the feature data store, administrators can see the current usage of their organization's allotted feature storage. Organizations that have purchased a Premium Feature Data Store subscription will see a chart displaying their database usage over time.

## Organization Status Dashboard

Although not a recent addition to ArcGIS Online, the organization status dashboard, provides a convenient way for administrators to interact with their organization's usage information. The dashboard includes five sections: credits, content, apps, members, and groups. Most sections include charts, tables, and lists that provide drill-down and drill-through capabilities that reveal specific information.

Regardless of organization size, administrators can fully understand the members and activities within their ArcGIS Online organization. By creating status reports, administrators can analyze and archive data regarding the activities, credits, members, and items in their organization. On the organization overview page, administrators can quickly reference information regarding their subscriptions and monitor feature storage. Using the organization status dashboard, administrators can interact with their organization's usage information and drill into items of interest. With these three avenues into information, administrators can efficiently and thoroughly monitor their organizations.



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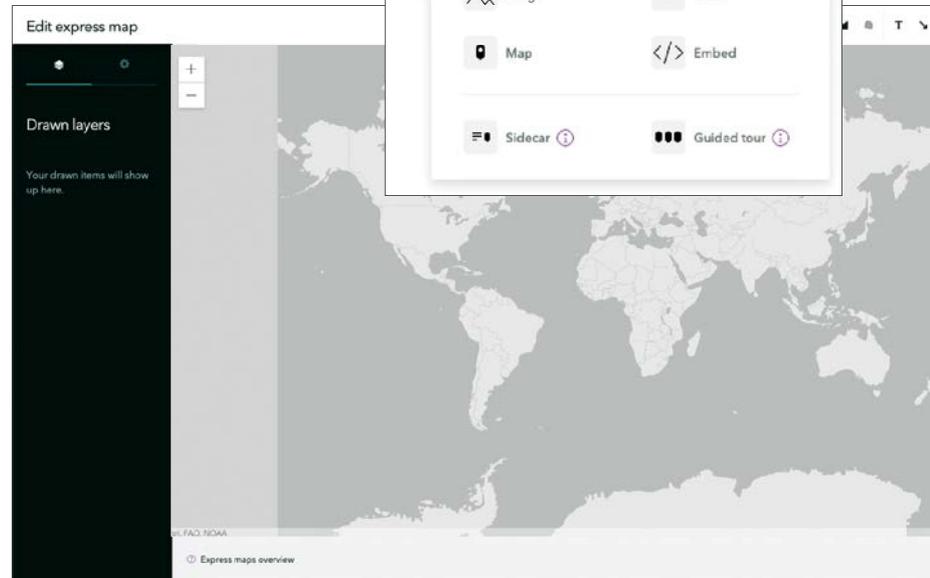
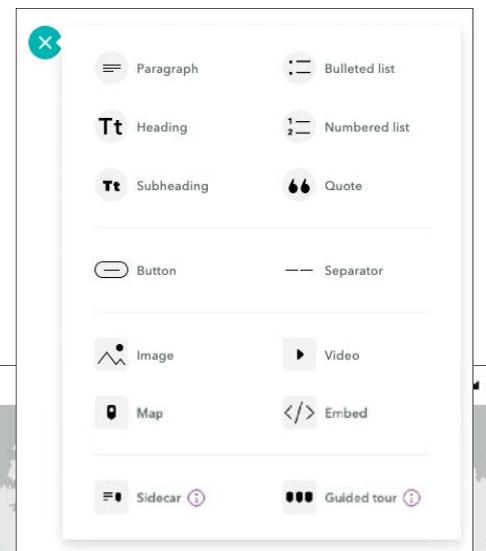
# Six Reasons ArcGIS Enterprise Users Should Get Started with ArcGIS StoryMaps

At long last, ArcGIS StoryMaps is available in ArcGIS Enterprise. Users who have upgraded to ArcGIS Enterprise 10.8.1 have access to an intuitive builder that makes it easy to incorporate maps and other visual elements to create a truly immersive narrative experience.

There are many reasons to adopt Esri's next generation storytelling tool, but here are six that will hopefully encourage ArcGIS Enterprise users to make the switch from classic Esri Story Maps templates to the new builder as soon as possible.

- 1. Getting started is easy.**  
 ArcGIS StoryMaps doesn't have templates. Instead, users build stories intuitively and on the fly using the block palette. It lets users create compelling narratives by adding headings, paragraphs, bulleted lists, and quotations using a simple plus (+) button.
- 2. Rich, immersive content makes for engaging stories.**  
 There are many ways to embed multimedia content in ArcGIS StoryMaps. One of the most useful tools for creating smooth transitions between maps and photos is the sidecar block. Using a series of slides, users can integrate media with text to create a simple scrolling experience.
- 3. Draw readers into particular places of interest.**  
 Another new immersive block, called guided tour, enables readers to see where an important place is on a map, and scroll through relevant photos, videos, and text. It's similar to the classic Story Maps Tour template, but it goes above and beyond what that template could do.
- 4. Create maps in minutes.**  
 No GIS training or cartographic experience? No problem! StoryMaps users can make quality maps with express maps. This tool allows them to add areas and points of interest, arrows, labels, pop-ups, and more without leaving the story builder.
- 5. Map narratives look cohesive and can be branded.**  
 ArcGIS StoryMaps has lots of options for making stories look cohesive and professional—and all this is easy to access via the app's modern design. There are six built-in design themes that users can apply to their narratives, or they can create their own themes using their company's logo, color palette, and other elements that constitute an organization's brand. Mobile-first design makes these map narratives look great on any device, and people can easily interact with maps using their phones. What's more, users can build whole stories using a tablet.
- 6. An elegant way to present work.**  
 Collections allow stories to be grouped by topic, author, or any other criteria—and they're a game changer. This feature of ArcGIS StoryMaps makes it possible to present a group of map narratives and share them as a cohesive, easy-to-navigate set. A collection starts with an overview page that shows the collection's title and description, plus a grid of thumbnails that represents each map narrative in the set of stories. Users can also add other ArcGIS apps, such as dashboards, configurable app templates, and surveys, to a collection.

→ The block palette lets users add headings, paragraphs, bulleted lists, and quotations using a simple (+) button.



↑ With express maps, users can add points of interest, arrows, labels, pop-ups, and more without leaving the story builder.

There is no way to automatically reformat classic Story Maps apps into ArcGIS StoryMaps, since there is no one-to-one relationship between the elements of classic stories and the blocks in ArcGIS StoryMaps. The best way to switch to the new system is to just jump in and start getting acquainted with the builder.

The new dependent user type, Storyteller, is now also available to ArcGIS Enterprise users. The Storyteller user type provides access to ArcGIS StoryMaps for just \$100 per year, so anyone who wants to make stories can do so at a more cost-effective price. Often, those in marketing, communications, and public relations sectors—or those who have other content creation roles—get the Storyteller user type.

For more details, visit the new Storyteller product page at [go.esri.com/storyteller](https://go.esri.com/storyteller) or contact your Esri representative.

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# IN FINLAND, A GEOSPATIAL APP GIVES TRANSPORT DRIVERS THE INFORMATION THEY NEED

Transport companies around the world deliver vital goods such as food, clothing, and electronics, making road-based freight transport an important part of the global economy. In Finland, 40 percent of transport companies consist of just one person and one truck, and these individuals work tirelessly to deliver essential goods.

To ensure that drivers receive accurate information about their trips, Finnish transport consulting company Tietorahti Oy collects and updates transport industry data on everything from gas stations to the maximum weight allowed on various roadways. Although some of this data was available before, drivers couldn't access it in one system. What's more, the data they did have access to wasn't always accurate. This made it difficult for drivers to get the trip information they needed while on the road.

That's why Janne Lausvaara, founder of Esri startup partner Tietorahti Oy, created a mobile app that drivers can use to easily access critical data while on the road. Employing the ready-to-use configurable templates that come with ArcGIS AppStudio, Lausvaara was able to build an app—without doing much coding—that makes drivers' journeys safer and the transport of vital goods more efficient.

## GATHERING INFORMATION IN ONE PLACE

In Finland, the information available to commercial truck drivers and dispatchers used to be found in several different places, such as enterprise resource planning and time management systems, according to Lausvaara. Several key pieces of information were also unavailable, including height and weight limitations on bridges and roadways. This made it challenging for drivers to get essential information about their trips, either during the planning phase or while en route.

As Lausvaara described it, information was “all over the internet and in different kinds of solutions.” He didn't believe that this was serving the local commercial trucking industry very well, so he set out to create one solution with access to all this data.

First, Tietorahti Oy used Google My Maps to introduce a paid solution, released on Google, for accessing transport industry data. This included data from transport companies, as well as open data on everything from truck stops and repair shops to truck height limits and gas stations. Within two years, the app had 1,700 users.

According to these users, however, the data included a lot of errors. The tool also had two specific limitations: a limit of 600 users and a restriction of 10 layers per map. Correcting erroneous data was a lot of work for Lausvaara, too.

“If there was wrong data, I had to fix it four times so users could see it,” he said. “And [the data] was difficult to edit, since it was in multiple places.”

Lausvaara decided to create yet another solution that would not only make information accessible in one place but also have rich data and easier editing capabilities.

## A SOLUTION THAT DOES IT ALL

Lausvaara wanted to create a map-based mobile app that was available in public app stores, but he didn't know where to start. In talking with Ilkka Suojanen, chief technology officer of Esri Finland, Lausvaara found out about AppStudio. Suojanen suggested it because, whereas it allows users to build geoenabled, cross-platform native apps, it requires minimal coding.

To begin creating this new solution, Lausvaara applied to join the Esri Startup Program, which helps early-stage startups, like Tietorahti Oy, build mapping and location intelligence into their products. After becoming part of the program in January 2020, Lausvaara employed AppStudio and worked with a single developer and a graphic designer to get his app up and running.

“I was really excited about AppStudio because I only had to use my code guy,” said Lausvaara. “I [could not pay] anyone to make me software, so [coding] was really easy with AppStudio.”

He watched video tutorials created by Esri's AppStudio team to learn how to use the product. Lausvaara said that videos from Esri product engineer Tina Jin, in particular,

convinced him that AppStudio was the best option for this. From there, implementation was pretty simple.

“I have seen a lot of Tina's videos, and [they] showed how easy it is to make an app. So I thought, if it's that easy, I have to do it with this [tool],” Lausvaara said. “Everybody needs this solution.”

Tietorahti Oy launched the new, free mobile app, called Tietorahdin kartta (which translates to “the map of Tietorahti”) in April 2020 using existing data from the previous Google solution. Within the app, there are galleries of ready-to-use maps that have relevant information for couriers, log transport companies, and container transport companies. For example, a courier can see parking places in city centers, while a container transport company can view port information.

Lausvaara used his own transport industry dataset that comes from 14,000 transport companies and includes over a million data points on things like revenue, equipment, type of transport, and GIS data. This allows Tietorahti Oy to inform transport companies when relevant information is available in the app, such as when loading and unloading locations are added.

Tietorahti Oy advertises its app to drivers with a paper leaflet that says, “[Y]ou have the power to choose what you can see on your map.”

## DRIVERS GET A TAILORED EXPERIENCE

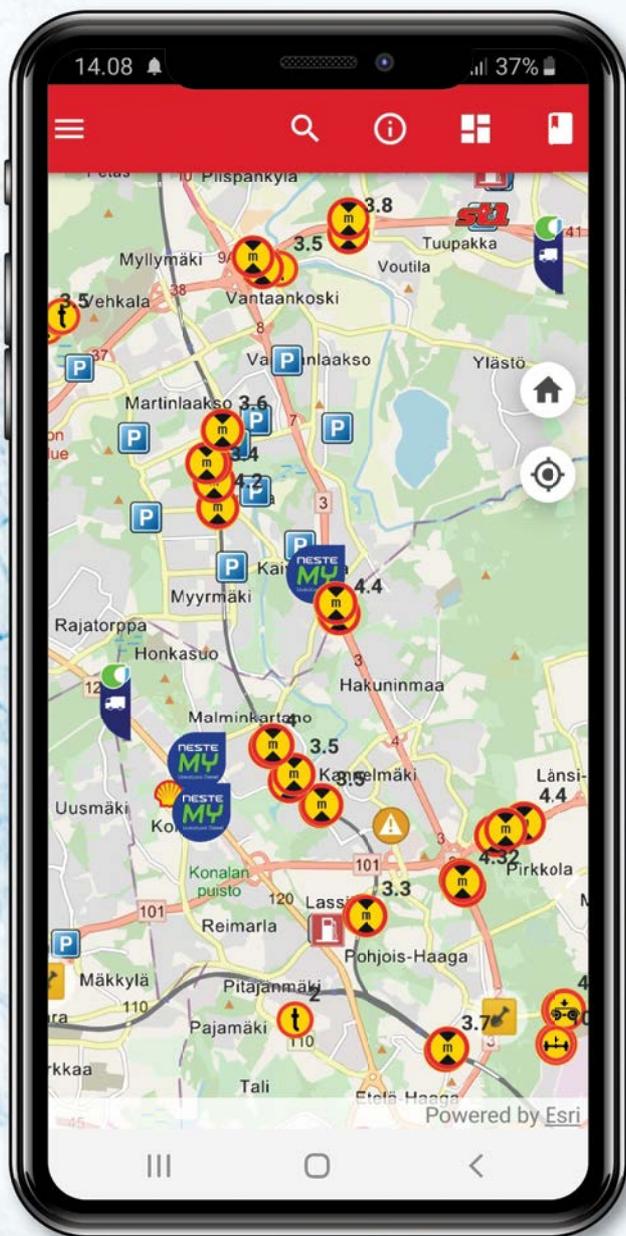
The new, free mobile app—which also functions as a navigation system and tailors its results to where a driver is traveling—has more than 5,400 users and has received positive feedback from transport companies. Part of the reason for this is that truck drivers and transport companies can create a customized experience for themselves. For example, drivers can decide to only view gas stations for which they have a card.

“Drivers can choose what map layers they see, and I was really excited when I found this out,” said Lausvaara. “The map and device remember [the options] drivers have chosen, and there is one map with all the data.”

The app collates data from agencies such as Traffic Management Finland. In addition to displaying information such as the locations of gas stations, parking places, rest stops, and loading areas, the app shows traffic incidents and roadwork information (crowdsourced from drivers), where showers and saunas are, and various types of weight and height limits for roadways around Finland.

Tietorahdin kartta is widely available to drivers throughout the country, which gives Lausvaara an efficient way to collect more data from users and, in turn, improve the app's data quality. And, perhaps most significantly, all this more accurate information is available in one place instead of scattered around different solutions.

Lausvaara finds it easy to make edits and correct errors in the data using the app as well. Previously, he said, he would



← Tietorahdin kartta is a mobile app that transport drivers can use to access critical data while on the road.

have three or four different maps with the same data, but now he can make one map, duplicate it, and edit the different layers within the map.

“Before we used AppStudio, we had a lot of manual processes when updating the data. Also, it had to be updated in several places. Now, we have only one master layer that other layers use filtered,” Lausvaara explained. “It’s less work...and there is more automation with AppStudio. We are saving time because the data is always in one place and only updated once.”

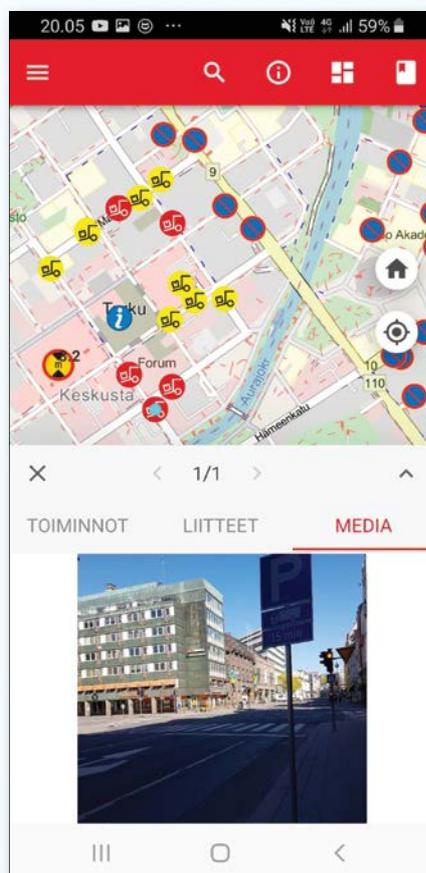
In conjunction with AppStudio, Lausvaara is using ArcGIS Survey123 and ArcGIS Online to crowdsource data and ensure that all the information is kept current. According to Lausvaara, this makes data collection much smoother when compared to the way he previously gathered data from drivers.

### LOOKING AT SHARING IN THE FUTURE

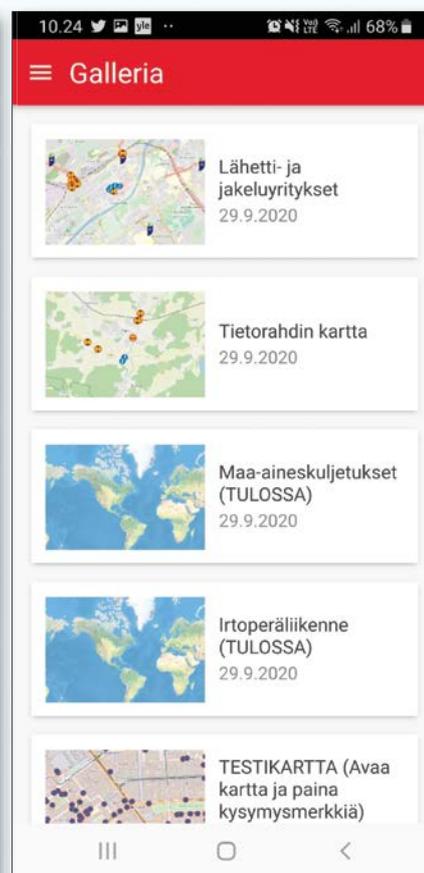
Pleased with the progress of Tietorahdin kartta, Lausvaara wants to eventually create a desktop version of the mobile app that transport company dispatchers can use. He would also like to share this data and his solution with similar organizations around the world.

“I want to share data and ideas with other countries’ transport-related groups. For example, if someone in Sweden has the same kind of software, we could possibly share data and ideas with each other to help support transport companies,” he said. “That would be really powerful.”

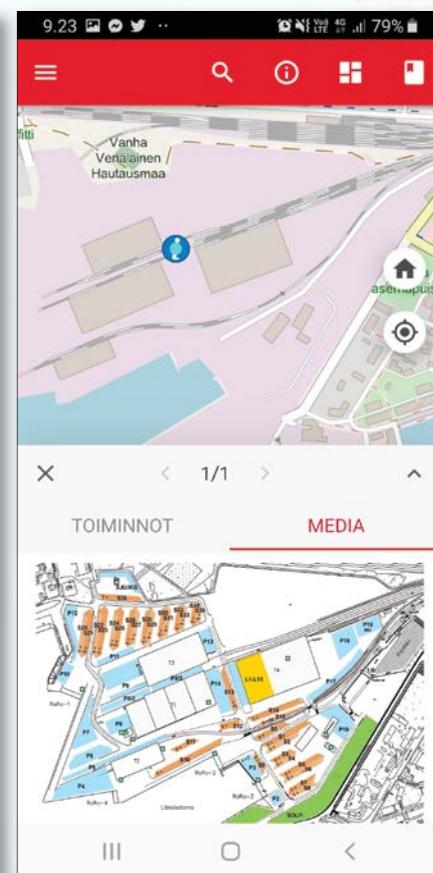
For more information on this project, email Lausvaara at [janne.lausvaara@tietorahti.fi](mailto:janne.lausvaara@tietorahti.fi) or visit [tietorahti.fi](http://tietorahti.fi).



↑ The app displays information such as the locations of parking places, loading areas, gas stations, and rest stops.



↑ A gallery has ready-to-use maps with relevant information for couriers and other types of transport companies.



↑ Truck drivers and transport companies can create their own customized experiences in the app.



# ArcGIS Survey123 Streamlines Assessment of Sydney Light-Rail Service

By Andy Lovell and Samantha Ross, GHD

The Inner West Light Rail (IWLRL), located in the heart of Sydney, Australia, runs for 8 miles (12.8 kilometers) predominantly along the corridor of a former freight railway line. The passenger transit service stops at 23 aboveground and underground stations as it goes from Sydney's central business district, past the tourist area of Darling Harbour, and out toward the suburb of Dulwich Hill.

The overhead wiring structures and sections of slab track that make up the IWLRL need to undergo regular structural evaluations. In May 2019, Esri partner and professional services company GHD was commissioned to undertake this routine assessment. The project required GHD to evaluate every single overhead wire and slab track in 10-foot (~3-meter) intervals. The company then had to put together individual PDF reports for each asset and section of slab track.

To do this, GHD planned to dispatch a team of field engineers to carry out the inspections over the course of a month. The engineers needed to be efficient and collect consistent data across the board. But this was difficult because each inspection period was often constrained by how long the railway could be shut down. What's more, preceding assessments had been conducted using pen and paper, along with digital cameras. Data was manually entered into a spreadsheet-based reporting template, and there was no easy way to match similar-looking photos with the correct assets.

GHD set out to find an innovative mobile solution that would allow its dispersed field team to capture consistent data across numerous inspections and generate simple reports, with photos,

to give to the client. ArcGIS Survey123 ended up fitting the bill.

## Consistent and Comprehensive Data Collection

Using Survey123 Connect for ArcGIS, the location intelligence group in GHD Digital created two custom forms for Survey123 to ensure that field engineers could collect consistent data across teams and inspection periods. The first was for the slab track assessment and the second was for the overhead wiring evaluation—and each contained feature-specific questions that applied only to the type of inspection being conducted. Both surveys were available offline, too, which was indispensable for inspectors who conducted assessments from tunnels that lacked mobile reception.

Accessing one of the two surveys on a tablet or smartphone, an inspector would select an asset's unique ID from a drop-down menu. Client-supplied information pertaining to that asset was then prepopulated into the form. From there, the survey guided the inspector to make observations about the asset and take photos of it from specified angles.

This combination of customized drop-down menus and free response text sections enabled inspectors to record consistent data while capturing other comprehensive details that could otherwise get overlooked. Inspectors also had access to reference tables that were embedded as images into the survey so they could quickly find definitions, repair priorities, and other asset characteristics that they were required to fill out. The survey collected data about asset defects in a repeat table, so there was no limit to the number of defects they could document for a given asset.

"Survey123 streamlines the repetitive motions of structural assessments, making my job quicker and easier," said Andrew Bell, one of the field engineers at GHD.

Upon completing the field data collection campaign, lead engineers reviewed all the submissions using ArcGIS Online. Employing the Survey123 feature report service in ArcGIS Online, the location intelligence group then created a feature report template to automatically generate the reports about the wire assets and slab tracks—complete with corresponding photos—in minutes.

## Time Saved Reduces Risks

GHD's field engineers were able to adapt quickly to this new method of data collection. They found that having the prepopulated asset details gave them the background information they needed to kick-start their assessments. The surveys also made it clear which questions required responses and how to answer them appropriately. Embedding the reference tables into the form also eliminated ambiguity about assessment guidelines and made it so inspectors didn't have to flick between screens to find those specifications.

Ultimately, using Survey123 saved field engineers time and resulted in their employing consistent terminology throughout their reports. This wouldn't have been possible had they collected data using pens and paper.

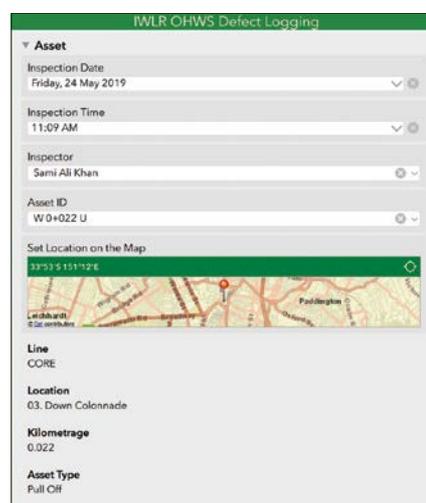
"Using Survey123 for data collection was significantly easier than collecting data manually for such a large area as *was* assessed in this case," said Olivia Britt, a member of GHD's field team. "It was helpful to be able to preprogram object types and intervals/nodes for data collection *and* to be able to collect data about discrete objects, *such as* individual wiring structures, and continuous objects, *such as* track intervals, using one program."

Furthermore, the time-saving features that come with Survey123 limited the team's exposure to the risks associated with doing data collection in the light-rail corridor. And being able to automatically generate complete reports on each asset, thanks to the Survey123 feature report service, was invaluable.

The ability of ArcGIS Survey123 to extract specific collected data and photographs and produce preformatted standard reports for each asset was a powerful feature, which produced quality reports and saved on reporting time, according to GHD geotechnical engineer Sami Ali Khan.



↑ Engineers used the offline capabilities of Survey123 to evaluate assets in tunnels, where cell reception can be spotty.



↑ The ArcGIS Survey123 forms contained a mixture of prepopulated asset information and free response text sections.

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## About the Authors

Andy Lovell, GISP, is the spatial systems program manager at GHD. He has spent the last 18 years building technical and consulting geospatial services across various industries, including mining, water, transportation, and urban planning. Samantha Ross is an engineering geologist at GHD. She has a range of experience with on-site projects, including coordinating geotechnical logging, supervising deep-hole drilling, and performing slope risk assessments.

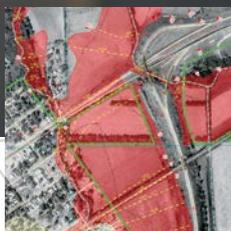
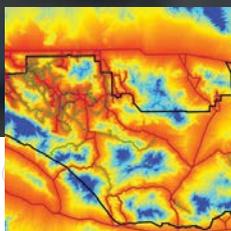
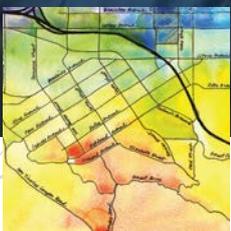


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# Putting Indigenous Place-Names and Languages Back on Maps

By Kelsey Leonard, University of Waterloo



Kelsey Leonard

How many Indigenous Nations and communities can you name? Who are the Indigenous Peoples original to the land you now reside and work on?

I have always been surprised by how few nonindigenous peoples are able to answer these questions. With thousands of Indigenous Nations existing throughout Turtle Island (North America)—and more around the globe—how is it possible that most settlers cannot name more than a handful of Indigenous sovereigns?

In 2014, while serving as a tribal coleader for the former Mid-Atlantic Regional Planning Body of the United States' National Ocean Council, I was confronted, again, with this phenomenon of Indigenous invisibility while reviewing our Mid-Atlantic Ocean Data Portal ([portal.midatlanticocean.org](http://portal.midatlanticocean.org)). In examining this digital mapping interface—which federal and state agencies, fishery management councils, and broader stakeholders throughout the United States regularly use—I noticed that Tribal Nations were absent from the map.

I realized in that moment that the absence of Indigenous participation in broader ocean planning forums has a deep connection to our erasure in maps. If we are not on maps, we usually don't have a seat at the table. And there is no justice for Indigenous Peoples if we are not participating in the decision-making that affects our territories.

We need maps by Indigenous Peoples, for Indigenous Peoples. Moreover, existing GIS ecosystems need to be designed in ways that support Indigenous data sovereignty and visibility—for the benefit of all.

→ The Mid-Atlantic Ocean Data Portal now reflects the diversity of Indigenous Nations in the region.

Through courageous conversations and dedicated allies, we were able to update the Mid-Atlantic Ocean Data Portal to reflect the diversity of Indigenous Nations in the region. But despite that success, as an environmental scientist and policy maker, I continue to be confronted by the erasure of Indigenous Peoples from policy tools and data, including maps. This erasure has far-reaching consequences that affect our shared sustainable future on this planet.

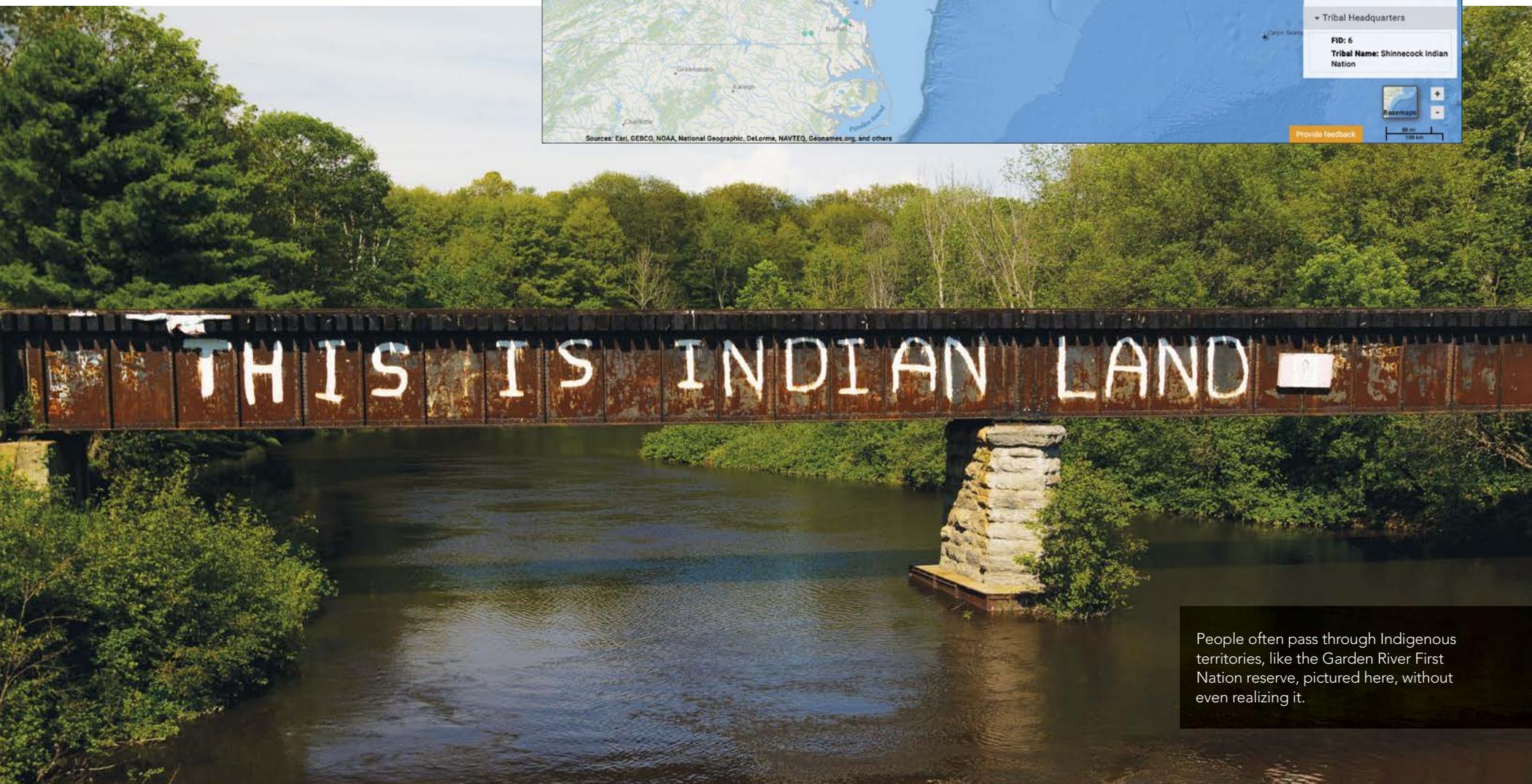
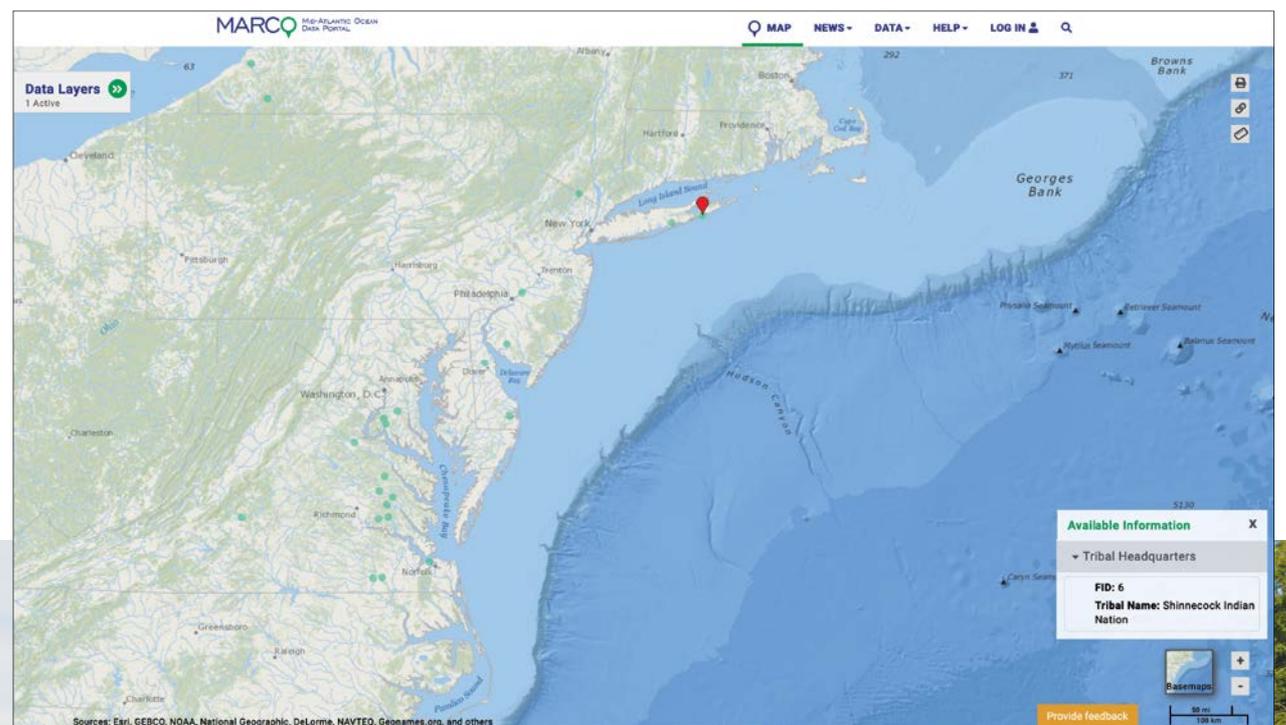
Unfortunately, contemporary maps are the physical manifestation of an inherited legacy of intellectual colonialism. For centuries, maps, mapmakers, and the discipline of cartography have contributed to (or, through acts of complacency, encouraged) the colonization and dispossession of Indigenous Peoples' lands, territories, and resources. This has essentially prevented us from exercising our sovereignty and Indigenous rights as protected by the United Nations Declaration on the Rights of Indigenous Peoples.

Not only have our territories been erased from dominant mapping regimes, but our languages are absent as well. Yet the

inclusion of Indigenous languages in mapping is critical for reconciliation and peace building, since language is, of course, key for communication and education.

Indigenous knowledge systems and science are diverse and dynamic, built on observations accumulated over millennia and passed on through a complex system of intergenerational transmission. Even the orientation of maps is being challenged by contemporary Indigenous cartographers, as seen in the *Decolonial Atlas* project "The Great Lakes: An Ojibwe Perspective" ([ow.ly/poTQ50Cm0Co](http://ow.ly/poTQ50Cm0Co)), wherein Ojibwe speaker Charles Lippert and cartographer Jordan Engel have digitized Anishinaabe geospatial knowledge of the Great Lakes and oriented the compass to the east (or *waabang* in Ojibwe), the direction in which the Anishinaabe traditionally orient themselves.

Forms of Indigenous decolonizing cartography like this offer a glimpse of what decolonized GIS mapping could look like in the future. And the future is now.



People often pass through Indigenous territories, like the Garden River First Nation reserve, pictured here, without even realizing it.

Our borders have been made so invisible that many people pass through Indigenous territories, including reservations and reserves, and never realize that they're in Indian Country. (*Indian Country* is a legal term that refers to all land in Indian reservations and Indigenous communities throughout the United States. The term is used colloquially among Indigenous Peoples of Turtle Island to refer generally to Indigenous lands, waters, and territories.) This erasure has severe implications and complications for transboundary cooperation among Indigenous and nonindigenous peoples and priorities as we chart a path forward in our current climate crisis.

In addition to being erased from maps, Indigenous Peoples also have to contend with the continued use of derogatory place-names. For example, the word *sq\*\*w* is a disparaging reference to an Indigenous woman, yet it is still used in the names of cities, towns, geographic landmarks, and businesses across the United States. As Indigenous communities face an epidemic of missing and murdered Indigenous women and girls, the continued use of derogatory terms like this condition the world to see Indigenous female bodies as inherently violable. And when place-names like that are captured in maps, they further socialize the public to believe in myths such as the “vanishing Indian,” which purports that Indigenous Peoples have disappeared, and to keep promoting colonial philosophies like the Doctrine of Discovery, which, for centuries, has justified the seizure of Indigenous lands.

In recent months, with social justice movements around the world toppling monuments and changing controversial holidays, we also saw the renaming of some disparaging place-names—though there are still too many on our maps. Calls for justice are being amplified within projects like the Land Back movement, which seeks the return of ancestral territories to Indigenous jurisdiction. And Colorado-based *High Country News* recently published an investigative journalism series exposing American universities that have participated in land grabs of Indigenous territories, causing intergenerational trauma to Indigenous Peoples.



← "The Great Lakes: An Ojibwe Perspective" shows the Great Lakes from the perspective of the Anishinaabe. (Map courtesy of the *Decolonial Atlas*, decolonialatlas.wordpress.)

- How are you fulfilling your responsibility to not only ensure that Indigenous Peoples are represented in mapping but also foster positive relationships that lead to more mapping collaborations with Indigenous Peoples?
- What steps have you taken to protect Indigenous rights and well-being across GIS ecosystems and ensure justice for all?

These are not easy questions to answer. But it is imperative to face them if we are to create a new mapping ecosystem that achieves the following goals:

- Promotes equitable outcomes for our collective benefit
- Respects and recognizes the rights of Indigenous Peoples
- Champions Indigenous languages and world views and builds capacity for Indigenous cartography
- Endows future generations with GIS ecosystems that benefit everyone

Indigenous Peoples need everyone to commit to the difficult work of decolonizing our GIS practices so we can create a world full of mapmakers, data scientists, and policy makers who are also data CARE-givers.

So where do we go from here? Despite cartographic atrocities committed against Indigenous Peoples, we can chart a new course with the help of the Global Indigenous Data Alliance (GIDA) and its newly developed CARE Principles. These principles—which revolve around the ideas of collective benefit, authority to control, responsibility, and ethics—advocate for Indigenous data governance and are directly applicable to GIS data and mapping.

To decolonize GIS mapping practices, consider the following questions:

- How can you ensure that GIS ecosystems are designed and function in ways that enable Indigenous Peoples to benefit?
- Are Indigenous Peoples in control of their own GIS data? Do they determine the ways in which their geographic indicators are represented?

#### About the Author

Kelsey Leonard, PhD, is an assistant professor in the Faculty of Environment at the University of Waterloo in Canada. She represents the Shinnecock Indian Nation on the Mid-Atlantic Committee on the Ocean, which is charged with protecting America's ocean ecosystems and coastlines. She also serves as a member of the Great Lakes Water Quality Board of the International Joint Commission. Leonard has been instrumental in safeguarding the interests of Indigenous Nations for environmental planning and builds Indigenous science and knowledge into new solutions for water governance and sustainable oceans. Connect with her on Twitter @KelseyTLeonard.

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# GIS-Based Study of Water Scarcity in Peru Offers Replicable Model

By Adam Stieglitz, Jim Valenza, and Aaron Ebner, the Andean Alliance for Sustainable Development

Even before the Inca empire ruled much of the western coast of South America, indigenous civilizations in and around the Andes mountains farmed familiar crops such as quinoa, chili peppers, and the all-important potato. Today, descendants of those societies continue to farm diverse and globally valued crops.

Yet recently, many of these communities have been unable to produce food like they did before—and the culprit is climate change. Farming communities that have survived for thousands of years are suddenly disappearing because of water scarcity.

To try and address this problem, the Andean Alliance for Sustainable Development (AASD) and the University of Louisville's J.B. Speed School of Engineering used GIS to study what could be contributing to water scarcity in one Peruvian community. What they found—and the methodology they used—could help other societies in similar situations tackle their own climate-related challenges.

## Advanced Technology Gets to the Root of the Problem

Sacclio is a small, indigenous farming community located in Peru's Andes mountains, roughly 10,000 feet above sea level. Farmers in the area grow corn, but the community is struggling to provide them with enough water for their crops. The large stream that brings water in is dwindling while farmers' demand for the vital resource is increasing. This is threatening not only their ability to produce distinctive varieties of Andean corn but also their indigenous way of life.

In 2017, AASD, a nonprofit agricultural organization in the highlands of Peru, partnered with the Speed School of Engineering on a multiyear project to figure out why Sacclio's irrigation system is now insufficient. AASD had been using GIS technology since 2012 for various mapping projects. But when the Speed School of Engineering came onboard—launching the faculty-led International Service Learning Program (ISLP) Peru, wherein students apply their engineering skills in the field—the project got access to a host of new technology, including unmanned aerial vehicles (UAVs), Global Navigation Satellite System (GNSS) receivers, and water flow measurement tools.

To begin the joint effort in Sacclio, faculty from the university and staff from AASD used ArcGIS Pro to design the base map that would depict the area of interest: the canal system that runs through the community. The team also used ArcGIS Pro to build the feature class templates that would be used in ArcGIS Collector to gather data.

In August 2018, a team of students from the Speed School of Engineering used Collector to map all 9 miles (14.4 kilometers) of

Sacclio's canal system. This created records of the various materials the canal is made of—including cement, rock, and earth—its hundreds of valves, and any major damage points. After that, faculty members and select students cleaned and processed the data and analyzed it in ArcGIS Pro. This content was then published to ArcGIS Online, which GIS staff members at AASD used to create shareable web maps for further analysis.

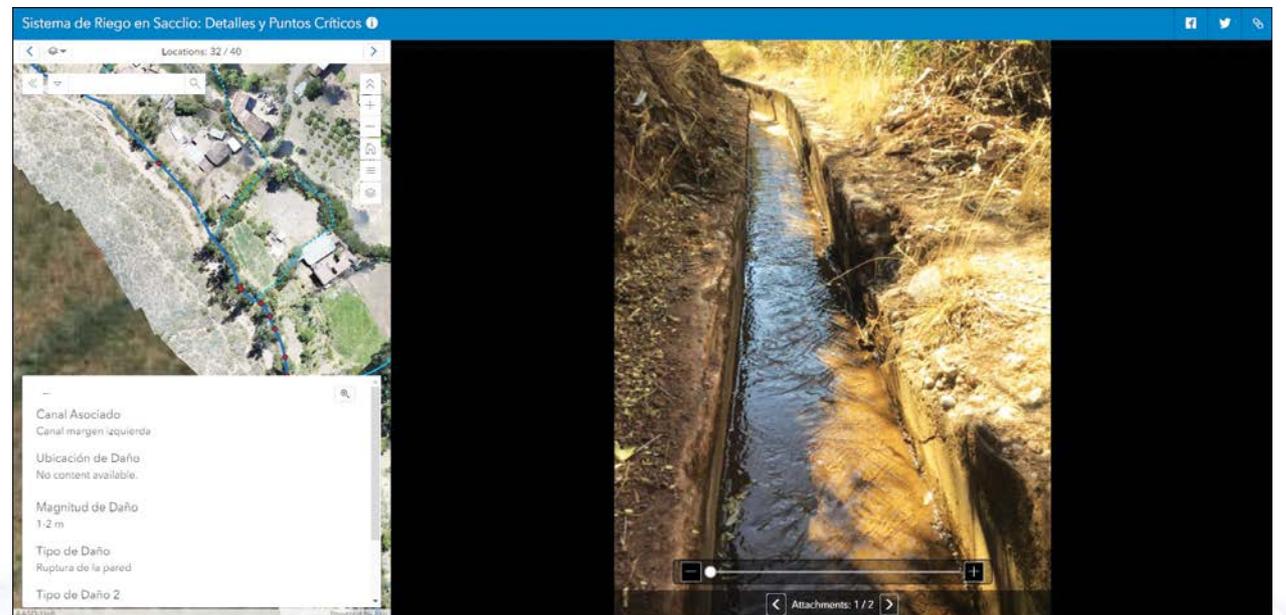
The extent of damage to the canal from natural causes such as rockfall, uprooting, and erosion turned out to be so extreme that a team from the Speed School of Engineering returned to Peru the following year to continue the project. Faculty members and students redesigned the survey to capture more details about damage locations and improve its feature accuracy. They also used mapping-grade GNSS receivers from Esri partner Bad Elf in conjunction with Collector to boost location precision.

For the first time, the team also used UAVs to capture high-resolution imagery of the Sacclio canal system, which substantially improved the resolution of the original basemap. Employing three Phantom 4 Pro quadcopters from DJI, project participants from the Speed School of Engineering and AASD collected thousands of aerial images over approximately 260 hectares of land. University faculty members then processed these images on-site using ArcGIS Drone2Map, which yielded two-inch pixel resolution. GIS staff from AASD then published the high-resolution imagery to the organization's ArcGIS Online account so it could be used as a base layer for all web app products.

In addition, the engineering students used improved technology to measure water flow rates again. Employing a Mariotte

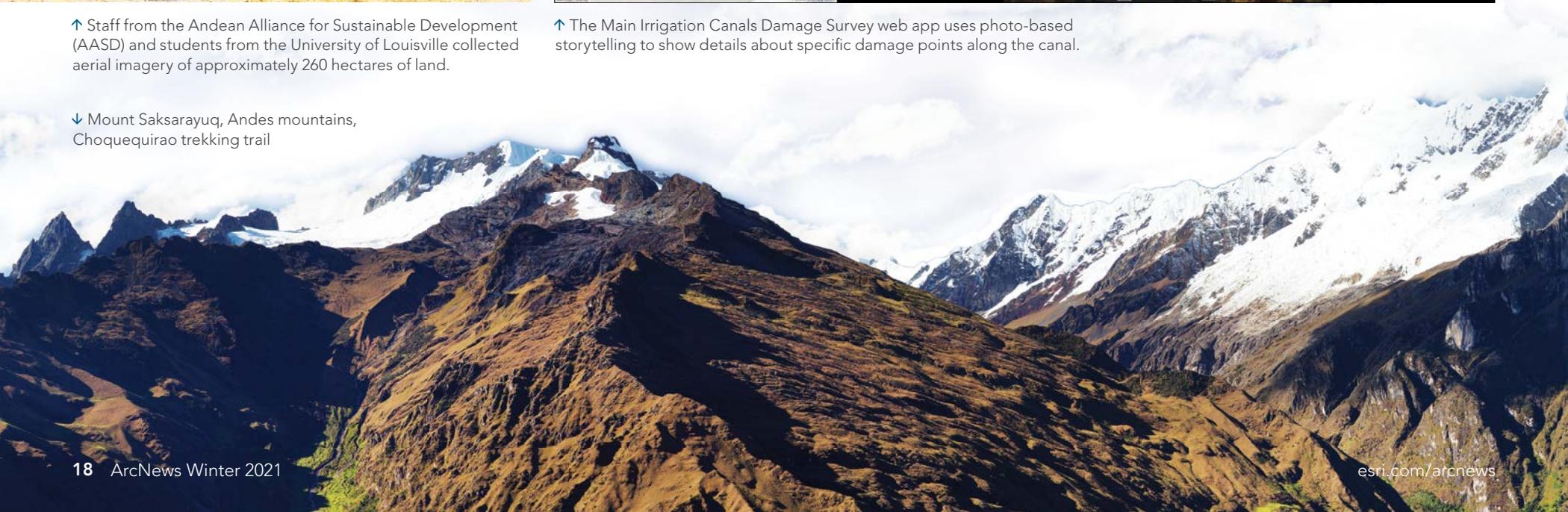


↑ Staff from the Andean Alliance for Sustainable Development (AASD) and students from the University of Louisville collected aerial imagery of approximately 260 hectares of land.



↑ The Main Irrigation Canals Damage Survey web app uses photo-based storytelling to show details about specific damage points along the canal.

↓ Mount Saksarayuy, Andes mountains, Choquequirao trekking trail



→ The team used UAVs to capture high-resolution imagery of the Sacclio canal system.



bottle (which allows fluid to flow constantly from a container), a Sonde electrical conductivity meter, and EcoWatch Lite software, they measured water loss in the canal by injecting measurable amounts of salt at certain points and seeing how much of it was still in the water at collection points downstream. The students found that Sacclio's canal system was losing up to 50 percent of its total water supply at the time the measurements were taken.

### Data Visualizations Offer a Way Forward

With this more accurate data, hosted in its own ArcGIS Online environment, AASD was able to use ArcGIS Web AppBuilder and ArcGIS Configurable Apps templates to create two interactive web apps that make it easier to share critical information about Sacclio's irrigation system.

Each app includes three major data points:

- The percentage of water lost, broken down by canal segment.
- Major damage points along the canal, described by type of damage, the severity, and their locations.
- Overall statistics about the canal, including its width, depth, number of valves, and build material at various locations.

But the two apps serve different purposes and are designed to give users distinct experiences.

The Sacclio Main Irrigation Canals Water Loss Locator, built with the Interactive Legend configurable app template, is data oriented. Users can select, search for, or layer information in various ways to view specific stories about the challenges the Sacclio irrigation system faces. Each data point in this app has a corresponding photo or video that brings users closer to what's

happening at various points along the canal.

The Main Irrigation Canals Damage Survey web app, built with the Attachment Viewer configurable app template, shows the depth and breadth of various damage points via photo-based storytelling. The map allows users to scroll through photos and videos of the entire canal and is an efficient and powerful way to communicate the severity of damage.

Having this quantitative data and spatial analysis available in two easy-to-use web apps makes it easier for the community of Sacclio to convey the gravity of its water scarcity issue to stakeholders who can do something about it.

For the past 10 years, the municipal government has consistently denied Sacclio's request for funding to repair its irrigation system. Without any compelling evidence or data, the government body has often deemed the problem not serious enough to warrant investment. But now, with the ability to quickly and efficiently share specific, location-based data with municipal representatives, leaders in Sacclio are confident that the community has a compelling case to receive funding to restore its ailing canal.

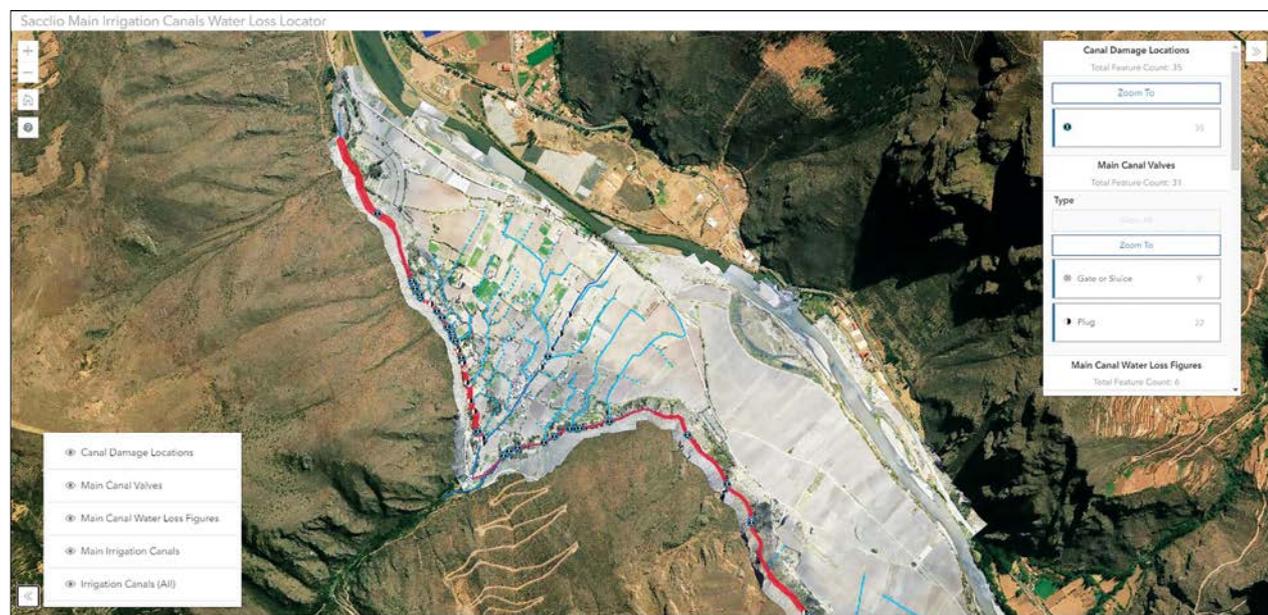
### A Replicable Model Based on GIS

In the Peruvian Andes, indigenous communities face unprecedented environmental challenges that stem from irrigation issues, climate change, and erratic weather patterns. That's why AASD and the Speed School of Engineering plan to implement similar GIS-based programs in other nearby districts. Although GIS is underutilized in the area right now, the technology can be especially helpful to remote communities that need to document

and communicate the issues they face. Thus, AASD remains committed to partnering with the University of Louisville—and perhaps other educational institutions—to use GIS to enact positive change in and around the Andes mountains.

What's more, impact-driven collaborations like ISLP Peru can and should be replicated around the globe. There are countless communities like Sacclio facing grave challenges due to changing environmental and climatic conditions. Connecting institutes of higher education with community-based organizations and local leadership is an effective way to use GIS to address complex challenges. This is a replicable model for development and experiential learning, and AASD will continue to refine it in the years to come.

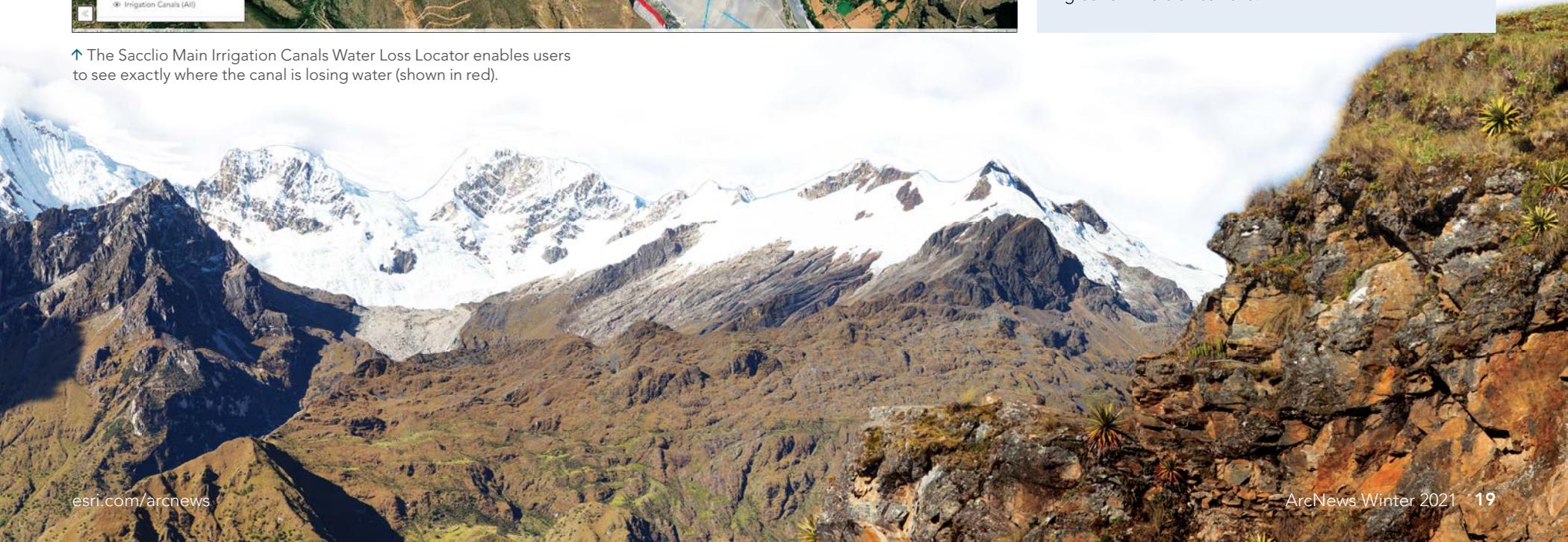
To learn more about this project, watch a video at [youtu.be/wd6q-WXj7aA](https://youtu.be/wd6q-WXj7aA). For more information, email AASD director Adam Stieglitz at [adam@alianzaandina.org](mailto:adam@alianzaandina.org) or AASD GIS specialist Jim Valenza at [jim.valenza@gmail.com](mailto:jim.valenza@gmail.com).



↑ The Sacclio Main Irrigation Canals Water Loss Locator enables users to see exactly where the canal is losing water (shown in red).

### About the Authors

Adam Stieglitz is the cofounder and director of AASD. He is currently pursuing a doctoral degree in educational leadership and organizational development at the University of Louisville. Jim Valenza is a GIS specialist at the AASD, where he has been integral to creating and growing the organization's GIS program since 2012. Aaron Ebner is the cofounder and executive director of AASD, which he has been leading on the ground in Peru since 2010.



# Facing Sea Level Rise, Miami Beach Uses GIS to Prioritize Mitigation Projects

Miami Beach, Florida, which lies on a barrier island a few miles off the coast of Miami, is one of the most vulnerable areas for sea level rise in the United States, if not the world.

By the end of the century, global mean sea levels could rise by about 11 to 43 inches, according to the United Nations Intergovernmental Panel on Climate Change (IPCC). South Florida is likely to face 17 to 31 inches of sea level rise by 2060, according to projections made last year at the Southeast Florida Climate Leadership Summit. And Miami Beach has a unique, bowl-like geography wherein the center of the island is lower than its beaches to the east and coastal defenses to the west, making it even more prone to flooding.

That's why the city has been working with Esri partner Jacobs, a technical consulting engineering firm, to find out where its biggest flooding concerns are and determine how to consolidate public works projects to better prepare for sea level rise while minimizing disruptions to residents. Using ArcGIS Pro and ArcGIS Spatial Analyst, the team at Jacobs combined climate change projections with the city's own infrastructural data—and now, Miami Beach is tackling these projects in a more efficient and effective way.

↓ By implementing blue and green infrastructure in its design to manage floodwaters, the city is consolidating public works projects to better prepare for sea level rise.

## Flood Management That Works—But There's More to Do

The city of Miami Beach already experiences unusual flooding. Higher-than-normal tides, called king tides, now flood the streets regularly.

"It could actually be a sunny day, and you'll see flooding in the streets and have to wade through water to get to your car," said Matt Alvarez, the Miami-Dade executive manager at Jacobs.

"Adding significant rain events to those high tides causes substantial flooding in the lowest-lying areas of the city," added Roy Coley, director of the Public Works Department for the City of Miami Beach.

The city began mitigating tidal flooding back in 2013. It implemented a cutting-edge stormwater management plan that took into consideration 30-year forecasts for sea level rise. Miami Beach started elevating its most vulnerable roads and improving its stormwater pumping system.

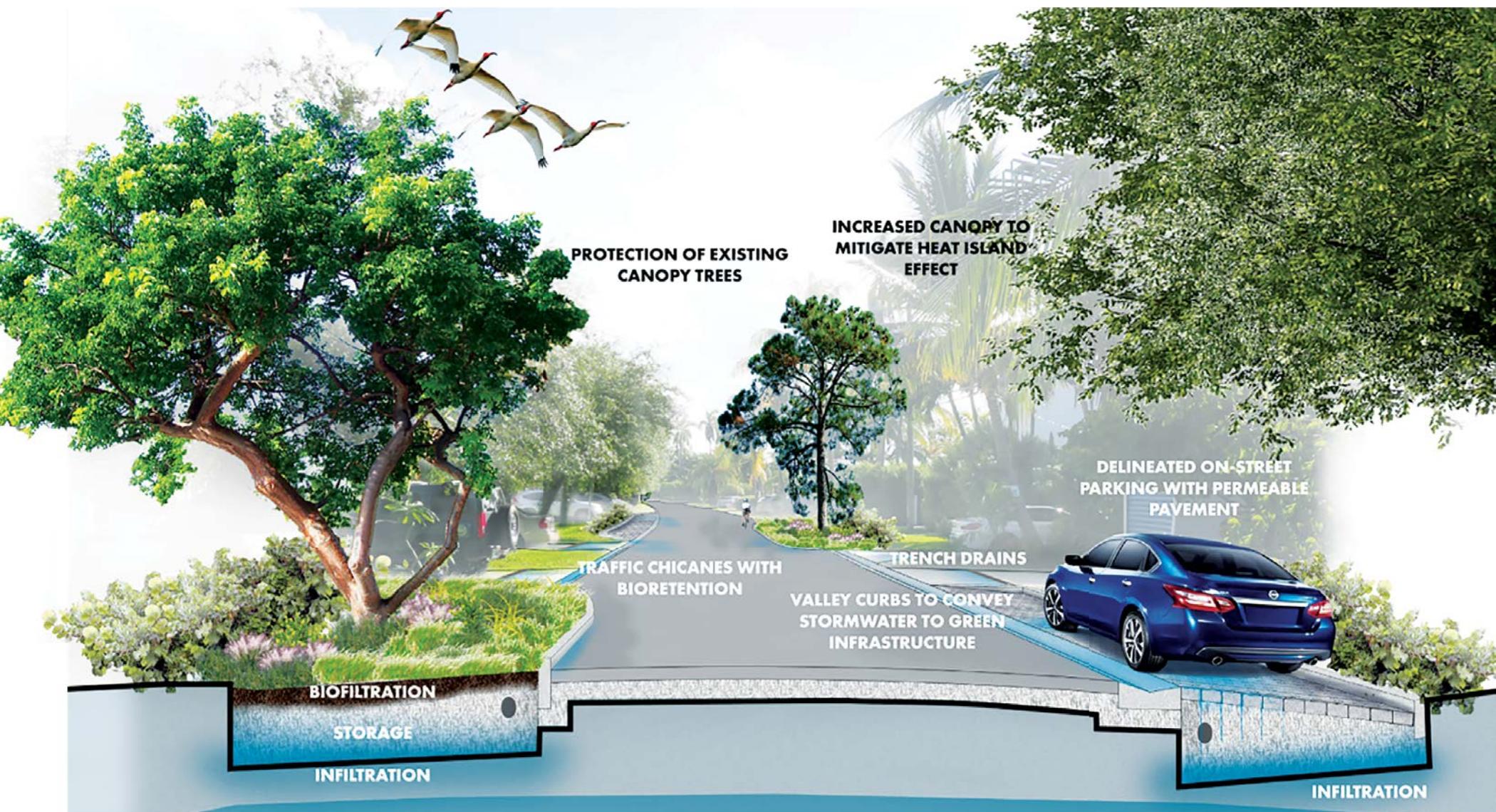
"We were one of the first cities to actually take bold steps to manage flooding," said Coley.

But predictions have changed since then, and by 2017, the city's new mayor, Dan Gelber, wanted to ensure that Miami Beach was on track to actually diminish the effects of sea level rise. Working with the Rockefeller Foundation, the city brought in the Urban Land Institute (ULI) to review the projects and plans it already had under way.

The organization did a comprehensive analysis and concluded that, overall, the city had done many things well. However, there was still room for improvement—especially when it came to implementing blue and green infrastructure (a way of using urban green spaces to manage floodwaters) and ensuring that each project provided multiple benefits to the surrounding neighborhoods.

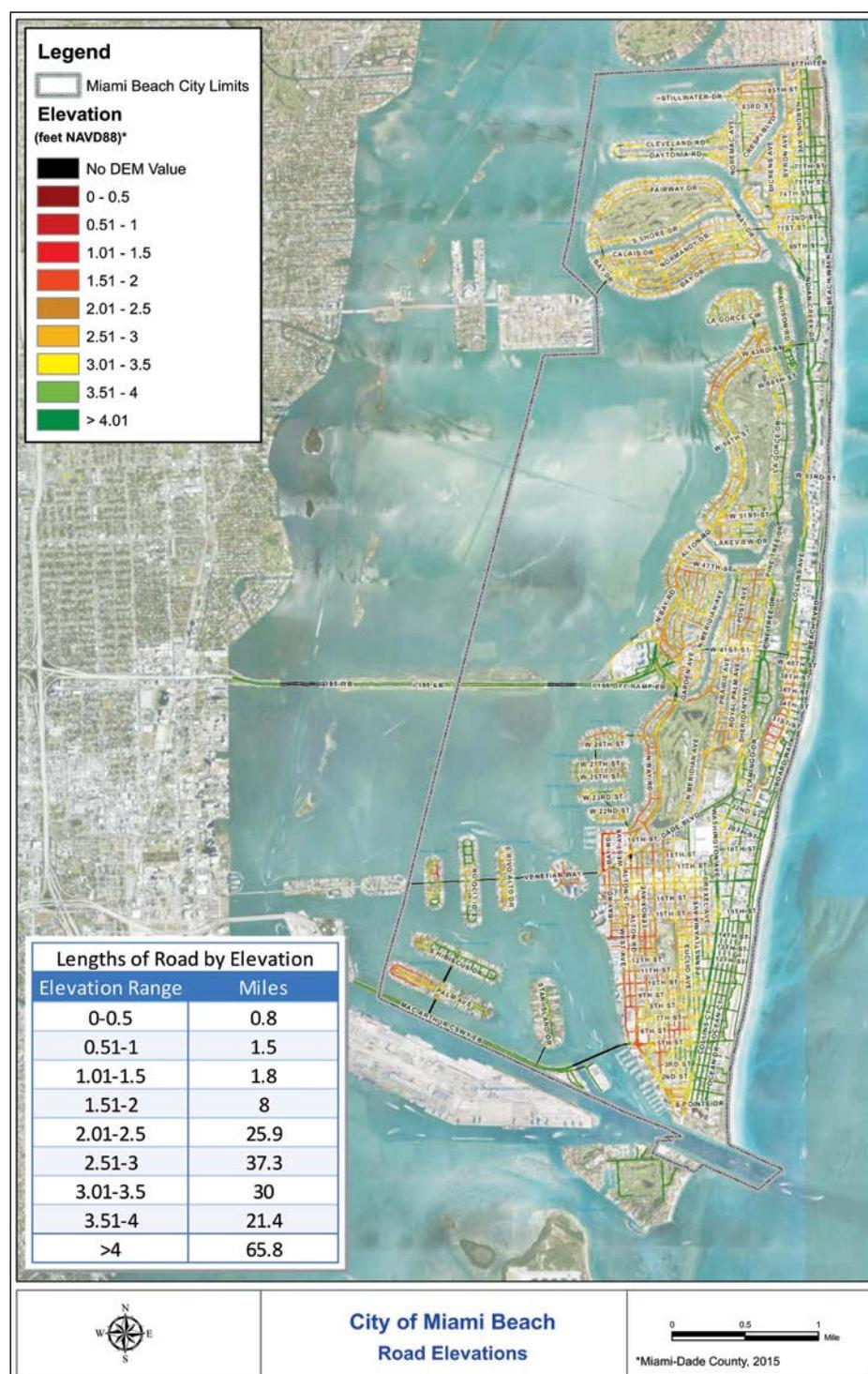
To put ULI's recommendations into action, the City of Miami Beach enlisted Jacobs. The team there—which consists of Alvarez; Jason Bird, the company's Florida resilience lead; hydrologists; planners; and a robust group of GIS experts and spatial analysts—used GIS to visualize all the data.

"It was fundamental for us to map out where things were happening, where the needs were, and how to prioritize the different neighborhood projects," said Alvarez. "I'm not sure how we would've done this project without GIS."





↑ Parks can be constructed to collect, infiltrate, and store stormwater during small rain events by incorporating permeable pavement, enhanced tree pits, and other features to ensure that each project provides multiple benefits to the surrounding neighborhood.



↑ Miami Beach, Florida, which lies on a barrier island a few miles off the coast of Miami, is one of the most vulnerable areas for sea level rise in the United States, if not the world. The city has been working with Esri partner Jacobs to identify the city's biggest flooding concerns.

### Taking On Sea level Rise While Minimizing Disruptions

With ArcGIS Pro and the Spatial Analyst extension, the team at Jacobs mapped out Miami Beach's infrastructural priorities. From there, it determined ways to improve how the city is preparing for sea level rise.

The City of Miami Beach provided extensive amounts of data from its asset and capital management program, which Jacobs combined with its own data on flood risk and city service needs. The project had three aims:

- Figure out how Miami Beach can better incorporate blue and green infrastructure to mimic nature's water cycles and reduce flood risk. This includes coming up with ways to preserve the island's freshwater lens, which keeps salty groundwater at bay, to protect trees and infrastructure and support public services and facilities.
- Evaluate the city's road-raising strategy and ensure that it fits Miami Beach's evolving needs.
- Examine project size and sequencing so the city can prioritize the most important ones and see if any are too large (and thus take too long) or too small (and don't provide adequate benefits).

"The city has done a great job identifying tidal flood risk areas that require immediate intervention," said Bird. "We've been able to add additional layers to previous analysis to capture other city needs, such as water, wastewater, stormwater management, and road enhancement projects. By spatially analyzing all those different critical city functions and understanding how they interact with one another, we've been able to review city projects and ensure that when a capital project is performed, we can minimize disruptions in the neighborhood."

"Flood risks, water and sewer needs, and other utility and infrastructure needs have been mapped out, so the city has a plan on where to go in first and so forth," Alvarez added. "GIS has been a very useful tool for our team to set project and neighborhood priorities across the City of Miami Beach."

### Projects Get Prioritized and Consolidated

After approving Jacobs's recommended flood adaptation guidance in October 2020, the City of Miami Beach was set to start implementing the suggestions that came out of it—beginning with consolidating road-raising and infrastructure improvement projects in certain high-priority neighborhoods.

"Now, something is no longer just a pump project or a pipeline project," said Alvarez. "We've developed groups of infrastructure projects that provide significant value to the community or neighborhood they're being implemented in. The groups of projects are very thorough and cover the needs in the area, allowing the city to go in once, do the work, and then have everything be done at the same time."

One area that Jacobs focused on specifically was helping the city of Miami Beach preserve its freshwater lens.

"As sea levels rise and saltwater pushes up, there's a layer [*lens*] of freshwater between the surface of the land and the saltwater," explained Coley. "If we lose that, our vegetation will go away. But by using blue and green infrastructure, we can constantly replenish that freshwater lens and abate the sea level that's rising beneath us."

"Flooding is a nuisance, but that freshwater is a very valuable asset to the city for preserving its freshwater lens and keeping seawater down," added Alvarez. "In this way, we can convert what is initially a liability for the city and bring it into use."

Being able to group blue and green infrastructure projects like that together with road-raising and stormwater system improvement plans in areas with the most pressing needs is going to make this work more efficiently and effectively than ever.

For more information, contact Coley at [roycoley@miamibeachfl.gov](mailto:roycoley@miamibeachfl.gov) or Nelson Perez-Jacome, city engineer at the City of Miami Beach, at [nelsonperez-jacome@miamibeachfl.gov](mailto:nelsonperez-jacome@miamibeachfl.gov).

## From the Meridian

By Gary Langham

Executive Director, American Association of Geographers



# Pulling Together When a Pandemic Pulls Our Lives Apart

Like many of you, I am spending a lot more time staring at video screens and multimedia messaging platforms each day. Gone is the routine of moving from office to home and traveling on behalf of the American Association of Geographers (AAG). Gone are the daily rituals with coworkers. And while I am grateful that technology can connect us better than ever before, we miss something critical without face-to-face interactions. It's the small things I miss most—the unscheduled chat in the hallway or in line at a local coffee shop.

Meanwhile, many in our discipline are balancing the dangerous trade-offs of pursuing work in person. The plight of K-12 teachers and professors whose schools and campuses reopened is much in the news, while countless students stand in harm's way as they try to supplement their income by working in retail, at restaurants, and in the gig economy. All the while, teaching, graduate research, and the practice of geography are being profoundly disrupted.

The COVID-19 pandemic is the crisis of our lifetime, training a merciless lens on the social and racial fissures that already made life so difficult for so many people. As AAG president Amy Lobben wrote in her July column for the *AAG Newsletter*, "The UN [United Nations] predicts that the global coronavirus lockdowns will drive an additional 130 million people to the edge of starvation."

Citing recent estimates from the Stop TB Partnership, she noted that as many as 1.4 million people could die from tuberculosis as a

direct result of these lockdowns. Lobben continued, "The impact on other indices of health is dizzying, with surges in suicide, domestic violence, and mental health problems (the United States Centers for Disease Control [and Prevention] reported in May that one-third of Americans are experiencing Generalized Anxiety Disorder, with rates higher for women, people of color, and people with less education). Factor in unprecedented unemployment directly tied to coronavirus lockdowns that are surging across class, race, and gender lines, disproportionately affecting women, people with disabilities, and people of color."

As the magnitude of COVID-19 reveals itself, geographers and GIS professionals have worked tirelessly under challenging conditions. Teachers, students, and GIS practitioners have attended to the crisis with the full energy of their profession and passion, sometimes at significant personal risk or cost.

The world has taken notice. You can't open a newspaper or an app without seeing the vivid work of geographers and GIS specialists, rendering the pandemic in spatial and temporal terms that the broader public can grasp and upon which policy makers can act. The work of geographers is more prominent and crucial than ever.

Yet our field is more at risk than at any point until now because we—in particular, our youngest colleagues and those most marginalized due to race, finances, or gender—are engaged in our own individual battles against the public health and economic impacts of COVID-19. At the

institutional scale, geography departments that were already challenged from many directions before the pandemic are now under pressure like we've never seen. Our profession is at risk, even as we are needed to share what we know with a world at risk.

Putting this awareness at the forefront, the AAG created its COVID-19 Rapid Response Task Force in mid-2020 to address the crisis's impact on the teaching and practice of geography. The task force consists of more than 60 AAG member volunteers on five subcommittees that seek to support our members—students, educators, and professional geographers in government and the private sector—in the distinct ways this period demands. Our goal is to address the systemic hardships facing geographers and geography. The nine projects we activated over the summer include the following:

- **The Bridging the Digital Divide program:** With Esri as a partner, the AAG brings much-needed equipment and software directly to minority-serving institutions. The program provides laptops, software, and connectivity to students so they can continue their studies within hybrid or virtual settings.
- **Membership dues assistance:** The AAG has extended memberships for free for its most vulnerable members. Eligible members include undergraduate students, graduate students and postdocs, those in regions with low and middle income economies, and anyone who has an income below \$25,000 per year.
- **A mentoring program:** The AAG Career and Research Mentors program connects geographers to experienced advisers across institutions. As of November, there were about 50 mentors listed with a wide variety of backgrounds and expertise. Current AAG members can sign up online to volunteer as mentors, and then they'll be added to the online database.
- **Enhanced career and leadership resources:** Two projects that feature refreshed and new resources are the AAG's Jobs & Careers web pages and a professional development webinar series with videos that people continue to share.

- **A COVID-19 internship assistance program:** This grant program supports students who get internships and enables them to attend their regional division conferences.
- **Research methods for COVID-19:** A series of webinars and workshops aim to help geographers employ a wide variety of research methods and processes to the conditions of the pandemic. These online workshops also enable students to connect with experts and with one another. Although students are the focus of these online offerings, the resources are available to all AAG members.
- **Stabilizing AAG's regional divisions:** New projects support the AAG's regional divisions by offsetting some of the financial impacts of the pandemic.

Through our response to COVID-19, the AAG is leveraging and connecting our ongoing work to strengthen academic departments, develop a robust workforce across sectors, support individual members, and advance the relevance of geography in the minds of decision-makers and the public. This is not business as usual, and our response can't be, either. Our programs identify solutions that provide relief to geographers so they can learn, work, and flourish in a thriving field—even during these precarious times.

Read more about one of these programs—Bridging the Digital Divide—in "A Starting Point for Bridging the Digital Divide" on page 23 and "How GIS Students at One University Got Much-Needed Equipment" on page 24.

### About the Author

Gary Langham, PhD, is the executive director of AAG. Previously, he was vice president and chief scientist at the National Audubon Society. In 2000, Langham founded the Neotropical Grassland Conservancy to foster grassland research with grants and equipment. He completed a National Science Foundation bioinformatics postdoc at the University of California, Berkeley, and received his PhD in ecology and evolutionary biology from Cornell University.



# A Starting Point for Bridging the Digital Divide

By Coline Dony, American Association of Geographers

Nearly a year into perhaps the world's worst pandemic, we know that one of the most profound impacts of COVID-19 is on space itself. For geographers, continuing our pursuit to advance understanding of the earth now means navigating places virtually. Our own communities and workplaces, our schools and classrooms, and even the very world we study must be experienced safely through technology.

Accessing people and places this way, first and foremost, requires digital connections, hardware, and software. Getting that kind of digital access relies on the presence of internet infrastructure, which already creates notable inequities among people and communities.

One of the places where this is most dire is on the tribal lands of many sovereign nations that coexist with the United States. In its 2020 broadband deployment report, the Federal Communications Commission (FCC) noted, "Tribal lands continue to face significant obstacles to broadband deployment."

Even when the infrastructure is available, the burden often falls on individuals to obtain the hardware, software, and broadband they need to get and stay connected. All this costs money—money that many simply don't have, especially when unemployment is high. According to a 2019 survey of the United States by the Pew Research Center, among adults with household incomes below \$30,000 a year, 44 percent had no at-home broadband service and 46 percent had no desktop or laptop computer.

The digital divide, which existed before the pandemic, has only widened during COVID-19. Students without adequate means are struggling to complete assignments on their phones or are sitting in school parking lots to access fast connections. The burden of this deficit has hit students of color the hardest. According to John B. King Jr., former secretary of education for the United States and now president and CEO of The Education Trust, only 66 percent of Black students and scarcely 50 percent of Hispanic and Latinx students live in homes with an internet connection, compared to 79 percent of White students.

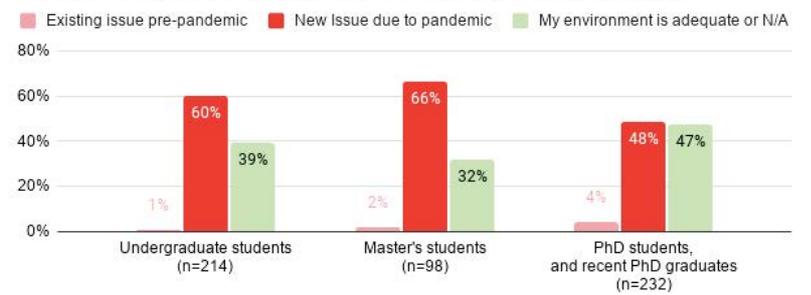
Students trying to get an education in geography have to take several courses that require geospatial software. This entails using laptops with memory and graphics and processing speeds that add costs beyond those for standard equipment. What's more, this equipment oftentimes has to run on particular operating systems.

Before the pandemic, students had access to GIS computer labs like the one at Fayetteville State University in North Carolina (see "How GIS Students at One University Got Much-Needed Equipment" on page 24 for more on this). That is not an option for many students for safety reasons. Access to Wi-Fi and a computer isn't enough for these students. They need the right hardware to run the right software to do their work.

In May 2020, the American Association of Geographers (AAG) surveyed its student members to see how COVID-19 has affected their circumstances. Sixty percent of the undergraduates surveyed said their learning environment is a new issue because of the pandemic, as did 66 percent of master's students and 48 percent of PhD students. When asked about the GIS software they need for their projects, 41 percent of undergraduates, 28 percent of master's students, and 21 percent of PhD students said it created a new problem for them in the pandemic—likely because they typically access this software on campus in computer labs.

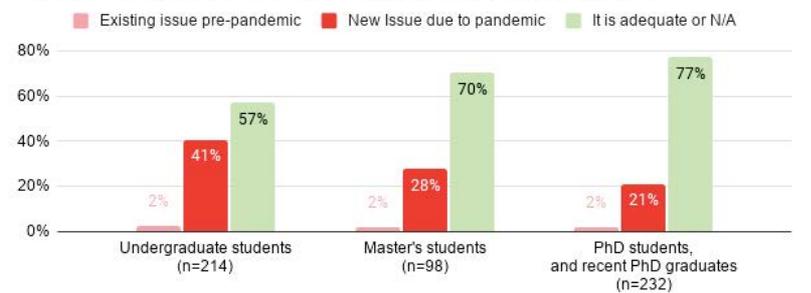
In response to these clear needs, the AAG launched Bridging the Digital Divide as one of nine interlocking programs to support

## What is your status regarding your learning environment ?



↑ Students reported an increase in issues within their learning environments since the COVID-19 pandemic started.

## What is your status on GIS software for your projects ?



↑ While the majority of students reported that the GIS software they use for their projects was adequate or not affected by issues, many still reported that they had pandemic-related problems.

*Bridging the Digital Divide was made possible by the program committee, composed of Emily T. Yeh from the University of Colorado, Boulder; Jason Post from Tohono O'odham Community College; and E. Arnold Modlin of Norfolk State University.*

geographers during COVID-19. (See "Pulling Together When a Pandemic Pulls Our Lives Apart" on page 22 for more on all these projects.) The program has already dedicated \$238,000 to faculty requests from eight tribal colleges and universities (TCUs), 14 historically Black colleges and universities (HBCUs), and 1 predominantly Black institution (PBI). It is serving students across more than 95 courses, 41 percent of which are GIS classes.

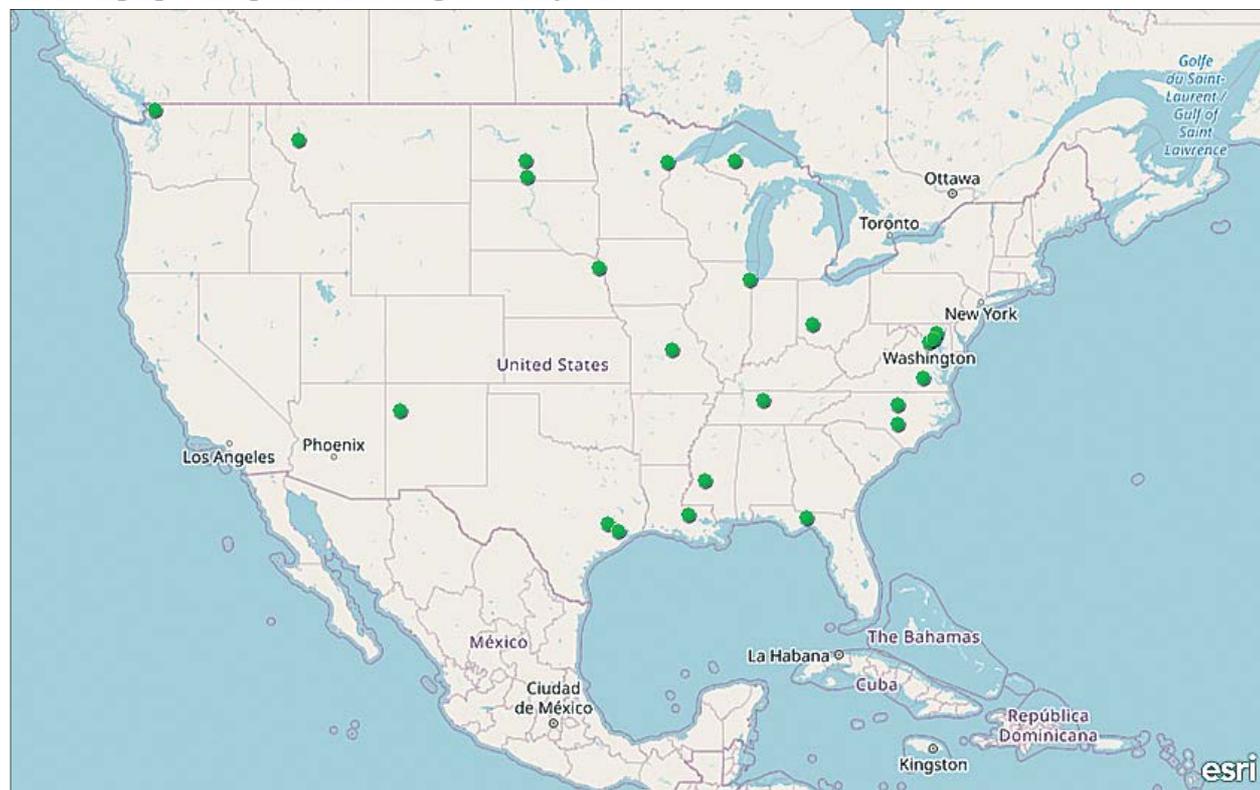
This first wave of requests showed us in more detail what types of equipment faculty members need. Laptops are the main requirement, so (at last count) the AAG is funding 200 student laptops. By providing these funds, we hope students can pursue the classes they wish to enroll in without worrying about how to afford the needed equipment.

We know that the digital divide is the tip of the iceberg in many ways—an indicator and a symptom of more far-reaching inequities within education in general and the geographic disciplines more specifically. As the AAG redoubles its efforts to recruit, retain, and promote the work of geographers who are Black, Indigenous, and people of color (BIPOC), we hope that this program removes one pernicious barrier on the path to pursuing a satisfying career and that it helps enable these young scholars to contribute valuable work to a world that needs their insight.

### About the Author

Coline Dony is a senior geography researcher at the AAG. She holds a PhD in geography and urban regional analysis from the University of North Carolina, Charlotte. To inform the AAG's membership services, her outreach and engagement with members focus on geoethics, modernizing geography education, and making geography more inclusive.

## AAG Bridging the Digital Divide Program Recipients



↑ The American Association of Geographers (AAG) has distributed funds to institutions across the United States through its Bridging the Digital Divide program.

Learn how to help the AAG connect more students to their geography and GIS classes at [aag.org/BridgeTheDivide](https://aag.org/BridgeTheDivide).

# How GIS Students at One University Got Much-Needed Equipment

At Fayetteville State University (FSU) in North Carolina, geography is arguably one of the most popular minors. In large part, that's thanks to Dr. Adegoke Ademiluyi, professor of geography in the Department of Intelligence Studies, Geospatial Science, Political Science and History. Four years ago, he undertook several initiatives to turn geospatial education into a high-profile degree program.

Unfortunately, the COVID-19 pandemic threatens to derail the progress that Ademiluyi and his colleagues have made. In response to its own diminishing budget, the State of North Carolina in July asked all schools within the University of North Carolina (UNC) system—of which FSU is a part—to submit contingency plans for dealing with deep budget cuts that would likely go into effect in the 2020–2021 academic year. Any significant cuts inevitably trickle down to degree programs. So external funding becomes critical to supporting program activities—especially those that enhance students' technical competencies in subjects such as GIS.

When the American Association of Geographers (AAG) started its Bridging the Digital Divide program, which aids students with technology needs during the COVID-19 pandemic, and offered its first round of funding, Ademiluyi was among the geography faculty members to respond. (See "A Starting Point for Bridging the Digital Divide" on page 23 for more on this.) This has enabled Ademiluyi to purchase laptops and adequate GIS software for his students. He wants to do more, though, including support off-campus Wi-Fi access and purchase additional laptops that could be loaned to students who need them each semester. That will require more funding.

The AAG's senior geography researcher Coline Dony caught up with Ademiluyi to talk about FSU's geospatial programs and how they have been affected by COVID-19. The interview that follows has been lightly edited for clarity.

## **Dony (D):** How has your program evolved to incorporate GIS studies?

**Ademiluyi (A):** The geography program began in 1979 and awarded its first baccalaureate degree in 1984. By 2010, facing declining enrollment numbers, a GIS expert was brought in to lead a program overhaul. The purpose was not only to boost the numbers but also to ensure that each graduate acquires career-ready technical competencies upon exiting the program.

Today, 10 years later, the program has three faculty members, including two GIS professionals, and a rapidly growing and highly motivated base of undergraduate majors and geospatial certificate seekers. The undergraduate certificate program in geospatial intelligence is something we added. It is certified by the United States Geospatial Intelligence Foundation (USGIF) and offered in collaboration with two other academic programs: intelligence studies and computer science. We also now offer a minor in geospatial intelligence.

In addition, we established a full-fledged laboratory facility in fall 2010

that's funded by the US National Geospatial-Intelligence Agency (NGA). The NGA also supports faculty development, student stipends, and scholarships.

More than 60 percent of the required courses in our program are now taught using GIS. We plan to introduce courses in drone technology (with equipment funded by the US Department of Defense) and advanced remote sensing technology. This fall, we changed the formal name of the degree program from a BA in geography to a BA in geospatial science to better reflect the courses' strong GIS technology component. Our students still get a well-rounded grounding in geography, though, with required classes such as Principles of Geography and new classes like Spatial Thinking and Data Visualization. This allows them to gain a deeper understanding of fundamental geographic concepts and helps explain geographic processes.

Over the last two years, the program has enjoyed a fourfold increase in enrollment, especially in the certification program. Continuing growth in the degree program itself is expected as soon as these new courses are deployed and accessible to students, wherever they may be.

## **D:** How has the COVID-19 pandemic affected your work as a GIS instructor and your students' ability to learn?

**A:** COVID-19 has dramatically affected overall attendance because of the need to take precautions, given that many students have high-risk family members. Since students learn GIS techniques at different paces, it is extremely difficult to ensure that all students get the proper instruction they need when they are not in class. This lack of instruction can make students stressed and confused, which sometimes results in poor class participation.

Learning GIS techniques is not only about the interaction between instructor and student but also about students' ability to interact with one another. When students cannot attend class in person, they miss out on that valuable interaction time. Students can't help one another as effectively as they could face-to-face. This has led to students being lost when it comes to understanding the material, which can cause them to turn in assignments late or result in an overall dearth of engagement.

## **D:** You have argued for using funds to let students purchase their own laptops rather than borrowing equipment. Why?

**A:** Remote learning has completely altered the concept of loaning school equipment to students for home use. We know that completing GIS tutorials and assignments takes more than the two or

three hours of class time students have each week. We also know that it takes approximately five hours for someone with experience to complete the task. For someone who is new to GIS, it could take longer. Brief equipment loans here and there won't suffice.

Students also must complete tutorials and assignments. They need a computer that's capable of handling the GIS software they use (in many cases, ArcGIS Desktop). With so many of us working from home already, the boundaries of school and home are blurred. Add to this the fact that many FSU students come from low-income families that cannot afford a computer that can handle the GIS software. Being able to own the proper equipment and keep it at all times can help students feel less overwhelmed and better ensures that they can participate in the class and the full program.

Due to strict campus guidelines during COVID-19, our students do not have access to the GIS lab outside classroom hours unless an instructor is present. While students can book these additional lab hours, what works for the instructor might not work for the student. Many of our students have families or are employed outside the university. They do not always have time to show up for additional lab hours, even if those are available. That's another reason student ownership of equipment is so important.

## **D:** If you had more funding, how many laptops would you need to successfully fund the spring 2021 semester, and how would your program go about distributing or loaning out the laptops effectively and efficiently?

**A:** We are grateful to the AAG and Esri for this opportunity to create a laptop rental system in our GIS program. The current program is patterned after our institution's book rental system, though there are some key differences. Each student is guaranteed access to textbooks for all their classes, and books must be returned at the completion of each course. Our current laptop rental system, however, is on more of a need-to-use and when-available basis.

For spring 2021, I would like to enable students to keep the laptops as long as they are enrolled in the degree or certificate program. We can also build in an incentive that would allow students to keep their laptops after graduation. That alone could encourage more students—who might not do so otherwise—to explore our program's offerings, since proficiency in GIS and its applications is seen as such a highly technical enterprise, especially in liberal arts institutions. Such an inducement would not only promote interest in GIS across FSU, but it would also make the program more attractive to a whole new range of talented students.

At Fayetteville State University (FSU), geospatial education is an engaging and high-profile degree program.



# Access to GIS Technology in Education Is Crucial

## The Pandemic Has Exposed the Digital Divide

The American Association of Geographers (AAG) has found that a significant percentage of students in minority-serving institutions—in particular at tribal and historically Black colleges and universities—don't have the powerful equipment necessary to connect to their classrooms. In addition, many of their communities lack reliable cell service coverage. As a result, they may select courses that require few resources. Although this can improve their ability to succeed in their classes, it may derail their career aspirations. These students are most vulnerable and likely to miss out on education.

In response to these issues manifested by COVID-19, the AAG launched a program that offered funding for basic equipment, software, and connectivity to faculty teaching geography to vulnerable students. The organization donated \$238,000 to help serve students across more than 95 geography courses, 41 percent of which are in GIS.

Esri has generously partnered with the AAG to donate additional funds to support students enrolled in GIS courses.

**But we need to do more.** Learn how you can help us connect students to their geography and GIS education.

[aag.org/BridgeTheDivide](https://aag.org/BridgeTheDivide)

*The American Association of Geographers is a nonprofit scientific and educational society. For more than 115 years, the AAG has contributed to the advancement of geography. Geographers focus on the intersection of place, people, and the environment. With more than 12,000 members spanning nearly 100 countries, the primary goal is to share interests in the theory, methods, and practice of geography.*



*"My two introductory courses are the fertile ground for the recruitment of future geographers and geospatial scientists, especially among first-generation college students and people of color. These courses enrolled a combined average of 70 students per semester. COVID-19 exposed the limitations of laboratory infrastructure needed in completing all assignments. Fifty percent finished with an incomplete grade."*

**Dr. Adegoke Ademiluyi**, Department Chairperson, Fayetteville State University

*"Upwards of 95 percent of the tribal communities our college serves have little to no internet capabilities at home. The technology gap represents a very real challenge for the Tohono O'odham Nation and our students. This longstanding social justice issue has historically restricted many Native American students from pursuing a higher education degree. After the switch to distance learning, over half of our GIS students could not complete coursework because of internet connectivity and computing issues at home. These inequities threaten to compound every semester of the pandemic and multiply across hundreds of institutions in the US."*

**Dr. Jason Post**, Director of the GIT Program, Tohono O'odham Community College



# Problem Solver Leads Pandemic Response by the State of Maryland



↑ Julia Fischer

In March 2020, during the early stages of the COVID-19 pandemic, the Maryland Department of Information Technology (DoIT) Geographic Information Office (GIO) deployed an information dashboard to keep Marylanders up-to-date on the most current case statistics and latest information. Julia Fischer set the groundwork and led the deployment of the solution, which has been a resource for millions since then.

As the department's geographic information officer, Fischer's intention has been to supply state leaders and local communities with the knowledge they need to protect residents. She and her team were still working in the office when they built the system, but shortly afterward, they launched the dashboard from home. As of mid-December, the site has had 9.5 million visitors.

"When we launched," said Fischer, "I was sitting downstairs on the sofa and watched it go live." Most of the maintenance was done by Fischer's team. They can easily access the platform from their homes.

The State of Maryland is a showcase for GIS technology. The governor's office, which uses GIS mapping and dashboards developed by GIO, is highly supportive of GIS initiatives, such as the current update of MD IMAP, Maryland's enterprise platform.

GIO makes GIS available to state agencies by managing data, providing training, and developing tools. For instance, the Maryland Statewide Address Initiative collects feature data for street centerlines and local structure points. The office makes aerial imagery available so that 9-1-1 dispatchers have context for answering emergency calls.

"The GIS program in Maryland is well established but demands a lot of commitment to maintain the speed that it's been moving," Fischer explained. "My staff works hard because they are deeply vested in seeing that Marylanders have the highest level of information possible."

"Coming into this leadership role in my late 30s, I still felt like I had a lot to learn," Fischer noted. "My predecessor was a strong support[er] and cleared the way for me even early in my career. So I have always had a good relationship with the executive staff, who trust me. I am grateful they chose me."

Fischer draws inspiration from GIS professionals who work in the trenches, staffing projects and developing initiatives. The state has a GIS person in every county to collaborate on projects, such as the next generation of its 9-1-1 system.

"They show up every day, are passionate and engaged, and do right by the citizens they serve," Fischer said. "They don't get the recognition they deserve. They are doing it right and the best that they can. In my position, I am trying to clear pathways for them."

Fischer is a problem solver, which is what drew her to GIS. Its many tools and methodologies offer an array of problem-solving

capabilities. The potential to change and solve the world's problems gives her purpose. Seeing the impact GIS makes across disciplines—environment, health care, socioeconomic—motivates her.

Fischer said that, as a sophomore in college, she accidentally fell into geography when she had to fill a vacancy in her class schedule. Then she took another class—and another. She was surprised when her adviser told her that she could make this a major, which she did by earning a bachelor of science degree in geography and a master of science degree in GIS.

GIS appealed to Fischer's creative side, and she relishes working on cartographic projects. Because she could marry GIS to her creativity, she found her calling. She also helps others develop their careers and offers advice to GIS leadership.

One of Fischer's maxims is that communication is highly important. Getting into GIS community networks and asking questions are essential to doing the job well. She believes that GIS is an industry filled with kind, collaborative, and compassionate people, who are open to sharing information, rather than competing. At their core, they see that sharing knowledge is for the greater good.

"My predecessor was very involved in the National GIS Council [NGISC]," Fischer said. "He introduced me to everybody and made connections for me. He understood the value of a network and was

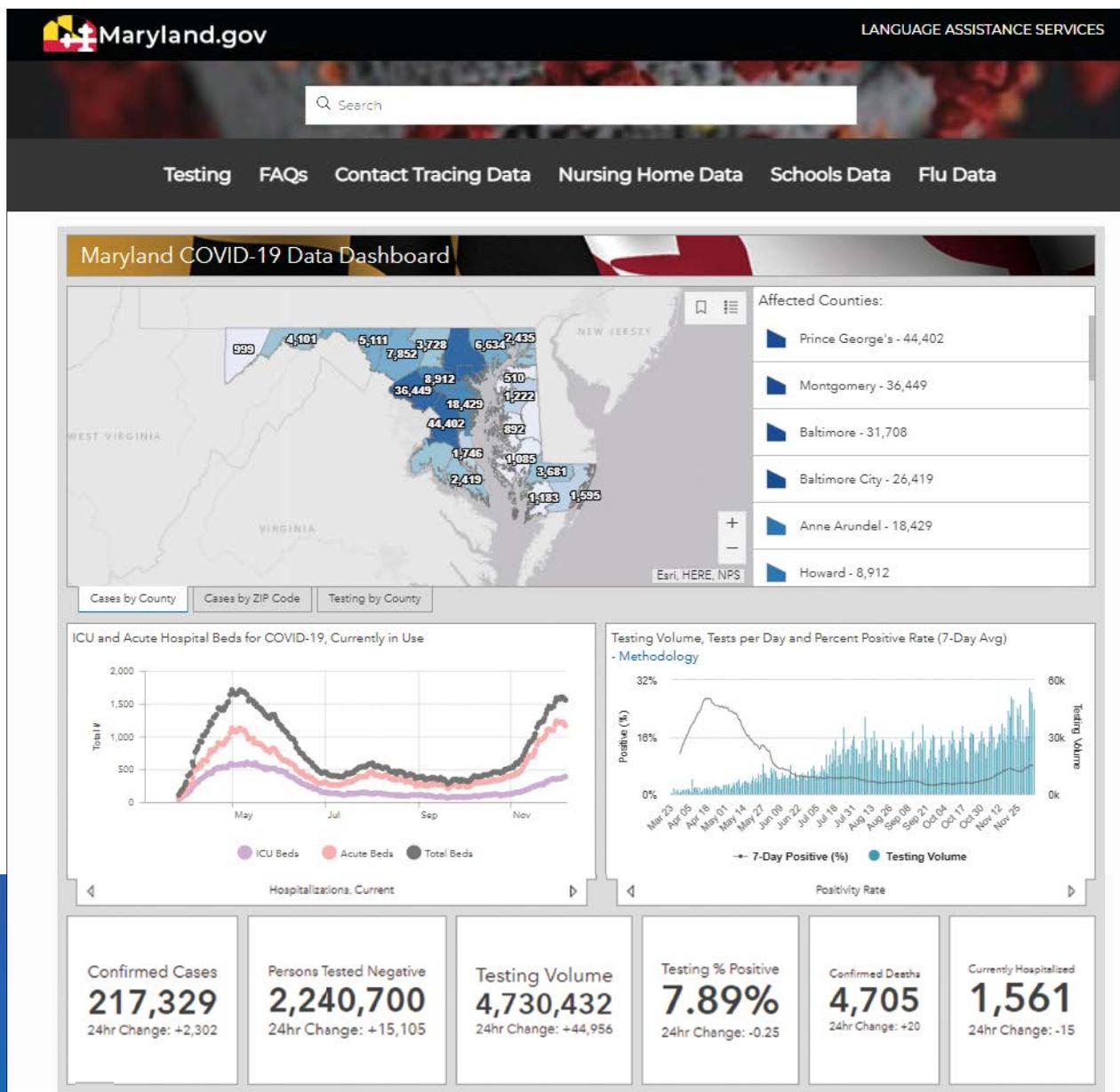
active in helping me develop mine. I am in the chief data officer network, and I also ask our vendors about their network groups. We want to share lessons learned, both mistakes and successes."

Maryland is an open data state. Fischer sees openness as an opportunity to bring the best and brightest together into a bigger pool, from state levels to national levels.

All states deal with the COVID-19 crisis, but each focuses on different aspects of the pandemic. For example, while Michigan's concern has been unemployment, other midwestern states are concerned about keeping supply chains for their produce moving. Maryland is focused on the military and defense, impacts on taxes, and the federal landscape.

Ultimately, states need to look at supply chains, unemployment, and taxes. If they are open, states don't need to invent their own approaches to solve these problems. Through open communication, they can share best practices and create a holistic approach to a nationwide problem.

"My focus is to continue to show the capabilities of GIS," Fischer concluded. "The GIS community's contribution to the industries they serve is not supplemental but a necessity. GIS professionals must become core participants in management and planning. Our industry seems marginalized, but I am looking to the day that it is not."



→ In March 2020, the Maryland Department of Information Technology (DoIT) Geographic Information Office (GIO) deployed an information dashboard to keep Marylanders up-to-date. As of mid-December, the site has had 9.5 million visitors.

# GIS Hero

# Hub Site Gives Road Maintenance Projects More Transparency

Roads are a vital part of a state's economy and keep people, businesses, and important goods and services moving. As such, adequately maintaining roadways is essential.

The Maryland Department of Transportation (MDOT) is dedicated to roadway maintenance and oversees groups that are responsible for planning, designing, and operating the state's infrastructure. This includes the State Highway Administration (SHA), which manages operations such as maintenance, construction, and traffic incident response.

Communicating with the public about ongoing projects like bridge replacements, intersection safety improvements, and bicycle and pedestrian enhancements is a priority for MDOT. To give Maryland residents visibility into current and future roadway projects, MDOT SHA created Project Life Cycle, a website that featured details on projects happening throughout the state. While this was an effective form of communication, the initial site needed an overhaul to improve its usability.

Several SHA teams collaborated using ArcGIS Hub to develop a new site, called Project Portal ([ow.ly/yakR50Cu75C](http://ow.ly/yakR50Cu75C)), which officially launched in 2020. The site is more modern and has improved usability, increased traffic, and streamlined back end processes.

"Our new site, created with ArcGIS Hub, allows our team and local officials to more easily communicate what's going on with roadway projects to our constituents," said Marshall Stevenson, GIS program manager with MDOT SHA. "We're doing a much better job of communicating both publicly and internally."

## A User-Friendly Interface

MDOT SHA's former website was very limited and inflexible. It focused too much on financials and felt more like an internal site than something that would be useful to the public. The site was too difficult to update with new information, and it wasn't even mobile-friendly.

"Our goal was to have an accurate, easy-to-use website to help educate the public about projects that may impact their travel," said Shelley Miller, district community liaison (DCL) for MDOT SHA.

The communications team, which led the project, also wanted a new solution that would allow the six DCLs throughout the state, who enter information about projects into the site, to better manage new and existing project pages. These liaisons, like Miller, wanted a system that was easy to use and allowed for more customization.

Ashley Ross, the Office of Communications Project Portal representative for SHA, chose to use Hub to do the website overhaul because she liked its user-friendly interface and how easy it was to incorporate graphics. Stevenson was on board, too, since he wanted a sustainable solution that even non-technical people could maintain.

Since MDOT SHA was already an Esri user, Stevenson just had to do a simple upgrade to begin using the software. From there, the team developed a template for individual project pages, with the goal of creating a sustainable and easily replicable solution.

Staff training was minimal. Ross made several technical guides, a how-to manual, and smaller documents for specific tasks such as uploading images. She also conducted hands-on group sessions for DCLs at MDOT's regional offices, as well as some virtual trainings to introduce the group to the system and answer questions.

The communications team began creating new project pages for Project Portal in fall 2019, and the final site launched in January 2020. It includes the landing page, a page

with a full list of projects, and 100 individual project pages. An events calendar and a map interface shows all projects grouped together according to their MDOT SHA district and individual counties. Each project page contains the latest project updates and relevant SHA contact information. Users can also enter an address into the site and explore projects happening nearby.

"Our Project Portal feature contains lots of information about these projects, including the status, pictures, and videos, and ways to get your questions answered by an expert," said David Abrams, deputy director for media relations in the SHA Office of Communications. "This feature allows us to keep the public informed."

## Positive Feedback All Around

After being in use for a full construction season in Maryland, Project Portal has received overwhelmingly positive feedback from both staff members and the public.

The use of Hub has improved back end operations at MDOT SHA by streamlining editing and web page creation. It has been easy for nontechnical employees to edit content, update photos and videos, and tailor pages specifically to what each district needs, according to Stevenson.

"Having this system in place that is not dependent on any other system [helps us] change things more easily. Someone can go in there and make an edit and be done," he said. "This [has] enabled us to add graphics, videos, and maps...that the site really didn't have before, making it a more user-friendly experience."

Instead of taking days, like it used to, to add project information to a web page, DCLs can update project information and have it published within an hour. Staff members can even add new details about a project using their phones, tablets, or laptops.

"Working with a project manager," said Stevenson, "staff can quickly and easily just go in there and make [a] change themselves."

The templates included with Hub have also improved consistency across pages. And Hub gives MDOT SHA the flexibility it was looking for when it comes to, say, sharing monthly reports.

"Hub allows us to add monthly updates, easy-to-use contact information, and many other important pieces of information for internal and external use while presenting it in a very streamlined, professional, and modern look," said Miller. "I really love the change using this program made in what we present to the public."

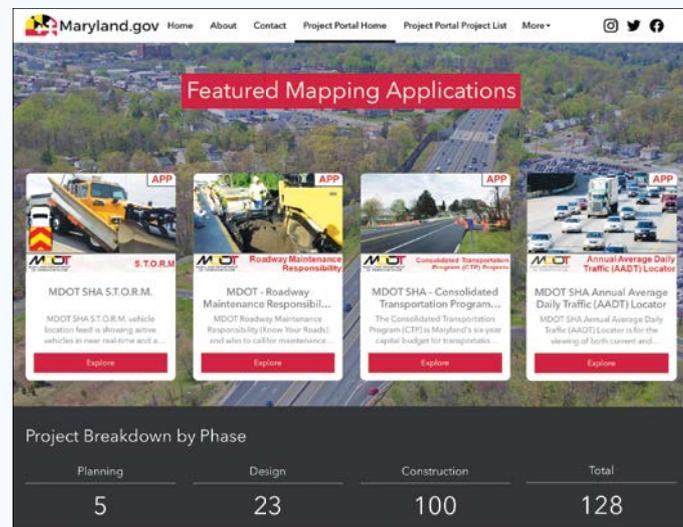
Stevenson said he has observed increased communication between the DCLs and project managers, thanks to the new portal. He attributes this to DCLs being able to update pages more often and, therefore, engaging in more one-on-one contact with project managers. DCLs are now becoming more knowledgeable about the projects in their areas, he said.

The mobile-friendly site has been a hit with Marylanders, too, which is MDOT SHA's top priority. In October alone, more than 2,700 users visited Project Portal, 18 percent of whom were returnees to the website. Everyone, including commuters, business owners, and students, seems to enjoy using it.

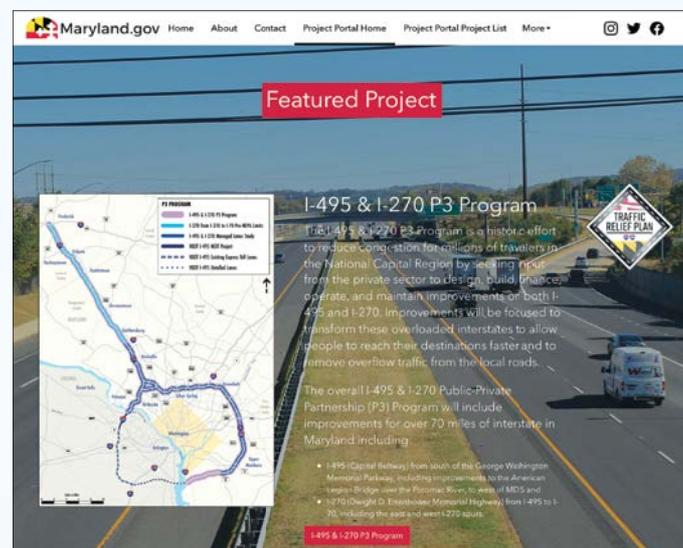
Ross stressed that getting this information disseminated builds trust between the public and MDOT.

Abrams echoed that sentiment, adding that the hub site makes it simple for customers to locate information about projects in their neighborhoods.

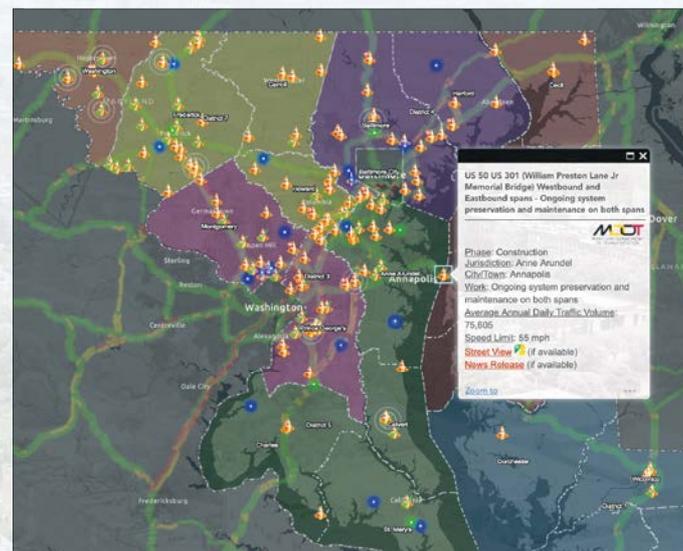
"We have received positive feedback from our customers, our contractors, and also senior managers at MDOT SHA," Abrams said. "They view the Project Portal as a resource that fits their individual needs to get timely information about our construction projects."



↑ Staff members like the streamlined, professional, and modern look that ArcGIS Hub gives to Project Portal.



↑ Hub makes it easy for nontechnical employees to edit content, update photos and videos, and customize project pages.



↑ A map shows all the roadway projects underway throughout Maryland.

# Esri Partners Attend to Immediate Needs and Get Long-Term Results

When government organizations needed to monitor resources during the COVID-19 pandemic, an Esri partner specializing in artificial intelligence (AI) stepped up to help. When a parks district was looking to repair and better maintain a large lakefront area, an Esri partner made the project less daunting. When a water district needed to upgrade its GIS, an Esri partner managed the whole project. Read on to find out more about each project—and keep in mind that this is just a small sample of what organizations in the Esri Partner Network can do.



## AI Helps Stem the Tide of COVID-19

Over the course of the last year, most technology, research, and analytics companies around the world turned their attention to helping stem the tide of COVID-19. **Geospark Analytics** (geospark.io), based in Herndon, Virginia, did the same, but with a focus on AI.

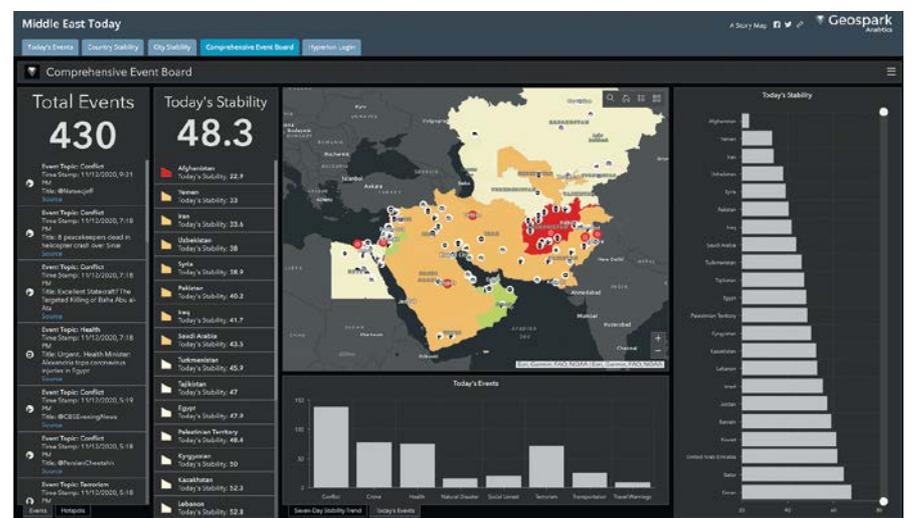
In April 2020, a number of federal and military organizations in the United States contacted Geospark Analytics to inquire whether its AI algorithms could be used to assess the impact of COVID-19 on the US health-care system. To see, Geospark Analytics turned to its Hyperion AI engine—specifically, the Health Events model—and began identifying, tracking, and analyzing COVID-19 events. The data in this model includes information from news sources and social media.

The team at Geospark Analytics employed a combination of the Hyperion platform's API and ArcGIS Online to develop streaming feature services that it released to the public through Esri's COVID-19 GIS Hub (go.esri.com/coronavirus). It also developed a dashboard (ow.ly/jHFF50Cjn0Y) to track global COVID-19 reporting. Armed with this information, the organizations that originally were contacted by Geospark Analytics have been able to assess the virus's effects on local hospital systems and better focus their relief efforts.

After conducting this initial project, Geospark Analytics fine-tuned its Hyperion AI engine to produce a county-level, seven-day forecast of the potential impacts of COVID-19. The model accounts for factors such as a county's total population; population density; the number of at-risk people; the availability of intensive care unit (ICU) beds; stresses on local hospitals and ICU systems; and confirmed COVID-19 cases, deaths, and recovery rates. These AI models are available to first responder organizations as feature layers and as a series of Esri technology-based dashboards. The layers and the dashboards have been accessed more than four million times.

"These assessments are not just dots on a map," said Geospark Analytics COO John Goolgasian. "This is actionable information."

In expanding its work on COVID-19, Geospark Analytics has integrated its data, three of the AI models on the Hyperion platform (Events, Hotspots, and Pulse), and its ArcGIS Online feature layers into other environments. This is allowing its federal and defense clients to better assess other issues, too, ranging from hurricane response to transnational organized crime.



↑ Geospark Analytics has integrated its data, AI models, and ArcGIS Online feature layers into other environments.

← Geospark Analytics also produced a county-level, seven-day forecast of the potential impacts of COVID-19.



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## Developing a Long-Term Shoreline Resilience Plan

In Chicago, Illinois, the lakefront along Lake Michigan—which is composed of approximately 26 miles of shoreline—is dedicated almost entirely to public recreation, with 18 miles of trails and 29 beaches. Recent historically high lake levels and the potential for repetitive severe storm damage, however, have presented a unique set of risks for this city jewel.

The Chicago Park District, which owns, maintains, and manages the majority of the lakefront, is developing a long-term plan to help guide investment in lakefront repair and maintenance and increase the area's resilience. What's more, it is hoping to parlay this into future partnerships with other agencies.

To help implement the plan, the park district worked with **Urban GIS** (urbangis.com) and shoreline engineering expert SmithGroup.

First, the team prepared a GIS inventory and condition assessment of the shoreline's protection features. Then it built a GIS repository of shoreline parcels and park boundaries, plus adjacent land-use information. The team leveraged ArcGIS Pro to perform various spatial analyses that showed decision-makers all the park district's assets, along with their conditions, relative distances, and priority indexes. The project team was also able to incorporate and digitize historical jurisdictional and infrastructure information from raster data sources going back to the 1800s.

From there, the team configured an internal ArcGIS Online site to enable decision-makers to visualize and query data in a dynamic, user-friendly interface. This allows city planners, engineers, and attorneys to analyze complex operational, programmatic, and land-use questions through spatially enabled decision tools and dashboards. The team also set up an ArcGIS Urban model to perform ongoing analyses of capital improvement and proposed development scenarios.

As a result of this project, the park district was able to address some of the higher-risk portions of the lakefront by adding significant parkland,



↑ ArcGIS Urban was used to inventory and assess the shoreline's protection features and build a GIS repository of parcels, park boundaries, and adjacent land-use information.

creating new recreational opportunities and amenities, and enhancing ecological resources. With the city's new tools and augmented location intelligence, the Chicago Park District has entered a new era of operational efficiency and effectiveness.

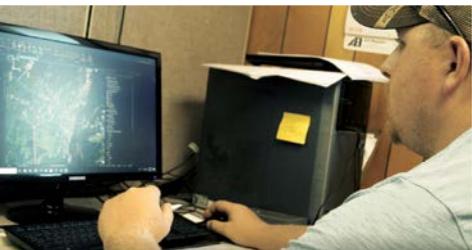
## A Water District Upgrades Its GIS—and None Too Soon

Hallowell Water District (HWD), established in 1921, provides water to the city of Hallowell, Maine. To meet the needs of 884 residents, 109 businesses, and 17 government agencies, the district uses between 200,000 and 250,000 gallons of water per day.

While HWD had a legacy GIS technology implementation—ArcGIS Desktop 10.3—the district didn't use it very frequently. It wasn't set up to meet HWD's current needs, including sharing data across agencies. So HWD set out to bring its GIS up-to-date.

To get this process started, neighboring Gardiner Water District introduced HWD superintendent Zach Lovely to **Honey Badger Analytics** (honeybadgeranalytics.com) in 2019. As a first step, Honey Badger Analytics conducted a quick capability review of HWD's systems and discovered that the water district was using less than 10 percent of what its GIS and data had to offer. From there, the goals were to bring HWD's GIS up to current standards, improve the district's overall experience with GIS, and give HWD access to the features and results it needed.

← By migrating HWD's prior work to ArcGIS Pro and ArcGIS Online, Honey Badger Analytics made the district's GIS accessible from anywhere.



↑ Honey Badger Analytics implemented ArcGIS Collector for Hallowell Water District (HWD).

Honey Badger Analytics implemented ArcGIS Pro and ArcGIS Online as the foundation of HWD's new system. By migrating the district's prior work in ArcGIS Desktop 10.3 to ArcGIS Pro and ArcGIS Online, Honey Badger Analytics made HWD's GIS accessible from anywhere. The Esri partner also used ArcGIS Hub to update HWD's web pages, implemented ArcGIS Collector for data collection, and deployed two additional ArcGIS solutions for reporting leaks and making notes on maps.

For HWD, Collector has made gathering and updating data simple, efficient, and effective. The cost savings alone of being able to collect and maintain data in the field, instead of doing annual data updates, is significant: the water district estimates that it has saved more than \$10,000 annually in these operations. Enabling HWD's only mobile worker to use the app right on his phone costs just about 33 cents per hour. What's more, he has access to the app 24 hours a day instead just during his 8-hour workday, which is helpful for emergencies.

In addition to improving processes and saving on costs, HWD's new ArcGIS implementation has resulted in other, unforeseen returns on investment (ROIs). For example, not two weeks after the new system was up and running, there was a large house fire in HWD's area of responsibility that led to the blowout of a 12-inch water main close to the supply tank. Within 10 minutes, Lovely was able to use Collector to get the affected water valves closed. If this had occurred prior to the implementation, Lovely would have had to go to the office (a 20-minute drive one way) to find the location of the valves, an in-line pump would have been lost, water from the hydrants wouldn't have been available to fight the fire, and customers within range of the supply tank would have experienced disrupted water service for a significant amount of time.

Another unforeseen benefit of modernizing HWD's ArcGIS implementation is that the district can now share data with its sister district in Gardiner. Now, when the two organizations work together on projects or if one of them needs extra coverage, the teams can view assets for both districts and communicate immediately. So two water districts can work together as one, even though they're each using their own ArcGIS Online setups.

For his part, Lovely is glad to have an efficient and effective GIS at HWD—and is happy to be setting the pace on finally using it.

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

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# Land Management Gets a New Look with Mobile Map Annotation App

Spring Creek Outdoors, LLC, is a 15-year-old wildlife and habitat consulting company based in Texas. Its offerings include conducting wildlife population assessments, making harvest recommendations, hosting seminars, and doing appraisals, but its true focus is on education. When the company first began employing ArcGIS technology in 2017, for instance, it used the software to create visualizations that helped teach landowners and land managers how to better understand their properties, as well as how to provide the support their lands needed to thrive.

For many of its clients, Spring Creek Outdoors revolutionized how they got their properties

inspected. This used to entail hiring a helicopter to perform in-person aerial assessments, but the cost and logistics of that were out of reach for many property owners. So the company came up with an effective solution: GIS-enhanced aerial drone imagery. This worked well for clients and even made aerial surveys a possibility for a wider range of landowners. But eventually, Spring Creek Outdoors wanted to learn more about how to apply location intelligence to the challenges landowners face.

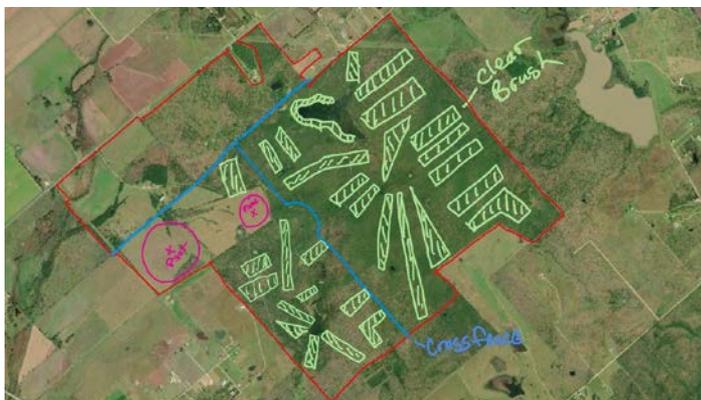
“Shortly after we began using GIS in our business, we attended a short course on GIS for ranchers and had our eyes opened to the range

of ways ArcGIS could be used beyond providing an overview of a property,” said Cathy Ledbetter, vice president at Spring Creek Outdoors. “We came back to the office and went right to work on finding ways to enhance our services by using GIS software.”

The company wanted to make the aerial survey data more versatile and useful for its clients. So Ledbetter and her team set out to find a user-friendly way to access maps in the field and annotate them on the spot with quick sketches and notes. Esri partner Bluefield GIS (bluefieldgis.com)—a 2020 graduate of the Esri Startup Program—had the answer.



↑ It took Spring Creek Outdoors’ chief biologist less than an hour to learn how to use Draw Maps for ArcGIS.



↑ On a tablet or mobile phone, users can employ virtual colored pencils, pens, and highlighters to make sketches and notes right on the map.



↑ The final output is a solid, GPS-based document that contractors can use to implement the planned project.

## Bringing a Biologist’s Vision to Life

Spring Creek Outdoors really discovered how helpful Draw Maps could be when a new client arrived with approximately 1,200 acres of wild land to survey and restore.

First, Spring Creek Outdoors’ biologist used the aerial imagery to make adjustments to the property boundaries, which were taken from a fragmented paper map. Then he used Draw Maps to sketch in the areas that needed to be cleared of overgrown brush and restored to native grassland. After that, he drew in areas to be irrigated to encourage native growth and sketched out where to put partition fencing to divide the types of wildlife that would be managed separately. The landowner and contractors were able to use the resultant maps to visualize and plan out the recommended work.

“An experienced wildlife biologist can stand on a high spot on a property and visualize exactly what needs to be done and what the finished project will look like, but the average landowner has a harder time seeing that in their mind’s eye,” said Ledbetter.

Draw Maps for ArcGIS enables biologists to share their vision with clients. Additionally, the app provides a polished way for the team to make notes and draw directly onto aerial maps while still in the field, yielding solutions that are faster and more accurate than ever before. And after all that, with ongoing help from Spring Creek Outdoors, clients can continue to change and refine the maps, making them into a solid GPS-based document that contractors can use to execute the planned project with precision.

Ledbetter said that the simplicity of Draw Maps is a major advantage because it is easy for employees to learn and use. “Our chief biologist is more interested in animals than technology, but he learned to use the iPad, Apple Pencil, and Draw Maps within an hour. He took it on a job the next day and was able to produce his first map while making it look like he’d been doing it for years.”

For more information on how Spring Creek Outdoors uses GIS and Bluefield GIS Draw Maps for ArcGIS, email [SpringCreekOutdoorsLLC@gmail.com](mailto:SpringCreekOutdoorsLLC@gmail.com) or call 325-623-5464.

## Seamlessly Annotating Maps On-Site

Bluefield GIS was founded in 2017 in Charlotte, North Carolina, with the goal of developing innovative, easy-to-use mobile mapping apps for GIS users. Its Draw Maps for ArcGIS is a mobile mapping app that allows users to employ virtual colored pencils, pens, and highlighters to make sketches and notes right on a map using a tablet or mobile phone.

When Spring Creek Outdoors started working with Draw Maps, team members were pleased to see that the app allows them to choose a surveyed area of interest—called a Collaboration—and load it into their mobile devices. From there, they can discuss the map with their clients and annotate it using the drawing tools of their choice. The resultant sketches are immediately transferred to ArcGIS Online, where staff back at the office can follow the field crew in real time and start working on the clients’ issues right away—even while the surveys are still under way.

“Draw Maps provided exactly what I had been wishing for,” said Ledbetter. “Our clients have been very excited about Draw Maps and always ask if they can have a copy of the annotated map.”

Fortunately, Draw Maps makes it easy for Spring Creek Outdoors to share marked-up maps as well. Field crews can share documents with clients using AirDrop, text, or email. Clients can open documents in the consumer version of Draw Maps and continue editing them on their own devices.

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# Patterns of Resistance to Technological Change and How to Transcend Them

By Ellen West Nodwell, IntegraShare Dimensions, Inc.

Having worked in GIS since the early 1990s, I have grown up alongside the increased popularization of geospatial technology. Retrospectively, I can see that in spite of the extensive evolution this field has undergone, certain patterns of resistance to technological change persist. Why?

Despite GIS becoming more ubiquitous and familiar, like other evolving technologies, it has also gotten more complex. For those who are not technologists, this complexity can be intimidating—and they tend to react accordingly.

After several decades of implementing, supporting, and leading geospatial technology implementations at all sorts of organizations, I have seen six distinct patterns of resistance emerge consistently. Let's explore them and see what we can do about them.

## The Fear Factor

When people first encounter geospatial technology, they often think, "This is beyond me." They then avoid GIS or push back if they're asked to use it. But is GIS the threat, or does the threat revolve around the fact that it is new or different? Likely, it's the latter.

This fear-based reaction is fairly common. People are afraid that they won't be able to understand or use the new technology. They worry that, if they fail, they will expose their lack of knowledge or, worse, become irrelevant at work and lose their jobs. So they balk at, avoid, or altogether reject this new information product.

Those who dismiss GIS as being too complicated may also react by guarding their turf. This can further frustrate the implementation process.

What's the solution, then? Engage with these people early in the change process. Start with relatable concepts, and build clear examples that are meaningful to them. Help them learn by taking time at the outset to empower them to succeed with GIS.

## Communication

A GIS implementation can be disruptive. Phrases such as, "We've always done it this way," or "If it ain't broke, don't fix it," pop up a lot. Uncoordinated, confusing, or conflicting communication can impede GIS adoption.

So how can an organization avoid this? By coming up with a well-orchestrated communication plan that leaves time for people to adjust to the new technology and contains built-in messaging that focuses on the value of the people who will be affected by it. Engage stakeholders early, and make any and all communication simple. Drastic change, especially, requires lengthier notice and robust internal marketing.

Enlist existing GIS users to help lead the change across the organization as well. Have them mentor new users, fostering shared ownership of the technology. Building a community and encouraging continual collaboration among its members are critical to successful GIS implementations.

## Misunderstanding GIS

Simply trying to answer the question, What is GIS? is tricky. Just search that online. Explanations move into complex information technology concepts pretty quickly.

ArcGIS StoryMaps apps are useful for this, since they show off GIS and how maps can be used to tell stories or

illustrate concepts. Dashboards that integrate maps and other media are also helpful for demonstrating how GIS works in less obvious ways. Just be sure to explain how GIS makes these kinds of visualizations possible.

## Metadata (or the Lack Thereof)

In GIS, it's important to know the details about the data—i.e., metadata. Yet it's common to see cryptic attribute headers, undefined units of measurement, and no details about scale. Too often, people neglect metadata in their published geospatial layers, but this makes the data less trustworthy.

Completing metadata is not the fun part of GIS, but it's critical for data integrity. With open data in particular, consumers need to know the pedigree and quality of the data, how to best use it, any constraints on its use, and other data facts.

Like the nutrition data found on packaged food products, it's important to show data's ingredients and how fresh it is. Geodetic information is critically important. How typical is it to come across data that hasn't been properly spatially referenced?

GIS professionals need to evangelize data quality by posting metadata when they publish their own data. Additionally, GIS leaders need to implement clear data integrity and technology standards and engage with people throughout the organization to spread awareness about the hazards of poor geospatial data quality.

## Disconnects with Users

As geospatial data processing, analysis, and visualization evolve, many attractive software interfaces continue to emerge. But some of these are complicated to operate, expensive to maintain, and poorly documented. Too many go untested, causing users to get frustrated and ditch the tools.

In implementing geospatial technology for the first time or at a larger scale, organizations need to focus on users' needs ahead of the software itself. Think first of the business problem users need to solve and then create a checklist to screen software candidates. The winner should answer the question, What are we trying to achieve? This will help GIS practitioners and managers facilitate the best interfaces and the right data inputs to help users gain insight rather than get frustrated.

## Poor Human Response to Structure

Some people detest process-driven workflows. This occurs because of several reasons: distraction; boredom; and lack of supervision, discipline, or incentives for follow-through. These points of failure can decrease the overall value of solutions. But those who operate within a GIS framework need to be reliable and willing to stick with it, even when they are bored with routine.

For example, parcel management requires steady adherence to process-driven workflows. Many people and organizations, from taxpayers to tax authorities, depend on this critical information. If parcel managers don't follow specific processes, errors are more likely to crop up, and that can be costly to all stakeholders.

Organizations can build into structured workflows, checkpoints for monitoring data quality metrics to enable leaders and supervisors to evaluate the effectiveness of workflows and the integrity of data over time.

## Opportunities for Positive Change

These six patterns of resistance to adopting geospatial technology can present organizations with difficult challenges. But they also engender opportunities for positive change. Awareness is the first step.

It is important to set goals and collaborate closely with stakeholders. Be a partner first and a geospatial services manager second, exerting the strong customer engagement skills required to build community and keep people interested in using geospatial apps with their data. Empower people to employ the technology to solve their problems and gain the deeper insight that only the spatial dimension provides. Encourage people to consider the inherent value that geospatial tools and data bring to solving location-based problems. Help people learn how to use the technology to meet their needs and grow within it. Listen and be a trusted adviser.

Through good leadership and strong partnerships, we can learn from one another, whether in our own geospatial communities or from the spectrum of geospatial practitioners across verticals and around the world.

## About the Author

Ellen West Nodwell, GISP, leads IntegraShare Dimensions, Inc., a GIS services company. She grew up in a family of mappers and came to GIS after doing manual analysis and mapping for more than 15 years. Nodwell has supported GIS users, administered GIS data, and managed a global GIS group. She became a GIS consultant in 2013 and founded IntegraShare Dimensions in 2016. Nodwell is engaged in several geospatial-oriented nonprofit efforts as well.

## Managing GIS

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



# IN NORTHERN CANADA, WINTER TIMBER OPERATIONS GO DIGITAL

Headquartered in British Columbia, Canada, Tolko Industries is a leading manufacturer of lumber and sustainable wood products. At its operations facility in High Level, Alberta, the annual harvest season runs from November to March. During this time, Tolko and its contractors harvest the volumes of timber its sawmill processes for the remainder of the year.

Tolko woodlands operations supervisor Michael Morgan is always looking for new technology to help the team increase productivity and meet demand for raw logs at mills.

“Anytime we see the market introduce new technology, we assess if there are opportunities to make our company more competitive and productive,” Morgan said.

For 20 years, this open-mindedness has driven Tolko to innovate with geospatial technology.

## A Challenging Mapping Environment

Within the province of Alberta, Tolko operates mostly on Crown (public) land. Prior to the start of the winter harvest season, Tolko staff members complete and submit a series of Forest Harvest Plans (FHPs) for provincial government approval. The FHPs must include maps of the proposed cutblock boundaries—the area in which they’ll harvest the timber—complete with an inventory of topographic features, such as roads, waterways, pipelines, and potential wildlife sites.

Before the FHPs are generated, mobile crews verify each boundary and topographic feature within the proposed cutblocks and confirm any

required protection buffers. But creating highly accurate maps under a tree canopy can be particularly challenging in northern Canada.

In the early days of GPS, when Tolko first started mapping boundaries, its legacy, all-in-one GPS receivers could take hours to acquire and lock onto four satellites, the minimum number for the required level of accuracy. Even with enough satellites available, dense canopy made some signals unusable, resulting in downtime and productivity losses.

“In the field, our staff would spend a significant amount of time waiting for a reliable position from the GPS receivers available at the time,” Morgan said. “Additionally, there was significant postprocessing of the data in the office to get it into a deliverable format to be integrated into the development of the FHPs.”

If the data was reliable, Morgan could apply the required buffers in ArcGIS Desktop and submit the plans for approval. If not, the crews had to do more work.

At the same time, Tolko’s mobile staff had a second job: to mark, or flag, the cutblock boundaries by tying brightly colored ribbons around trees. But the ribbons posed their own challenges. For some operations, the flags need to remain visible for several years, yet wildlife often chew them off. In northern Canada, they can easily get covered by snow. If an operator misses any of these flags and crosses a boundary or protective buffer, there could be environmental damage.

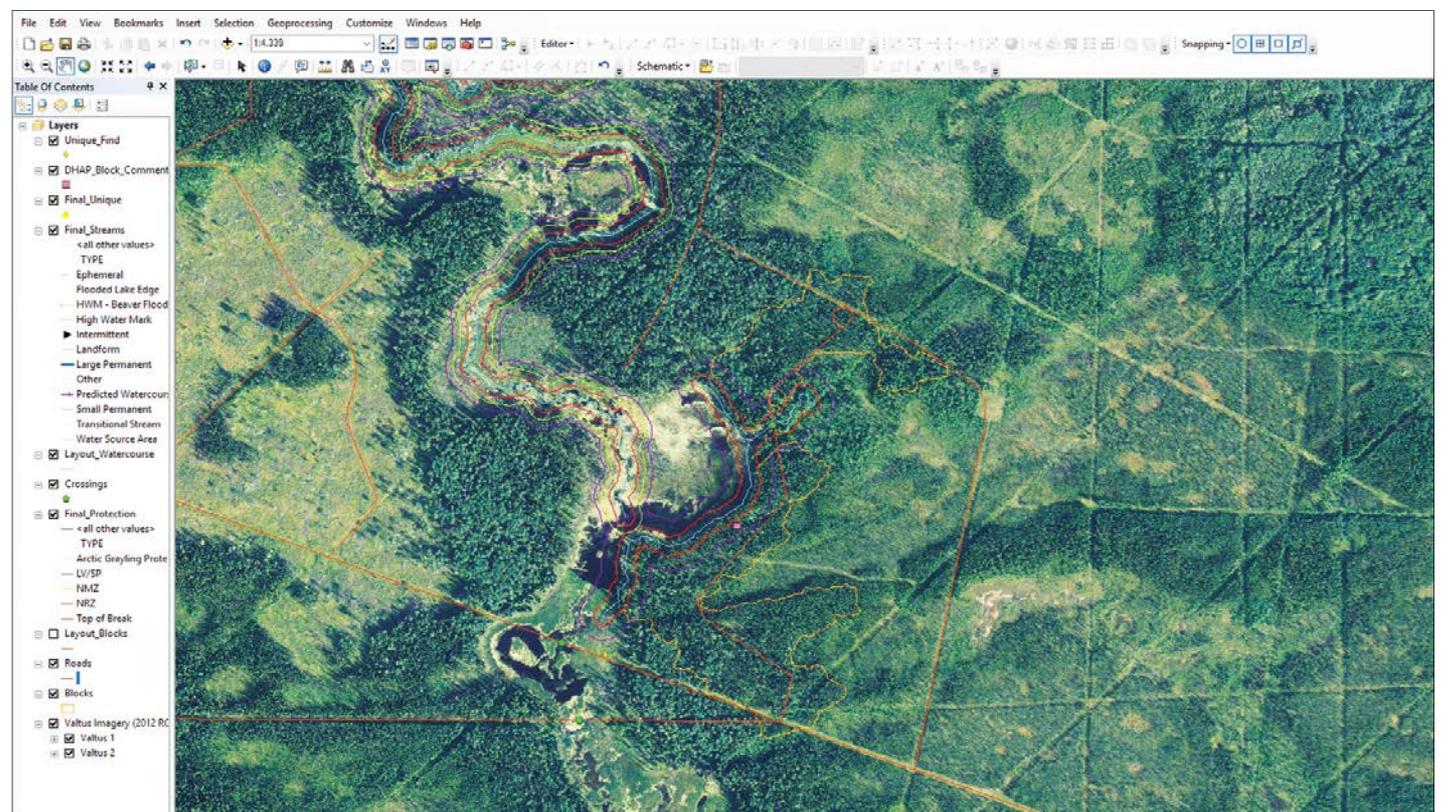
“We could avoid a number of the operational challenges and increase operational efficiency by going digital,” Morgan said.

## New Technology Increases Productivity

About five years ago, as part of a continual improvement initiative, Tolko presented the government with a business case to update its mapping technology. The company’s proposal included a combination of Web GIS based on ArcGIS software; highly accurate GPS data collection; and real-time data sharing of boundaries, topographic features, and buffers. With this digital mapping solution, Tolko could accurately map all protected demarcations while increasing productivity.

The proposal was accepted, and Tolko began looking for its real-time, handheld, digital mapping solution.

First, the company wanted to replace its GPS receivers. The new data collection system needed to have a larger screen with good overall visibility. After trying out a variety of devices over



↑ A completed map shows permanent buffers in red (which indicate a watercourse and roads) where timber can’t be harvested, and a dark purple buffers show where operations will be reduced to minimize ground disturbance.

↓ Mobile crews use geospatial technology to verify the locations of protected topographic features, such as this watercourse.

several seasons, Tolko decided that a combination of iPads and iPhones worked best, particularly thanks to the battery life that facilitates longer shifts during the limited seasonal windows.

To improve the iOS devices' accuracy, Tolko tested a number of GPS receivers. Ultimately, the company selected the Arrow 100 GNSS receiver from Esri partner Eos Positioning Systems because it performed best in the challenging operating environment. Particularly important was the Arrow 100's support of all four current Global Navigation Satellite System (GNSS) constellations, including the Russians' GLONASS constellation. The increased number of usable satellites available under canopy helped greatly boost Tolko's productivity and location reliability at higher northern latitudes.

"The Arrow 100 gains access to far more satellites by supporting all four constellations, which means higher accuracy and reduced downtime," Morgan said. "For us, being a remote northern community where GPS satellites are a bit less visible, supporting a constellation like GLONASS was already a huge improvement."

Being a heavy Esri software user, Tolko selected ArcGIS Collector as its app of choice for real-time data collection. The app not only eliminated manual data transfers to and from the field but also allowed Morgan to more rapidly verify the quality of the data being collected than his previous import/export workflow did. Because much of Tolko's work takes place in areas without cellular coverage, mobile technicians perform their tasks in offline mode and then sync the Collector data with ArcGIS Enterprise at the end of each day.



↑ To do real-time data collection in the field, Tolko now uses ArcGIS Collector. Its offline mode is very helpful in areas without cell service coverage.



↑ Prior to switching to a digital operation, mobile workers marked cutblock boundaries by tying ribbons around trees.

Having the data in the cloud also allows Tolko to easily share its approved maps with logging contractors, which means the company no longer needed to flag cutblock boundaries with ribbons.

"Prior to the approval of the current process, we would have had to hang ribbons everywhere in the block," Morgan said. "We can use highly accurate digital maps and modern GNSS technology to ID these same features."

The company equipped its heavy tree harvesting machinery, called feller bunchers, with Op Tracker, a mapping system that is compatible with ArcGIS Online and made by Esri partner Lim Geomatics. Because Op Tracker is built on Esri technology, Morgan can send the FHPs directly from the office to mobile workers in the field. Inside the logging machines, operators use Op Tracker's mapping interface to navigate while the app simultaneously collects productivity data in the background.

Each machine is also equipped with an Arrow 100 GNSS receiver that the operators use to see their positions in real time in Op Tracker. In the cab, operators just have to glance at a screen to monitor where they are in relation to identified features and associated protection buffers—all without the need for physical ribbons and paper maps.

This real-time navigation system is particularly vital during December and January, when harvesting operations occur 24 hours a day, in two shifts, with very few hours of daylight. Geospatial technology essentially becomes the harvesters' eyes, guiding them through the darkness.

"The operators know exactly where they are," Morgan said. "This has increased our productivity quite significantly over the past five years."

The operators also use this navigation system on other machinery, called skidders, to transport harvested timber to roadside landings, where it's picked up by trucks and sent to the mill. Increasing efficiency in all phases of the operation is key to Tolko's success in such a short harvesting season.

"For us to gain the operators' buy-in initially on all of this technology, we had to show them the increased productivity," Morgan said. "Now, I don't think you could take this system away from them."

#### Transformed Forestry Operations

Printing enough ribbons to demarcate the current expanse of Tolko's seasonal harvest would cost hundreds of thousands of dollars per year, according to standard printing estimates. By going digital, Tolko has eliminated this expense.

"Having our boundaries and features mapped digitally is a huge cost savings," Morgan said. "With the high-accuracy Eos Arrow GNSS and the flexibility of the Esri products, we are now able to take our business to the next level of efficiency."

Tolko no longer alters natural wildlife environments with flagging, either. And the company's steadfast commitment to innovation has allowed it to forge new paths in efficient harvesting operations. As the demand for lumber increases, according to industry-standard price tracking, Tolko is right there, surging its production.

What's more, the company's quest for innovation persists. Tolko continually interprets analytics from Op Tracker throughout the harvest season. This data helps both Tolko and its contractors identify opportunities for even more improvement. It also provides insight into how to further optimize operations, such as determining which machines are better suited for specific types of timber or terrain.

"All of this technology has helped us maximize our efficiency in the short operating season," Morgan said. "The upgrade to a geospatially smart system has transformed our forestry operations and opened the door for even more innovation."

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# The Relevance of Cartography

## A Cartographer's Perspective

By Tim Trainor  
President, International Cartographic Association



# Stay the Course, and Seize the Moment

Everyone's life has been altered in some way as we all grapple with the impacts of the COVID-19 pandemic. The International Cartographic Association (ICA)—like most professional organizations around the world—has also been affected. In the challenging times we're experiencing, it's important to establish routines that give us a sense of balance. Staying the course wherever possible can help us feel a sense of normalcy.

To that extent, the ICA program continues through the various outlets of participation available to those interested in cartography and geographic information science (GIScience). The ICA's commissions and working groups persist in their efforts to advance many diverse topics. And cartographic research and professional practice continue via remote locations—often at home—and are reported through the ICA's many communication channels, including the *International Journal of Cartography*, *ICA News*, *eCARTO News*, and the ICA website.

One area that has been significantly altered by COVID-19 is the opportunity to meet in person with colleagues from far reaches of the globe. Special moments of engaging in conversation; sharing a meal; having a coffee; and listening to interesting ideas, thoughts, developments, and experiences are a tragic loss. For the ICA, this means that conferences, commission meetings, and workshops have been greatly impacted. In a few areas around the world where authorities have been highly effective in managing the virus, local events have taken place—and this offers a road map for future behavior during the pandemic.

A flagship event for the ICA is the International Cartographic Conference (ICC), which is held every two years in a different location. The next ICC

is planned for Florence, Italy, later this year. The Italian Cartographic Society and the Florence Local Organizing Committee have worked tirelessly to plan, monitor, and adjust the event, though we are still not sure what the coming months will look like. At the end of 2020, as scientists predicted, COVID-19 cases were rising in many parts of the world, and everyone needed to take precautions to prevent further spread of the virus. Within that reality, the ICA deemed that the original plan of meeting in July was too risky. Based on suggestions by Italian officials and an evaluation done by the ICA Executive Committee, ICC 2021 has, for now, been delayed until December 13–17, 2021, but will still take place in Florence. For more current information, it's best to periodically check the ICA website.

With every challenge comes opportunities. So we should all seize the moment and figure out how we can expand our options for advancing cartography and GIScience right now. COVID-19 has proven that location information is critical for managing every aspect of the virus's impacts, from its effects on public health to widespread economic consequences. Maps are helping people understand so many aspects of the pandemic. They inform us of cases, trends, and repercussions and can guide good decision-making when it comes to monitoring, controlling, and preventing outbreaks and taking corrective actions. Looking toward the future, new opportunities will come about where cartography can play an important role.

Along this journey, the ICA commission chairs met virtually in late October to share their recent achievements and plans for upcoming events. Now that we are limited to a virtual world, ICA commissions are testing and using different

technologies to advance their programs. One outcome of that session was to schedule monthly webinars, available to everyone, on topics related to each commission's theme. Again, visit the ICA website for details on these events.

Another mainstay of the ICA is the Barbara Petchenik Children's World Map Drawing Competition, a biennial map drawing contest that encourages children in different age groups to create their own representation of some aspect of the world in graphic form. The ICA created this as a memorial to Barbara Petchenik, a cartographer and past vice president of the ICA who maintained an enduring interest in maps for children. This year, the theme is A Map of My Future World—a topic that was selected based on suggestions from 17 countries. There are no significant rule changes for the competition in 2021, and participants have until September 1 to submit their maps. We encourage all ICA national members to participate. Find more details about this at [icaci.org/petchenik](http://icaci.org/petchenik).

In addition, Regional Cartographic Conferences (RCCs) offer opportunities for several countries to organize, meet, and share current and recent work from area cartographers and GIScience professionals. EuroCarto 2020, organized by Austria, Germany, and Switzerland, moved to an online forum rather than meeting in Vienna, Austria. While participants lamented not being in the city of music and dreams, they experienced the benefits of a robust program, free of charge. Approximately 420 participants from 55 countries attended, including participants from outside the discipline. Program highlights consisted of keynote presentations, larger thematic sessions, and shorter spotlight sessions. All abstracts are available at [abstracts-of-the-ica.net](http://abstracts-of-the-ica.net), and recorded videos can be accessed at [eurocarto2020.org](http://eurocarto2020.org).

The nature of virtual meetings and conferences is having a positive effect on inclusion. Many events are complimentary and, oftentimes, open to everyone. This is particularly helpful for people who don't have the means to travel to cartographic conferences—especially those who live in developing countries. They can now sign in to events online and participate, share their work, and expand their knowledge with colleagues around the world.

National and affiliate members of the ICA are helping the association stay the course as well by communicating ICA updates through their own channels and, in some cases, increasing participation at and adding sponsorship to commission events. While national members represent their respective countries, affiliate members have a special interest in the ICA and contribute their expertise to the organization. Affiliate members come from diverse organizations, including private companies with either a national or international focus, educational institutions, government departments or agencies, and scientific organizations.

As we continue to navigate the COVID-19 pandemic, let us all ensure that we stay the course in our daily responsibilities and commitments so we can continue to provide the cartographic and GIScience expertise that people expect from us. Fulfilling our roles contributes to those around us and helps achieve some sort of stability in these challenging times. Beyond these efforts to sustain an environment of normalcy, this period also offers opportunities to seize the moment to explore, collaborate, support, study, and research different topics within our discipline that can change the world for the better. So let's join together as part of the ICA family to collaborate and seek out opportunities that advance the good work the ICA does.



← The International Cartographic Association (ICA) commission chairs held a virtual meeting in October to share recent achievements and plan for upcoming events.

↑ The Barbara Petchenik Children's World Map Drawing Competition encourages children to create their own representation of the world in graphic form.



### 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.

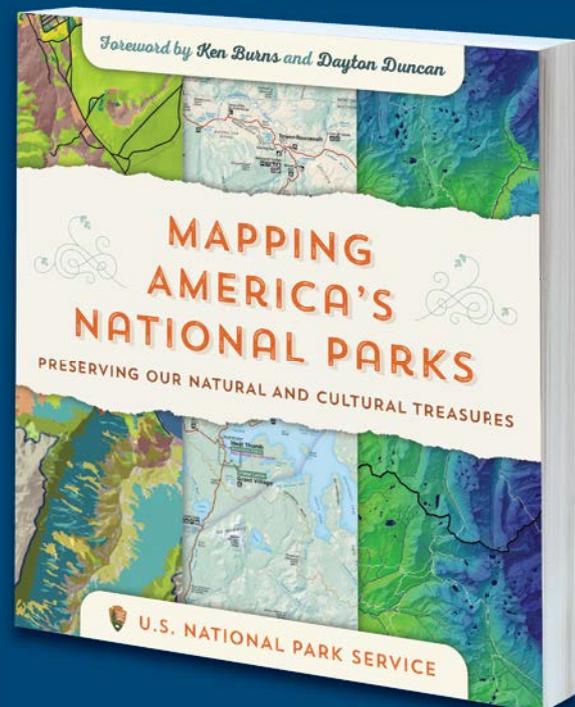
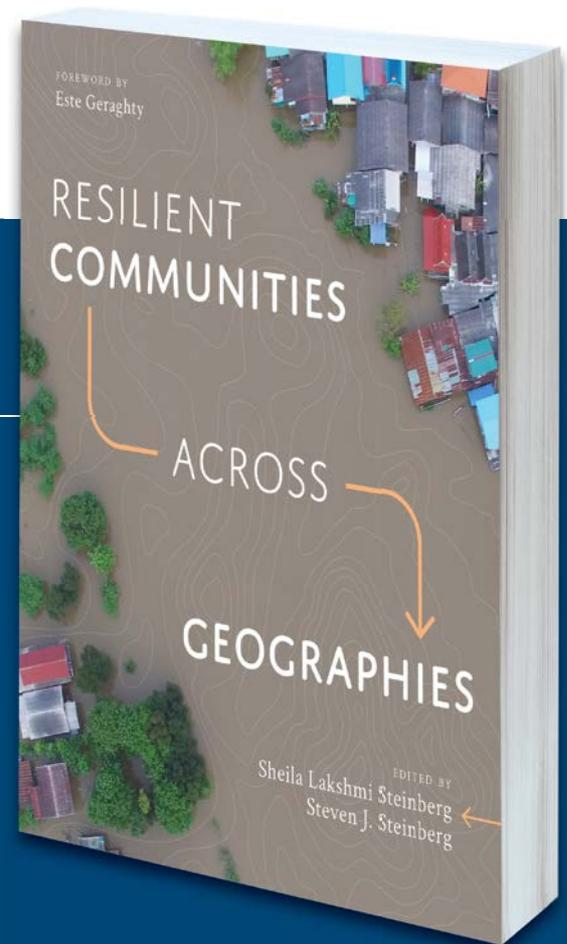


# Esri Press

## RESILIENT COMMUNITIES ACROSS GEOGRAPHIES

By Sheila Lakshmi Steinberg and Steven J. Steinberg

Communities around the world possess unique cultures, skills, and abilities within the context of their particular built and natural environments. Effective community planning, then, hinges on being able to identify communities' strengths and resources—and mapping can help. *Resilient Communities Across Geographies* is a collection of case studies that examine how to apply GIS to environmental and socioeconomic challenges so communities can perform effective analysis; engage in valuable planning activities; and, ultimately, create more resilient communities. Each chapter in the book examines spatially driven approaches to tackling obstacles in geography, the social sciences, landscape architecture, urban planning, environmental studies, sociology, economics, migration, community development, meteorology, oceanography, and other fields. Foreword by Esri chief medical officer Este Geraghty. December 2020/January 2021, 350 pp. E-book ISBN: 9781589484825 and paperback ISBN: 9781589484818.



## MAPPING AMERICA'S NATIONAL PARKS: PRESERVING OUR NATURAL AND CULTURAL TREASURES

By the US National Park Service

Get an insider's look at how the US National Park Service uses maps and geospatial technology to protect and manage national parks across the United States. The maps in *Mapping America's National Parks: Preserving Our Natural and Cultural Treasures* are more than beautiful representations of special places. Within the maps are layers of geographic information that the National Park Service uses to perform myriad essential services, from providing security for individual wildlife species and entire ecosystems to sharing intelligence on wildlife trafficking, zoonotic diseases, and field medicine protocols. Go behind the scenes to see how mapping and geospatial analysis support the full range of natural resource stewardship and science activities at the National Park Service. December 2020/February 2021, 250 pp. E-book ISBN: 9781589485471 and paperback ISBN: 9781589485464.

## STEAM

### STEAM at Work! Children's Book Series

The STEAM at Work! series encourages children in grades 1–5 to explore career paths in science, technology, engineering, art, and math (STEAM). Each of the four books demonstrates different environmental and social issues, which the characters use their skills to solve. The series encourages critical and creative thinking about the world, and readers will be inspired to make a difference in their communities.

The first book in the series, *Lindsey the GIS Professional*, is available in six languages: English, Spanish, German, French, Russian, and Chinese. So no matter which language kids are comfortable with—or learning—they can follow along as Lindsey collects information about the world around her to make a map of her favorite park. The book includes a glossary and free, downloadable activities and teaching materials.



For more information on all Esri Press publications, visit [esri.com/esripress](https://esri.com/esripress).

# The Business Case for People-Focused Change Management

Whether a technology initiative succeeds or not depends on more than the technology itself. Human factors have a big influence on the results as well.

Recognizing this, Esri has created a people-focused change management practice. Certified change management consultants work side by side with users to secure executive sponsorship, engage all organizational stakeholders, and craft effective strategies to ensure that those who are impacted by technological change have the information and tools they need to smoothly transition to new workflows.

Esri spent two months last year collecting input from organizational and GIS staff members who had been involved in recent ArcGIS implementation projects. The purpose of the 2020 Esri Change Management Survey was to assess the “state of people-focused change management.” In other words, Do organizations know what people-focused change management is? Are they using it? If so, has it made a difference? (The survey did not ask about usage or awareness of Esri’s change management practice. Rather, it centered on people-focused change management in general.)

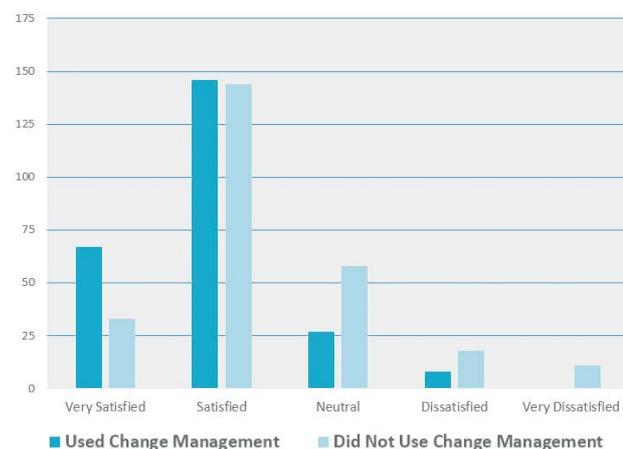
More than 500 people from public and private sector organizations around the United States participated in the survey, and Esri found that usage of people-focused change management was split almost evenly among them. Fifty-one percent of respondents had projects that did not include a change management aspect, while 49 percent had projects that did. The scale of implementations ranged from a single department to the entire organization.

Results of the survey were clear: including people-focused change management in an ArcGIS implementation project offers significant benefits.

## Whether or Not a Project Will Achieve Its Business Goals

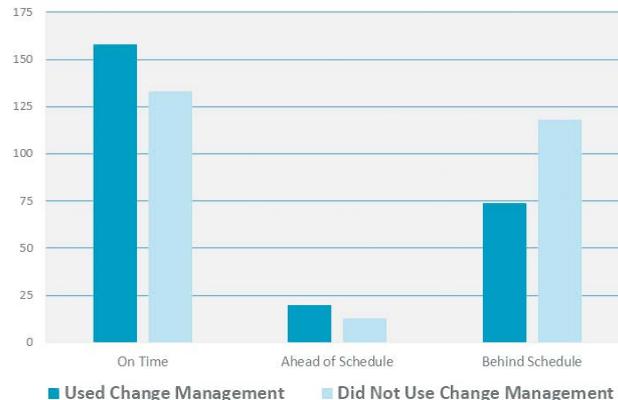
As with any business investment, technology should deliver advantages that outweigh the costs.

Eighty-nine percent of survey participants who employed people-focused change management in conjunction with their ArcGIS implementation projects were satisfied or very satisfied that the projects had achieved or would attain their business goals. By contrast, only 67 percent of the participants who did not use change management reported being satisfied or very satisfied that their projects had done or would do that. And only about half of this latter group—55 percent—said that their projects finished on time or ahead of schedule.



↑ Participant responses to the survey question, Overall, how satisfied are you that the technology implementation has achieved or will achieve business goals?

Tellingly, participants who used change management were more than twice as likely to be very satisfied that their projects would achieve their business goals than participants who did



↑ Responses to the question, Compared to your project timeline estimates, how did your project finish?

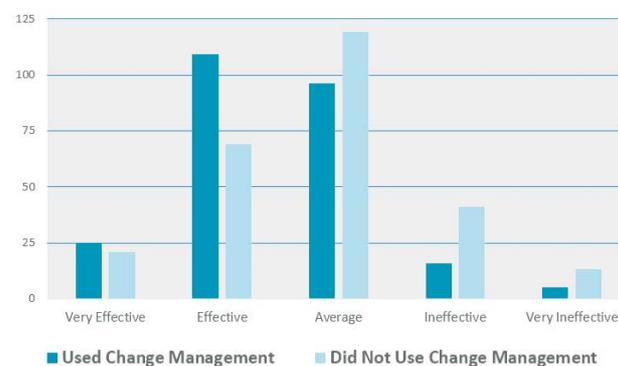
not use change management (27 percent versus 12.5 percent). Furthermore, no participants who employed change management were very dissatisfied with this aspect of their projects, whereas 4 percent of those on the other end of the spectrum were very dissatisfied with their outcomes.

## The Speed, Scope, and Proficiency of Adoption

While project teams can take a build-it-and-they-will-come approach to deploying new technology, they do so at the risk of low adoption rates. Results from the survey shed light on how including people-focused change management impacts key metrics related to adoption.

Survey participants were asked to rate how their change management projects affected the speed of technology adoption, the number of users who started using it, and their proficiency with the new technology. Once again, the responses reveal disparate outcomes between the two groups.

Regarding the speed of adoption, more than half (53 percent) of participants whose projects embraced people-focused change management said their project was effective or very effective at getting users to quickly adopt the new technology. Only about a third (34 percent) of participants whose projects lacked a change management aspect attained speedy adoption rates.



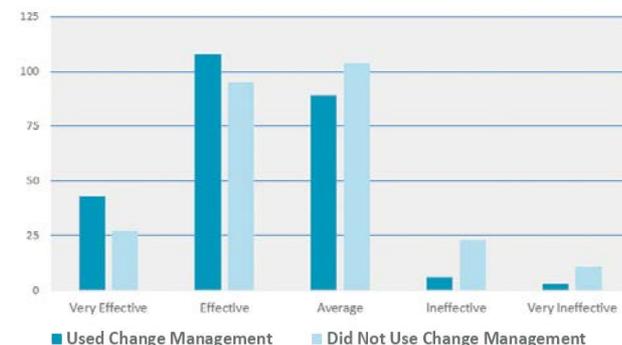
↑ Survey responses to the question, How would you rate the project’s impact on speed of adoption?

When rating the impact their projects had on the number of users employing the new technology after it was implemented, the two groups differed by 14 percent. Fifty-nine percent of participants who used change management chose the effective or very effective rating versus 45 percent of participants who didn’t employ change management. Interestingly, 15 percent of participants who didn’t use change management rated their project’s impact on the number of users as ineffective or very ineffective, whereas less than 6 percent of those who did employ change management chose either of those ratings.



↑ Responses to the question, How would you rate the project’s impact on the number of users?

User proficiency with the new technology can be an indicator of long-term adoption. Sixty percent of participants who employed change management rated their project’s impact on user proficiency as effective or very effective compared to 47 percent of those who did not use change management. In addition, more than three times as many participants who did not use change management rated their project’s impact on user proficiency as ineffective or very ineffective, compared to participants who did engage in people-focused change management (13 percent versus 3.6 percent).



↑ Responses to the question, How would you rate the project’s impact on user proficiency?

Finally, survey participants who did not engage in change management were asked if they thought that including a people-focused change management plan would have increased users’ adoption of the technology they implemented. More than half—59 percent—of them said yes.

It is clear that not heeding the people side of technology can have, at worst, undesirable consequences and, at best, fewer desirable results.

## A Change Management Approach Has Demonstrated Importance

When implementing technology to improve operations, gain insight, and produce better products and services, humans certainly play a vital role in ensuring that technology’s success. The results from the 2020 Esri Change Management Survey reinforce the importance of engaging and supporting the workforce before, during, and after new technology implementations.

Simultaneously deploying ArcGIS and a people-focused change management plan helps organizations achieve faster adoption rates and a higher number of users working with greater proficiency. Most importantly, people-focused change management helps organizations achieve the business values they set out to attain by making a technological investment.

To learn more about people-focused change management and Esri’s change management practice, visit [go.esri.com/change-management](http://go.esri.com/change-management).



# New Training and Certification Offerings

## Training

### 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.

Do you need to use GIS to make decisions about where to invest public safety resources? Are you in charge of ensuring the security and performance of your ArcGIS Enterprise infrastructure? Or maybe you need to proactively address the workforce-related impacts of implementing new technology.

If any of these scenarios speaks to you, the following courses can help:

- **ArcGIS Analysis Workflows for Public Safety**—Ideal for crime analysts and other public safety professionals in law enforcement, homeland security, emergency management, and related fields, this course employs realistic scenarios to teach a standard analysis workflow that provides deeper insight into how location affects public safety incidents, trends, and operations. Working primarily with ArcGIS Pro, participants explore effective tools and techniques for visualizing and quantifying public safety data.
- **ArcGIS Enterprise: Administration Workflows**—Participants in this course learn to master techniques to configure and maintain an ArcGIS Enterprise solution that meets their organization's needs. The course focuses on the architecture of ArcGIS Enterprise, server licensing roles and extensions, and capabilities that support common GIS patterns of use. It also covers best practices for managing servers, data, and services while ensuring system performance over time.
- **Preparing for Change**—This workshop-style course is for managers and others who plan to include people-focused change management in an upcoming ArcGIS implementation project. Facilitated by a certified Esri change management practitioner, the course reviews the foundational steps of the Prosci ADKAR model for change management. Attendees also receive templates that they can use to jump-start change management efforts immediately after class.

### Build New Skills This Year in an Esri MOOC

Massive open online courses (MOOCs) offer a free and convenient way to stay up-to-date with fast-changing technologies. Participants get access to ArcGIS software, and each course includes video lectures by Esri experts, hands-on software exercises, and interactive forums to engage learners around the world. Everyone who completes the course content receives a certificate of completion. View all Esri MOOCs at [esri.com/mooc](https://esri.com/mooc).

Upcoming MOOCs include the following:

- **Cartography**—This course, which was included on Class Central's Best Online Courses of All Time list, starts again on February 3 and runs for six weeks. In it, participants learn how to create beautiful maps using ArcGIS Pro. Entertaining video discussions among Esri cartographers teach learners about fundamental cartographic concepts, practical mapmaking techniques, and common pitfalls to avoid when creating a map. Learn more and register at [go.esri.com/carto-course](https://go.esri.com/carto-course).
- **Do-It-Yourself Geo Apps**—Also included on Class Central's Best Online Courses of All Time list—this course has received rave reviews since it was first given in 2016, and Esri is offering it again March 31 through April 28, 2021. Take a guided tour of ArcGIS apps and learn how to create customized experiences without writing code. Learn more and register at [go.esri.com/learn-geo-apps](https://go.esri.com/learn-geo-apps).

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## Certification

### New Exams Coming in 2021

In keeping with the certification exam development cycle, Esri is reviewing all core ArcGIS Desktop and ArcGIS Enterprise exams and considering which ones need a new 2021 release. Stay up-to-date with current exams at [esri.com/certification](https://esri.com/certification).

### Tips for Preparing for an Exam

One of the most common questions asked by individuals who are planning to take an Esri Technical Certification exam is, How should I prepare?

First, the most important task is to select an appropriate exam based on your existing knowledge and workplace experience. Choosing an exam that assumes four years or more of active experience with a range of ArcGIS tools and apps when you've only been working in a limited fashion with ArcGIS Pro software for a year is not a recipe for success.

After selecting the right exam for you, carefully review the candidate qualifications and skills measured, provided on the exam page. Note topics that are less familiar to you; these will likely require focused preparation time.

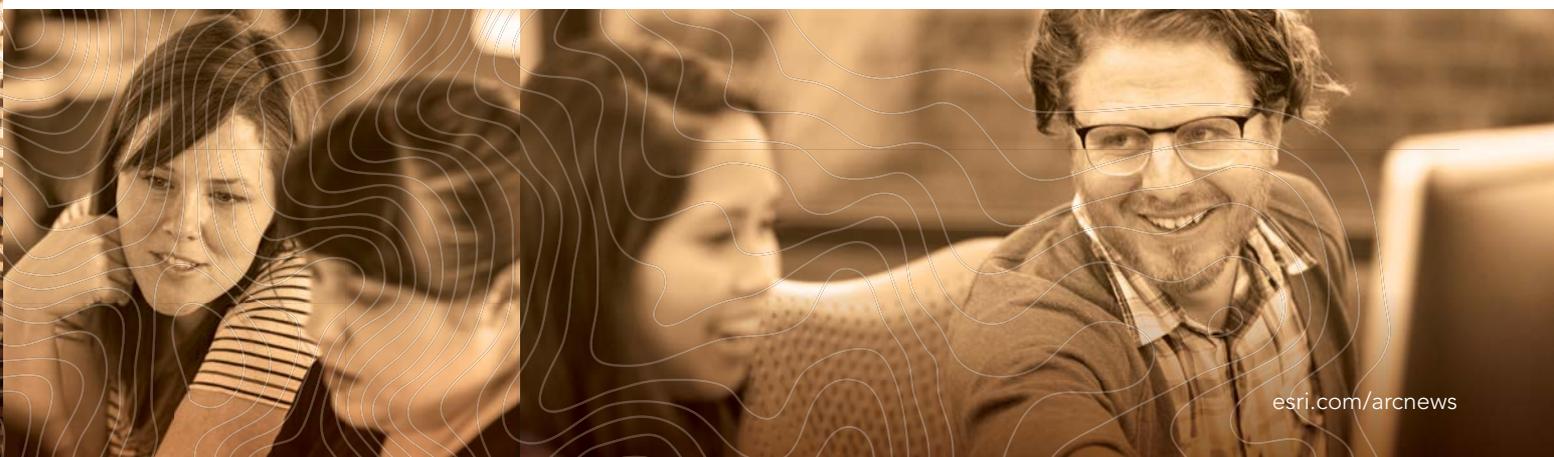
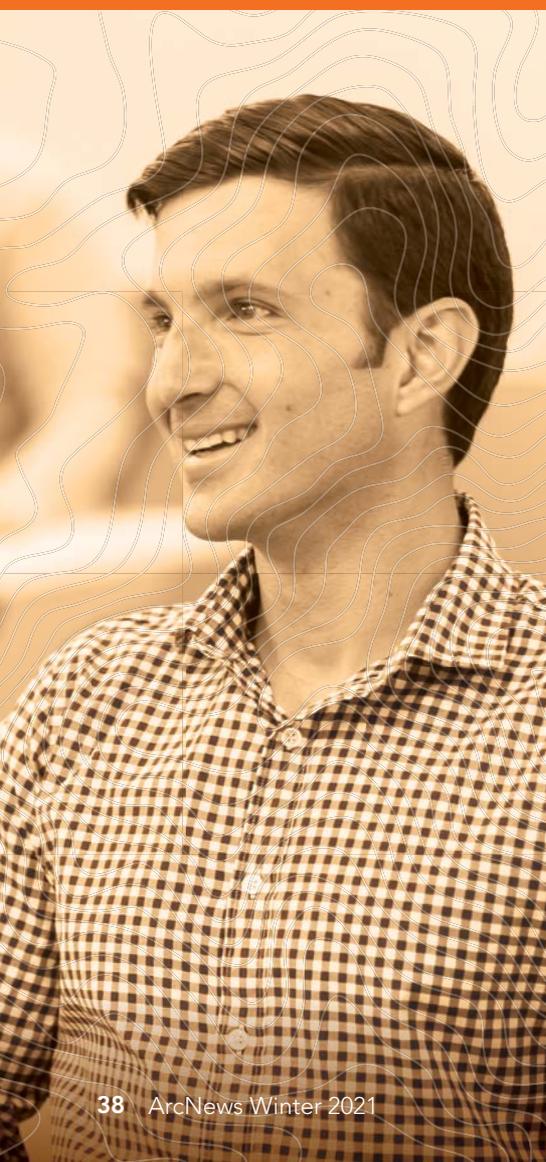
Each exam page also includes a preparation resources document. Review these individual resources and, again, pay special attention to those that discuss software tools and apps that you don't frequently use.

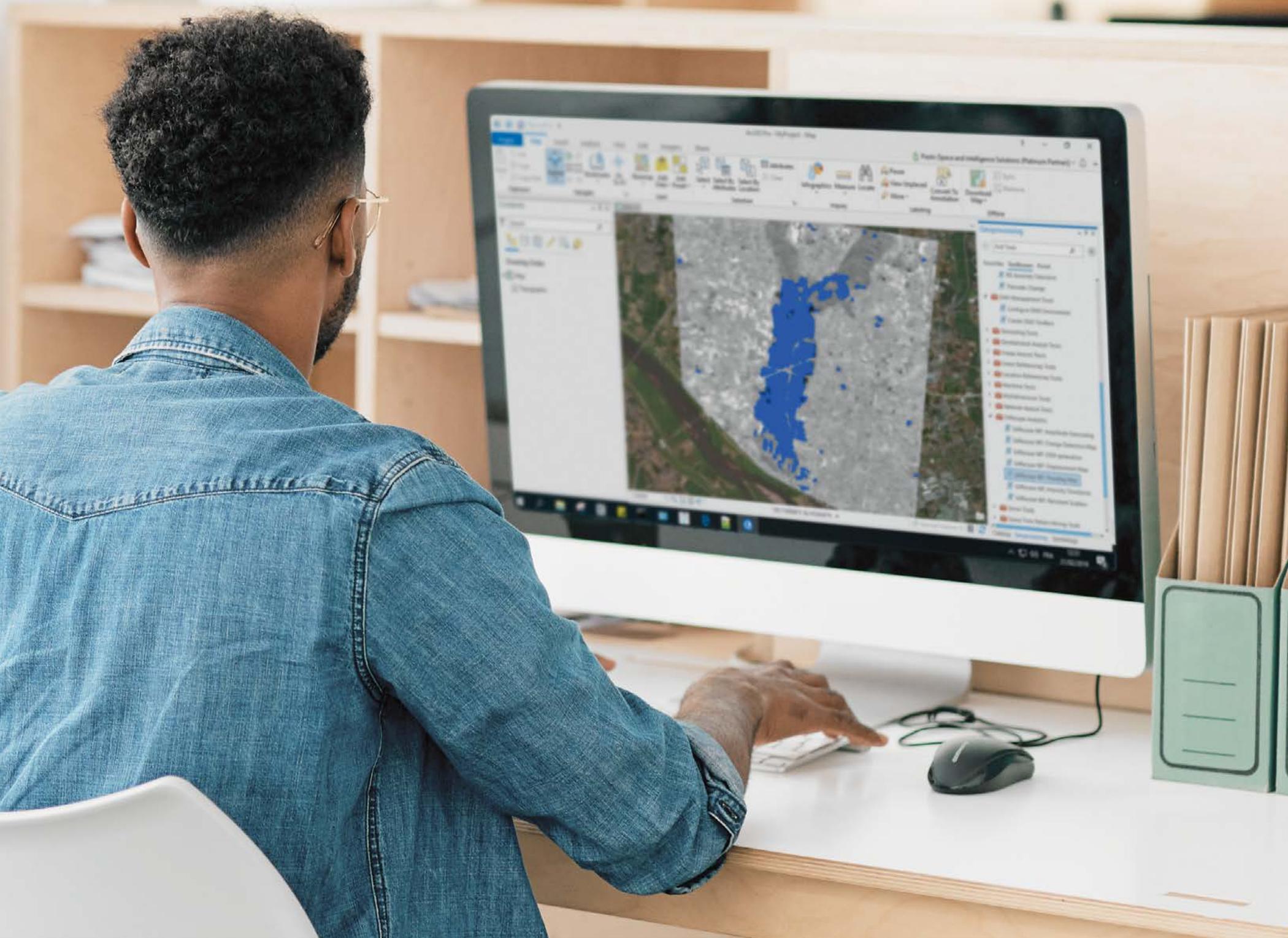
Finally, when the day of your exam appointment arrives, make sure you are well rested and understand Pearson VUE testing policies. Take a deep breath, and start the exam. Achieving your certification goal is well within your reach.

To explore the latest Esri Technical Certification exams, visit [esri.com/training/certification](https://esri.com/training/certification). Also join the Esri Technical Certification groups on LinkedIn and GeoNet to connect with other professionals and discuss all things certification.

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