ArcNews

Esri | Winter 2019 | Vol. 41, No. 1

Briefly Noted

Esri Named a Leader in Location Intelligence Platforms
Independent market research firm Forrester recognized Esri as a leader in location intelligence technology in The Forrester Wave: Location Intelligence Platforms, Q4 2018 Evaluation. The report acknowledges, in our opinion, Esri's predominance in the business-focused location intelligence marketplace and highlights the company's long-term commitment to innovation in its market-leading geospatial cloud. To learn more, visit esri.com/forresterwave.

New Hubs Show Regional Ocean Health
Esri has partnered with the Ocean Health Index (OHI) team to release new ocean health data. A joint project of Conservation International and the National Center for Ecological Analysis and Synthesis, OHI looks at the social, ecological, and economic benefits that oceans provide to people. While OHI's ocean health scores are already integrated as a data layer in ArcGIS Living Atlas of the World, Esri and OHI will launch Ocean Health Hubs, powered by ArcGIS Hub, to enable ocean managers to explore data that will help them understand regional ocean health. Visit ohi-science.org/ohi-global/index for more details.

ArcGIS Capabilities Expand to More IoT Devices
ArcGIS Runtime SDK will begin supporting development for embedded Linux devices on the Qt platform. This new software developer kit (SDK) support for ARM embedded Linux systems—the chipsets that run on the small, embedded devices that are the backbone of Internet of Things (IoT) systems—will bring the capabilities of ArcGIS to myriad devices. To sign up for the beta program, email embedded@esri.com.

Weathering Hurricane Florence

A profound change is taking place in how local municipalities, state and federal agencies, and other organizations prepare for and respond to disasters. Instead of shifting from everyday operations into emergency mode, in which real-time collaboration and communication with the public suddenly become critical, they are being more proactive, employing Web GIS before, during, and after disaster situations to unite their daily operations with emergency needs and foster ongoing cooperation.

As Hurricane Florence barreled toward the eastern United States in mid-September 2018, the City of New Bern, North Carolina; the South Carolina Emergency Management Division (SCEMD); and nonprofits including the National Alliance for Public Safety GIS (NAPSG) Foundation and Humanity Road were as ready as they'd ever been to take a direct hit. In large part, that's because they already had scalable and dependable Web GIS configurations in full use.

"Web GIS has progressed to an operational capacity so powerful that organizations can take advantage of it right away, deploying apps to first responders and citizens as soon as the infrastructure and processes are there," said Ryan Lanclos, Esri's director of public safety industries. "Being prepared for the next thing that's coming—whatever that incident might be—is critical to execute an effective response and recovery. We saw a lot of people proactively taking measures to do that in the lead-up to Hurricane Florence."

The next event always comes sooner than anyone anticipates, so baseline readiness is paramount. Here's a look at how New Bern, SCEMD, NAPSG Foundation, and Humanity Road leveraged the power of Web GIS—including new special emergency management solutions from Esri—to direct their response and recovery operations in very effective ways.

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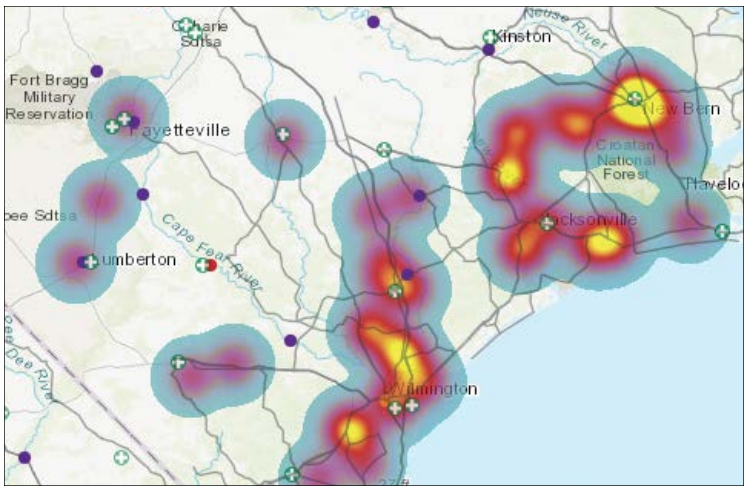
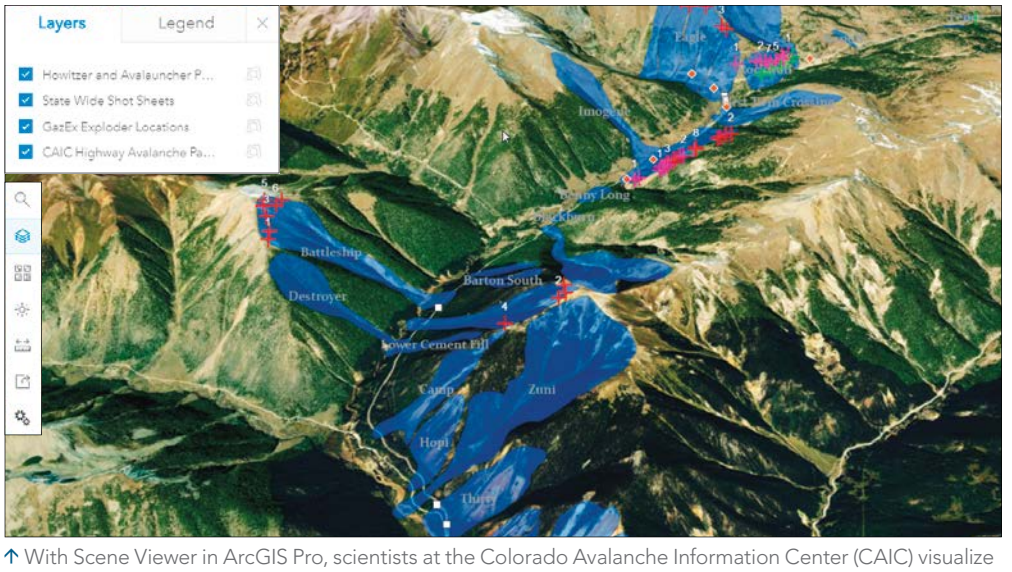


↑ Humanity Road's heat map of rescue requests in eastern North Carolina helped the coast guard strategically pre-position assets so units could respond to Hurricane Florence quickly and effectively.

Reducing the Risk of Avalanches with GIS and Machine Learning

Each winter in Colorado, avalanches pose a serious risk to residents, visitors, and travelers. Since 1950, they have killed more people in the state than any other natural hazard, and Colorado accounts for a third of all avalanche deaths in the United States. That is why scientists at the Colorado Avalanche Information Center (CAIC) analyze current weather conditions to predict when and where avalanches are most likely to occur, especially along highways. By assigning avalanche danger ratings and issuing warnings, the center helps reduce the chance that people will get injured or killed by avalanches.



↑ With Scene Viewer in ArcGIS Pro, scientists at the Colorado Avalanche Information Center (CAIC) visualize avalanche paths in 3D so they can figure out where to place explosives and when to discharge them.

During the snow season, CAIC publishes daily avalanche forecasts for Colorado's backcountry areas to help people plan their winter outings. The center also issues forecasts of the avalanche hazard in transportation corridors for the Colorado Department of Transportation (CDOT) to improve public safety on the state's highways. Road crews mitigate avalanche risk by using explosives to release any looming packs of snow and then safely clear the debris off highways.

For years, CAIC had been using ArcGIS to map snow avalanche paths as polygons. But scientists thought their GIS had more to offer for database management and prediction. They wanted to make it easier for forecasters to collect data in the field and push it back to a geospatial database so everyone could see and use it almost instantaneously. They also wanted to be able to better visualize where avalanches were happening and why.

Esri partner Earth Analytic, Inc., developed SmartMountain, a set of web-based and mobile apps that allows users to gather, organize, and share data that is critical to keeping snowy environments safe. For about a year now, CAIC and CDOT have been collaboratively using a

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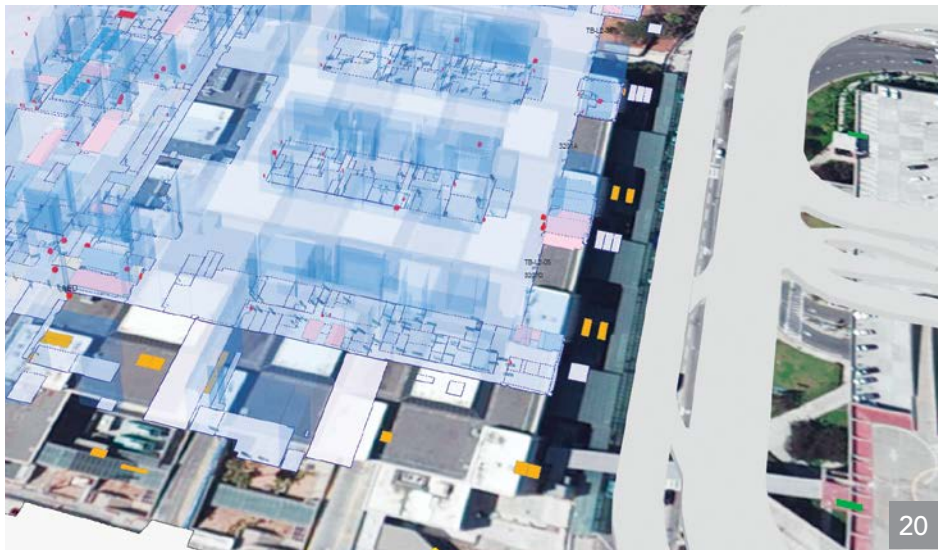
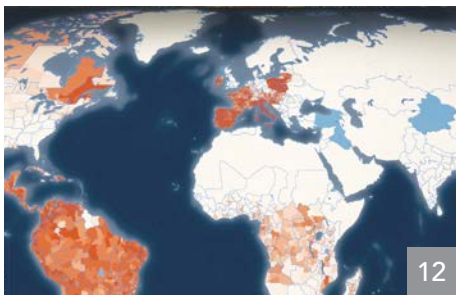


The $15 billion development project taking place at Los Angeles International Airport (LAX), which is scheduled to be completed in 2028, is the largest public works initiative in Los Angeles history. That is why Los Angeles World Airports (LAWA) is leveraging GIS strategically—to streamline the workflows of multiple construction projects and ensure that 24-hour-a-day airport operations proceed smoothly.



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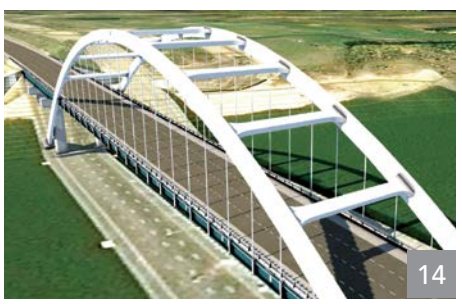

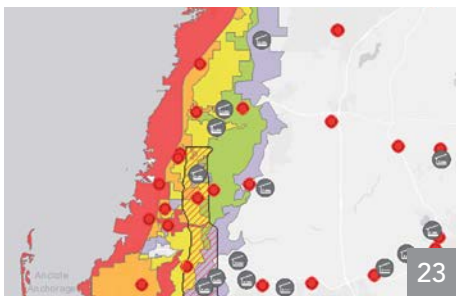

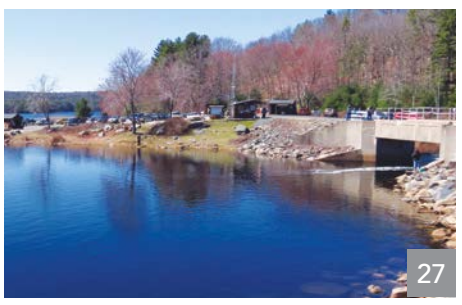

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Esri Introduces **User Types** in ArcGIS Online

ArcGIS Online is always evolving to meet users' needs. One of the biggest upgrades that came out of the December 2018 update is that Esri transformed Named User levels into User Types, which match user characteristics with specific GIS capabilities and apps.

With these new User Types—Creator, Viewer, Field Worker, Editor, and GIS Professional—organizations have more granular control over the GIS tools their employees have access to. Staff members can get their work done more efficiently, while companies and organizations ensure cost-effective productivity.

The **Five** New User Types

Creator

People who create maps and apps, perform spatial analyses, and share the results with colleagues and clients via ready-to-use apps need to be given a Creator User Type. Creators can employ the following three app bundles:

- The Essential Apps Bundle, composed of Esri Story Maps apps, Web AppBuilder for ArcGIS, Operations Dashboard for ArcGIS, configurable apps, Map Viewer, and Scene Viewer
- The Field Apps Bundle, which consists of Collector for ArcGIS, Survey123 for ArcGIS, and Workforce for ArcGIS
- The Office Apps Bundle, which contains ArcGIS Maps for Office and ArcGIS Maps for SharePoint

GIS specialists, asset managers, and data journalists get a lot out of the Creator User Type. And for existing users, the Creator User Type is exactly the same as the former Level 2 Named User.

Editor

Editors can modify and add spatial data to ArcGIS Online to improve how accurate and current an organization's geospatial information is. Employees who have this User Type tend to review and edit incoming data to ensure that their organization's system of record contains authoritative data. Editors typically have job titles such as data entry clerk, GIS technician, or data quality engineer.

Viewer

The Viewer User Type is for employees in an organization who need to view the maps and apps created by others but don't need to build them. Viewers—whose job titles tend to fall along the lines of executive officer, manager, or sales manager—can access their organization's private information to make informed decisions and monitor performance. For existing users, the Viewer User Type is identical to the former Level 1 Named User.

GIS Professional

The GIS Professional User Type is for superusers who produce advanced maps, visualizations, and analyses. The maps they create and geospatial insights they uncover empower people both within their organizations and involved in particular projects. The GIS Professional User Type includes ArcGIS Pro (Basic, Standard, or Advanced), as well as the Essential Apps Bundle, the Field Apps Bundle, and the Office Apps Bundle. GIS analysts, GIS managers, geodevelopers, cartographers, and the like would benefit most from the GIS Professional User Type.

Field Worker

Employees who collect real-time data, manage field assignments, inspect assets, and conduct surveys will find the Field Worker User Type to be a great fit. If staff in an organization could benefit from using Collector, Survey123, and Workforce to do real-time data collection, tasking, and operations, then having access to this User Type will greatly improve their efficiency and productivity. Common job titles for those with a Field Worker User Type include maintenance foreman, field technician, and volunteer.

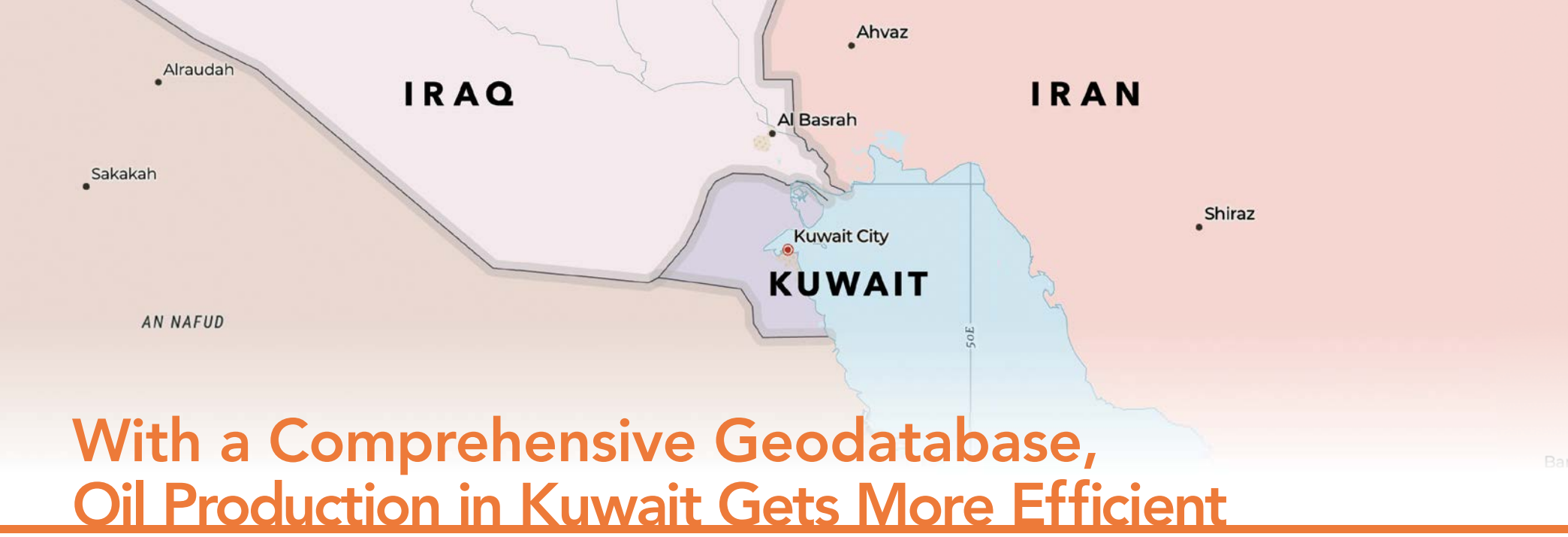
Esri created User Types in ArcGIS Online because users expressed, through ArcGIS Ideas, that they wanted more options than Level 1 and Level 2 Named Users. Send the ArcGIS Online team your ideas by visiting **go.esri.com/ideas**.

Continued Flexibility

While User Types define the capabilities and apps available to each ArcGIS Online user, administrators can still give organizational members access to supplementary apps and further refine specific users' roles.

Add-on apps allow organizations to tailor their members' apps to match their particular needs. For instance, if a user requires a compatible app that isn't included with a User Type, such as ArcGIS Business Analyst or Navigator for ArcGIS, then an administrator can add one or both of those. Or if an Editor needs to use Collector, the organization can purchase that app and assign it to the user. Administrators can also still assign custom roles to specific users or groups of users by refining their permissions.

Additionally, the March 2019 release of ArcGIS Enterprise 10.7 will include these User Types. That means that all organizations using Web GIS will have the flexibility to choose among a variety of User Types and match each of their team members with the capabilities and apps they need to complete their work.



With a Comprehensive Geodatabase, Oil Production in Kuwait Gets More Efficient

By Majeed Al-Muwail, Faisal Al-Bous, Nasir Osman, and Fawzi Abdulrahman, Kuwait Oil Company; and Faisal Shah, Ahmed Saad, and Scott Pezanowski, Openware

Kuwait's oil era began on February 22, 1938, when oil was first discovered in Burgan field in the country's southeastern desert. The very first well, aptly named Burgan No. 1, is still producing. Over the last 80 years, scores of other oil fields have been discovered across the country. Today, the Kuwait Oil Company (KOC)—whose primary role is to explore, develop, and produce hydrocarbons within the State of Kuwait—has thousands of wells and more planned to meet future production targets set in its 2040 Strategic Plan.

At KOC, oil production begins at the well and extends through flow lines to preliminary processing facilities known as gathering centers. To get the crude out of the ground and to the 30 gathering facilities throughout Kuwait requires a profusion of infrastructure—cables, pipelines, communication lines, rig roads, fences, and shelters—both above and below ground.

But the oil field infrastructure in Kuwait became congested out of necessity a few decades ago. When Iraq invaded its neighbor to the south in 1990, it resulted in tremendous damage to the oil fields. As Iraqi forces retreated, they set fire to 600 wells and destroyed 10 gathering facilities. After liberation, Kuwait needed to rebuild, and the fastest way to obtain the revenue to do that was to accelerate oil production. Given the scale of the damage, however, and the need to build facilities and ramp up production quickly, this extensive development project ended up introducing inefficiencies into the production process. KOC had to construct new pipelines, flow lines, and power lines around the oil lakes that formed when its facilities were damaged, so new development couldn't follow the existing pipeline corridor. Thus, the amount of usable land on the oil fields was reduced, and subsurface development, including both exploratory drilling and drilling for production, was limited.

To address this congestion, the operations technical services team at KOC formed an Infrastructure Master Plan (IMP) in 2006 that aims to decrease field congestion; keep track of land reservations and resolve conflicts; mitigate land encroachment; and comply with health, safety, and environmental regulations. The team uses GIS to administer all this, specifically relying on the ArcGIS platform to optimize future reservations for wells, pipeline routes, facilities, and more.

A New Way to Collect, Develop, and Implement Data

KOC started developing the IMP by building a comprehensive and robust ArcGIS geodatabase that includes detailed geospatial and nonspatial information about all existing and proposed KOC assets. Initially, the IMP team—which consists of GIS specialists, GIS developers, GIS data management engineers, and AutoCAD drafters—designed the geodatabase so it featured a unified data model of all KOC assets. This required employing entity-relationship modeling to ensure that the conceptual representation of the structured data was well designed. After doing a thorough analysis of the model, the IMP team produced a database schema for it to define and describe the contents of the geodatabase.

Next, the IMP team developed a highly integrated data collection technique for mapping assets that involves doing a topographic field survey of all KOC's operational areas. Survey crews are equipped with survey-grade GPS receivers, as well as radio detectors and ground-penetrating radar devices that they use to trace both conductive and nonconductive underground features. Not only does this setup provide a controlled and reliable mapping solution, but it also ensures that the data conforms to international standards for spatial data accuracy.

All known oil features are mapped, including aboveground wells, pipelines, manifolds, and buildings; belowground pipelines and electrical and communication cables; and natural and man-made surfaces like bodies of water, oil lakes, and berms. Numerous feature attributes are recorded as well, such as the information on the metal tags attached to each KOC asset; details about the wells, like when they were built; the types of crude transported by particular pipelines; and pipe diameters.

From there, the surveyors and AutoCAD supervisors on the IMP team process and edit the data in CAD format and then convert it to a Microsoft SQL Server geodatabase so it can be visualized in ArcGIS Desktop. The data is housed in ArcSDE, which allows many users to edit the geodatabase synchronously without locking features or duplicating data, thanks to its integral versioning capabilities.

This extensive data collection, development, and implementation effort is giving KOC a large amount of highly accurate and up-to-date geospatial information about Kuwait's oil fields and all the associated infrastructure. Now, this data is serving as the back end for the unique apps that the IMP team's GIS developers are creating to help KOC employees enhance and even expand Kuwait's oil and gas production.

Aligning Current Needs with Future Development Prospects

Prior to forming the IMP and adopting GIS, KOC followed an ad hoc site selection process without considering future needs and impacts. But with ArcGIS technology, the company is currently implementing a long-term land management program that will help it secure space for future development, in line with KOC's 2040 Strategic Plan.

Selecting a spot to put a new well is still quite complicated, though, due to ongoing congestion problems. When a new well is proposed, KOC geologists first determine the desired subsurface location for drilling. When these locations are overlaid on the crowded features, however, there are often conflicts. The process is further complicated by competing objectives, including costs, practicality, future development plans, operational and maintenance needs, and KOC's rules that set spacing standards between features. To minimize

→ As part of the Infrastructure Master Plan (IMP), survey crews collect data on oil production assets and verify features out in the field.

these conflicts, the company has often had to find alternative locations—adjacent to where the oil is instead of right above it, for example—which end up being costlier.

Now, ArcGIS Desktop streamlines the site selection process by employing geoprocessing tools and frameworks that help KOC secure quality locations for future wells, services, and facilities; optimize locations for better land management; and ensure compliance with environmental health and safety standards. Moreover, the operations technical services team relies on ArcGIS Desktop to evaluate KOC's existing infrastructure layouts and propose cost-effective scenarios for reorganizing assets to ensure that land is used efficiently and economically in the future.

Currently, the map document of KOC's assets is published to ArcGIS Enterprise, where KOC users—ranging from field operators to senior engineers and team leaders—can access and employ it to help ensure the long-term success of land planning.

Continued Enhancements with 3D, Centralized Apps, and Real-Time Feeds

To continue generating cost-effective approaches for land development, the IMP team plans to keep enhancing and centralizing its existing geodatabase and building apps to disseminate this vital information throughout the company. This will facilitate more collaboration and data sharing among teams, which will empower KOC's leadership to make better decisions in a timely manner.

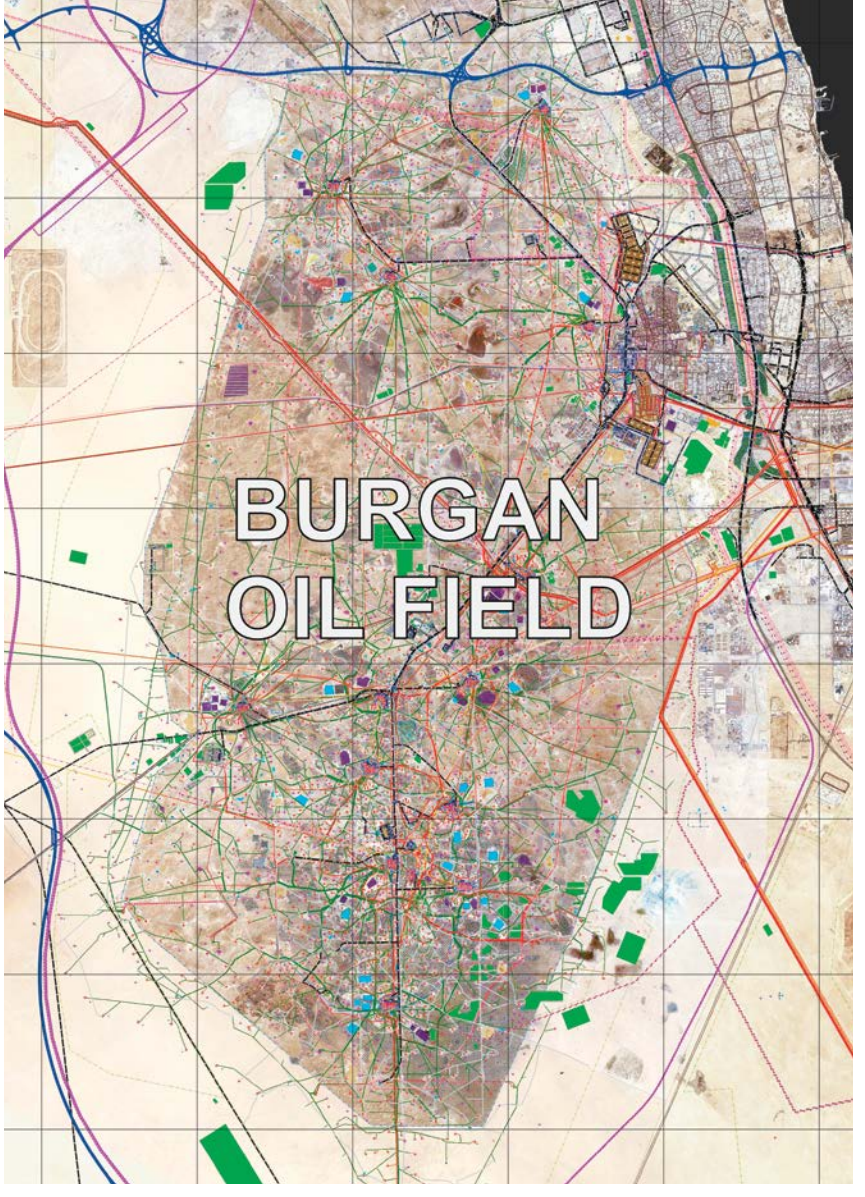
Additionally, KOC is using digital aerial imagery and lidar data from Esri partner The Sanborn Map Company to create high-resolution, natural-color orthophotos and a digital terrain dataset that it can use to make 3D simulations of pipelines; do 3D spatial analyses of pipelines, gathering centers, and difficult-to-reach or dangerous areas; perform hydrologic modeling to identify potential (and unproductive) water-prolific areas; and better represent the terrain of oil fields overall. This remote data collection, which can be done quickly and on a more massive scale than survey-based data collection, not only reduces costs but also minimizes risks to humans having to map inaccessible, hazardous, and remote areas.

KOC is centralizing its app development as well. Instead of making apps one at a time, on an as-needed basis, the IMP team will put them on a web portal where key company personnel can access the latest, most accurate information whenever they need it. This will enable users to find the maps and apps they want, enhance collaboration among teams, and make it easier to share GIS services and geoprocessing tools. The portal will also offer KOC's attribute data via a unified, interactive, map-based interface. Other specialized GIS apps developed by KOC will support the needs of individual teams, including the crisis management group, the environmental health and safety division, and the team that optimizes pipeline routes.

Likewise, the operations technical services team is continuing to integrate existing services that base asset management around real-time information. Having instant access to live data feeds about the weather, for example, gives decision-makers at KOC more context about the environmental issues that continually challenge Kuwait's desert-based oil production processes.

All this development is designed to place the most valuable geospatial data in the hands of KOC's decision-makers via easy-to-understand maps. But the success of these apps depends on first having an accurate, comprehensive, and up-to-date geodatabase. And KOC finally has that.

For more information, email KOC senior GIS analyst Faisal Al-Bous at fbous@kockw.com or KOC GIS specialist Nasir Osman at nosman@kockw.com.



↑ Kuwait's initial oil find was in Burgan field in the country's southeastern desert. Its first oil well, named Burgan No. 1, is still under production.

About the Authors

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continued from cover

Weathering Hurricane Florence

READY FOR WATER RESCUES AND QUICK WITH DAMAGE ASSESSMENTS

Located near the coast at the confluence of two rivers—and about 90 miles from Hurricane Florence's point of impact—New Bern had prepared for big storms before. Two years prior, when Hurricane Matthew, initially a category 5 storm, was forecasted to roll through the Carolinas, the city set up Esri's Damage Assessment configuration on Collector for ArcGIS to help emergency responders keep tabs on field resources and conduct damage assessments. But Matthew turned back into the Atlantic Ocean after making brief landfall as a category 1 storm in South Carolina, and New Bern was spared. It was clear this time, however, that the city wouldn't be so lucky.

"When we heard that Florence was coming and we knew how bad it was going to be, our first thought was to evacuate," said Alice Wilson, New Bern's GIS manager. "But then we knew some of us had to stay here to help the people who stay behind."

City officials set up an emergency operations center (EOC) the day before the storm hit. Wilson and her team tested all their geospatial tools ahead of time, including the Damage Assessment configuration that emergency responders would use out in the field and Operations Dashboard for ArcGIS, which teams in the EOC would employ to oversee operations. They also wanted to be able to provide the Federal Emergency Management Agency (FEMA) with as much information as possible as quickly as possible.

"We knew, based on our elevation data, *[which]* areas would be affected," said Wilson.

City officials also knew from Hurricane Irene in 2011 that the Neuse and Trent Rivers that surround New Bern could swell up to seven feet, if not more. Wilson pulled stream gauge data into ArcGIS Desktop so staff in the EOC could monitor the rising rivers. They readied for water rescues.

"We'd put a mandatory evacuation in place, but people stayed for one reason or another," said Wilson.

When Florence hit the afternoon of Friday, September 14, it was an immediate impact. The rivers swelled by 10 feet.

"We were getting call after call for water rescues," she said. "People were calling telling us they were in their attics and needed to be rescued."

By 11:30 p.m. that night, staff at the EOC were aware that about 150 people needed to be rescued, according to the City of New Bern's Twitter account. But that was only half of what was to come.

"We got through our stuff and then got a call Sunday morning at 1:00 that *[the neighboring town of]* Pollocksville needed water rescues," said Wilson.

Rescue teams from New Bern weren't familiar with Pollocksville, though. At one point, the fireman in the EOC said his water rescue crew couldn't find high ground. So Wilson used GIS data from North Carolina's statewide GIS advisory group and found contour lines for Pollocksville. She employed ArcGIS Desktop to map where that crew was and where it needed to go. Staff in the EOC then used walkie talkies and cell phones to direct the team to higher ground.

"We conducted over 300 water evacuations," said Wilson, "and not even just in our city."

Using data from ArcGIS Living Atlas of the World and local information, such as where street closures and shelters were located, Wilson and her team created online, public-facing maps as well. They posted a tabbed story map on the city's website that showed stream gauges, wind velocity, and more information about Florence's sheer potency. They also have a live app that displays all the power outages in New Bern in real time, which proved crucial during the storm, saving city staff untold amounts of time answering phone calls from residents asking about outages.

The whole time, Wilson manned two computers: one that showed a map of New Bern in ArcGIS Desktop and one that pulled the online maps and apps she and her team had built into a dashboard that everyone in the EOC could see on a big monitor.

"It was pretty chaotic, but we tried to make sure we had as much information as possible as Florence came in," said Wilson.

The storm passed through on Sunday, September 16, and the City of New Bern immediately began doing damage assessments using the Damage Assessment configuration it had set up in Collector. Utility workers, firefighters, and inspectors—from both New Bern and outside cities—jumped in to help.

Some of them had never used Collector before, let alone the Damage Assessment configuration, so Wilson and her colleagues trained them quickly and sent them into the field. Utility workers went first to the houses they knew had been completely inundated by water to see what they would need to do to restore service. Firefighters and inspectors went out in pairs to examine any fire concerns and record all the destruction using the app.

"We had significant damage," said Wilson. "The storm surge affected us the most."

In addition to the heavy flooding that deluged some parts of town, New Bern had four feet of water inside its historic downtown buildings. Big bear statues that usually stand outside certain businesses were floating down the street. And a few yachts ended up landbound, stranded next to houses and even a hotel.

By the following Friday—just seven days after Hurricane Florence hit—New Bern had finished its damage assessments.

"All the houses that were really damaged fell right where we thought they would," said Wilson. "So we knew our data was good."

Inspectors recorded an estimated $100 million of losses to both commercial and residential properties. Although that number is breathtaking—especially for a city of 30,000 residents—Wilson was impressed by how fast New Bern recorded this much damage.

"I was here when we had Hurricane Irene, *[which]* was probably the worst hurricane that I've been a part of," said Wilson. "Back then, inspectors would use these forms that were FEMA generated, and they would go handwrite all this information. They would bring it back to me, and I would have to enter it all. It was so time-consuming. You were trying to read somebody's handwriting, and after a while, they would just scribble something because they were so tired."

The Damage Assessment configuration, which works on both Collector and Survey123 for ArcGIS, is so much faster, according to Wilson.

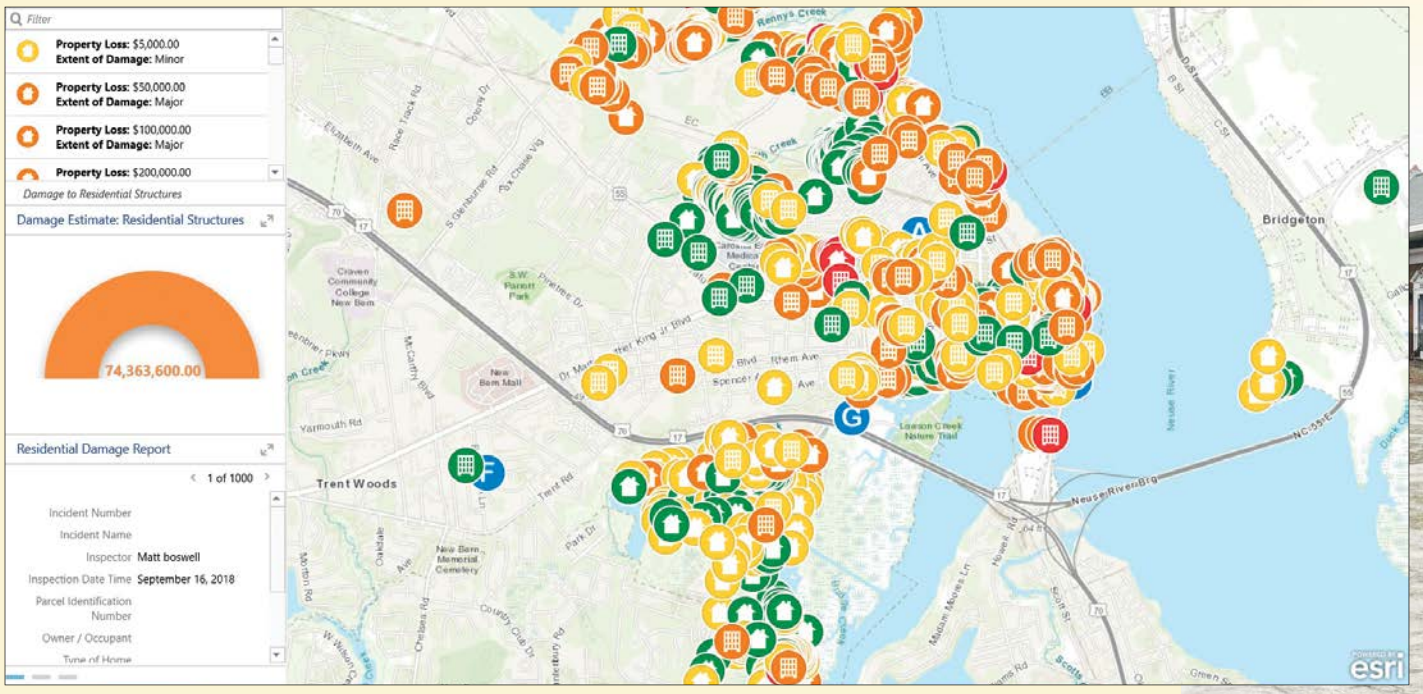
"Because it's spatially located, I don't have to do anything," she said. "We were sharing this live. We *[didn't]* have to process it and turn it around."

As of that same Friday, FEMA was already aware of New Bern's damage assessment values.

"I can't even think of the amount of time we've saved," said Wilson. "Esri tools…have been instrumental in getting us back on our feet."

With only a few injuries and no deaths recorded in New Bern due to Hurricane Florence, Wilson said she has never been prouder of her community.

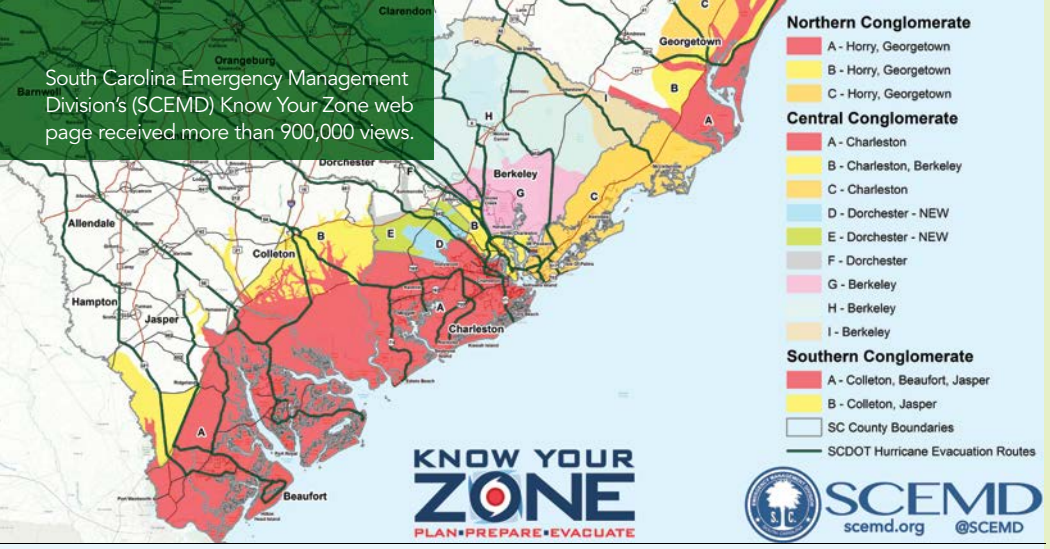
"Without question, we just knocked it out of the ballpark and not only helped this city but also helped neighboring cities that didn't have what we have," said Wilson. "Hopefully now we can plan a little better when we rebuild."



↑ New Bern recorded approximately $100 million in damage to residential and commercial properties during Hurricane Florence—$75 million to residential properties and $25 million to commercial properties.

↓ Large bear statues that usually adorn the entrances of certain businesses were found floating down the street. (Photo courtesy of the City of New Bern.)

Check out Esri's new solutions for emergency management operations at **p.ctx.ly/r/8t2z**.



South Carolina Emergency Management Division's (SCEMD) Know Your Zone web page received more than 900,000 views.

A CHANGING STORM LEADS TO A SURPRISE FLOOD EVENT

When Hurricane Florence set in on South Carolina, Charlie Kaufman, the GIS manager at SCEMD, was well equipped to be agile.

"South Carolina Emergency Management as a whole is a support agency for county and local governments," explained Kaufman, who is essentially a one-man GIS shop. "My role as the GIS manager for the emergency management division is making GIS products to support not only agencies that are assisting at the state level but, if I can, also making GIS products that can support counties."

The products he puts together range widely, from hundreds of GIS layers and web apps to dashboard-based situation reports and predictive flood models. For Hurricane Florence, this array of GIS proved indispensable, since over the course of just a few days, the nature of the storm changed several times, affecting everyone's response operations.

"We initially thought a category 4 storm was going to broadside us," said Kaufman. So South Carolina governor Henry McMaster ordered a mandatory evacuation for several coastal counties. He encouraged people to go to SCEMD's Know Your Zone web page to determine if they were likely going to be affected by the storm surge.

"Our hurricane Know Your Zone website really got engaged," recalled Kaufman, who used ArcGIS Online to host the map. "My final tally for that was I had over 900,000 views on it."

At this point, SCEMD began planning search and rescue and life safety response operations. Kaufman readied his search and rescue grid map. He also used Web AppBuilder for ArcGIS to make web maps that first responders could take out into the field and use on their tablets and smartphones.

"We have a statewide common operating picture…that's already in a web application that we use to monitor disasters all the time," explained Kaufman. "I have about 300 GIS layers ready to go so I can create offshoots of that on the fly if I need to."

Although a lot of water dropped in South Carolina when Florence made landfall, it didn't end up being the category 4 storm SCEMD had been expecting. While emergency responders commenced operations as soon as the wind stopped blowing, some of the people who had evacuated started to come back, thinking that all threats from Florence were over. But then the rain didn't stop, and a lot of the water that deluged North Carolina headed south. That's when the rivers started to rise.

"It turned out to be a flood event," said Kaufman. "We weren't expecting that much rain, so the flood event was a surprise."

The response was protracted, which required continued collaboration across several agencies. Kaufman built internal daily situation reports in Operations Dashboard and sent them out to everyone involved in the response so they could get an overview of what was going on.

"That had county closures, shelter numbers, *[and]* a quick weather radar of significant events that were happening in the state," he explained. And it was just a modified version of the standard daily situation report SCEMD sends out on "blue-sky days," when no emergencies are taking place, so it was easy to get up and running because people were already well-versed in using the app.

Kaufman also used flood models from the Department of Natural Resources, the National Guard's data and briefing maps, and his own web apps and maps to layer all this information and get an idea of where floodwaters were predicted to rise and fall. This helped all responding agencies allocate resources appropriately.

"The flood covered a large area, so they worked downriver as it *[developed]*, trying to stay ahead," said Kaufman. "The National Guard sandbagged highways, trying to keep some of them open. The coast guard was out there with police and other law enforcement doing rescues, too."

While many search and rescue crews do still request paper maps from Kaufman (which he gladly supplies and updates to keep response efforts moving forward), he did see an uptick in use of his Web GIS products during Hurricane Florence. The search and rescue grid app, for instance, got more than 500 hits. And the Florence imagery viewer, which Kaufman built using photos from the Civil Air Patrol and the National Oceanic and Atmospheric Administration (NOAA), received several hundred hits, too.

"We're getting better every time we do this, with practice—though we wish we didn't have the practice," said Kaufman. "The mapping products are getting better, people are able to better use the products out in the field, and they're asking better questions of what they want. *[…]* ArcGIS Online is getting better, so are REST services. You can pull NOAA weather feeds in *[and]* you can give them weather maps *[as]* web maps or hard copy."

Ultimately, said Kaufman, he was able to give emergency responders better data, allowing them to make better decisions.

CREATING REAL-TIME COMMON OPERATIONAL PICTURES

While local municipalities and state agencies throughout the Carolinas did what they could to mitigate injuries and damage from Hurricane Florence, two remarkable nonprofits—NAPSG Foundation and Humanity Road—employed GIS to give search and rescue crews, emergency managers, and evacuated residents a real-time picture of what was happening on the ground. With Web GIS at the center of their workflows, both organizations were able to map crowdsourced photos and share critical, on-the-ground information with people who needed it.

"Photos are worth a thousand words, but putting a photo on a map makes those thousand words actionable," said Paul Doherty, program manager at NAPSG Foundation.

As just one part of its larger mission to incorporate geospatial technology more deeply into public safety and emergency preparedness, NAPSG Foundation partnered with another nonprofit, GISCorps, to stand up an Esri Story Maps app with crowdsourced photos from areas affected by Hurricane Florence.

"Across the entire impact area, there's no single place to go to find images of what it looks like on the ground. But it's not as simple as just putting a story map out and hoping people will add photos," explained Doherty. "The general public is hopefully out of the affected area and is not going to take the time to add a photo. But reporters and first responders are posting photos to Twitter and Facebook—they're just not georeferenced. So if you're an emergency manager, those photos slip through the cracks. They never get mapped. GISCorps *[volunteers]* look at the photos and say, 'there's a street address, a business name, a street name,' and they put that *[photo]* on the map."

With this resource, search and rescue teams were able to see the conditions they were about to head into. And when FEMA was trying to figure out if certain shelters got flooded, staff were able to check the story map to see images of each location.

Just as photos get lost in the fray during an emergency, so does valuable information, such as where shelters are located or whether there are communication outages.

"Sometimes the public doesn't know where to go for official information because the event is so large and moves so fast," said Cat Graham, the chief operations officer of Humanity Road, which sends out reports during disaster situations that list local officials; websites that display power outage information; and the status of local hospitals, airports, and other critical infrastructure. Not only does this help the public navigate events like hurricanes, but it also assists aid agencies as they prepare to service those areas.

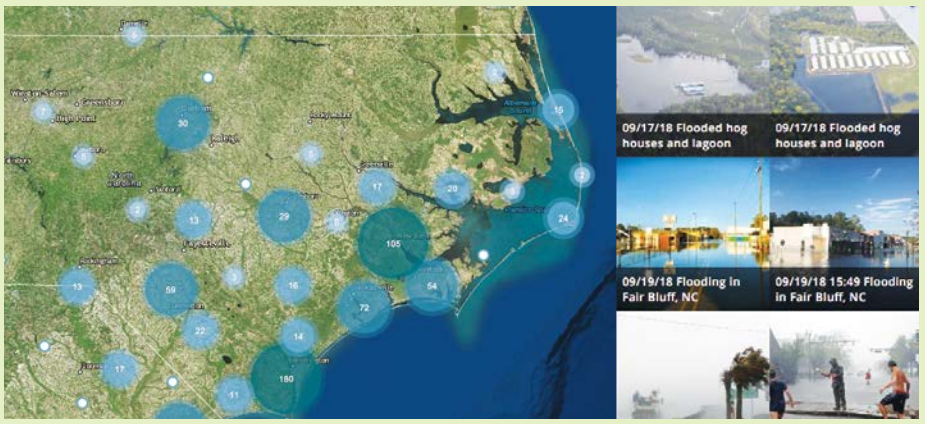
"Many people don't realize that power companies are mandated to provide a public power outage map, but communications companies are not. So it becomes challenging to get information," continued Graham. "We wonder, are we not seeing cries for help because there are none or are we not seeing cries for help because there's no communication in that area?"

To help fix this problem, the US Coast Guard activated Humanity Road for Hurricane Florence to provide a live strategic map of search and rescue requests emerging on social media—a first for disaster-related digital deployments. Humanity Road's diverse group of volunteers scoured social media feeds from about 700 cities and 30 counties for hashtags and keywords such as "help" and "I'm trapped" to identify legitimate requests for assistance. Meanwhile, two US Coast Guard Academy cadets, Reid Wiegleb and Evan Twarog (who were volunteering with Humanity Road) built geospatial information products, including a heat map—hosted in ArcGIS Online—of rescue requests that coast guard command centers were able to consume. This gave decision-makers and first responders a common operational picture of what was happening on the ground so they could position assets effectively.

"You might have seven different teams doing seven different tasks," said Graham. "When you get all those seven together and you can make a common map, you get a beautiful picture of exactly what's happening on the ground."

Both nonprofits want to see local, state, and federal organizations use geospatial information and GIS more robustly during nonemergencies as well so they can be ready to use it when disaster does strike.

"Geospatial information and tools are no longer a nice-to-have for public safety agencies," said NAPSG Foundation executive director Peter O'Rourke. "It will absolutely change the decisions *[being]* made if you use it on an ongoing basis."



↑ The National Alliance for Public Safety GIS (NAPSG) Foundation partnered with GISCorps to stand up a story map with crowdsourced photos from areas affected by Hurricane Florence.

Create Tailored Web Pages with **ArcGIS Enterprise**

Sites

Introduced in ArcGIS Enterprise 10.6.1 is a new web development known as Sites. This technology gives users the ability to design and build tailored web pages that highlight an organization's GIS content. With Sites, users of all GIS experience levels can work securely with geospatial data, right in the ArcGIS Enterprise portal—and they don't have to learn how the portal works, how to navigate it, or even how to access groups.

A site is essentially a website for finding data: there is a home page, and then one or more web pages can branch out from it to connect users to more focused content. Using the Sites app, team members who are authorized to build sites can construct and manage sites and pages for their organization. They can create a distinct look and feel as well that speaks to an individual department's or team's specific needs.

Key to Sites is its ability to customize how data is presented and prioritized. Users can create branded web pages for each department, team, project, or story they want to tell by incorporating data and maps from the relevant groups within the ArcGIS Enterprise portal. Each site can have its own branding, design, and data. This ensures that information that is important to a particular group is always front and center, at users' fingertips, and displayed in a clean and modern interface.

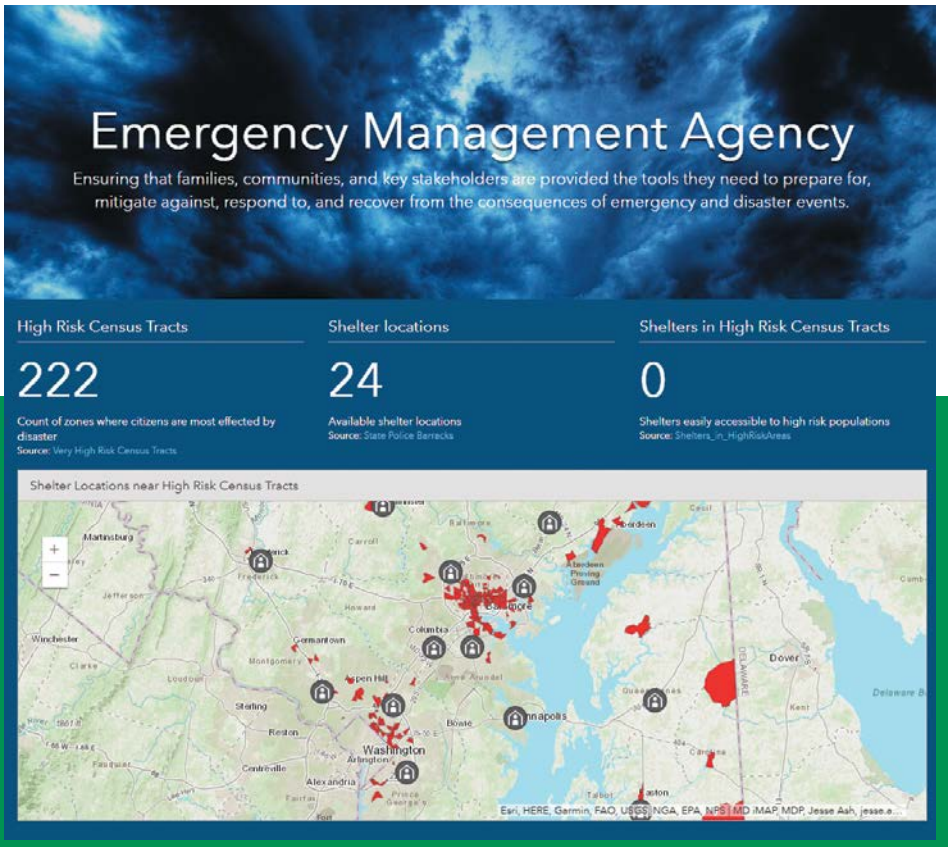
The Sites app makes it easy to build and edit sites and pages. To start creating a site, users choose the groups they want to add to it. The Layout Builder offers widgets—from web maps to iframes—that can be inserted as the site is being designed. Users can also change the background images and web page colors to achieve a specific look or match an organization's existing design standards.

Say a fire department needs quick access to its own response times and real-time fire activities. A dashboard would probably work best to show turnout time, while a web map could feature the incoming calls and responding units. In a few quick steps, a staff member on the GIS team can create the fire department's site to highlight this important information for stakeholders, including other firefighters, emergency medical technicians (EMTs), and city officials. For the firefighters and others who end up using the site on both desktop computers and mobile devices, all they have to do is scroll down the page to find the information they need in one place, with no extra clicking, tapping, or searching.

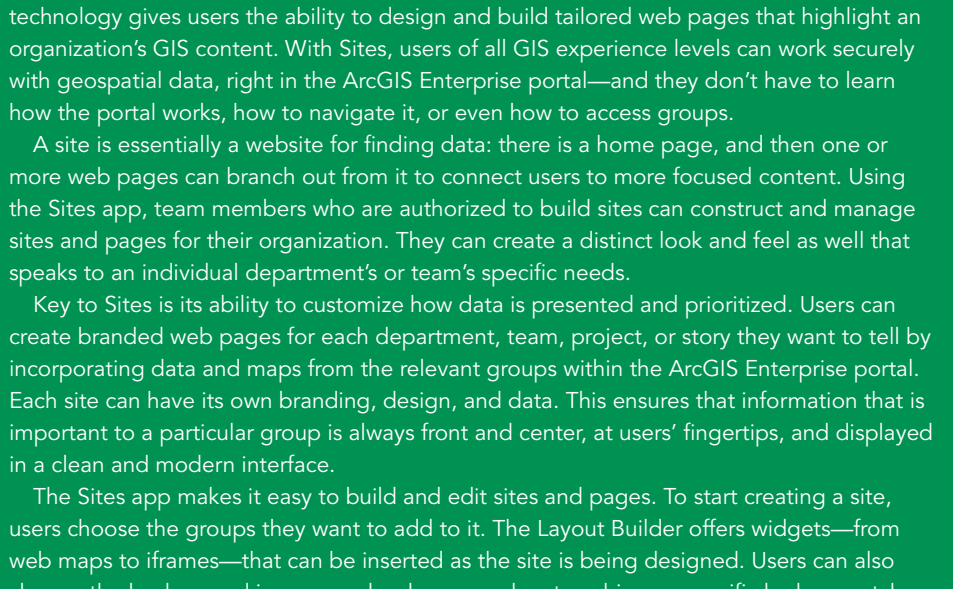
In ArcGIS Enterprise 10.7, members of an organization who have been assigned a Creator or GIS Professional User Type can be added to a Sites team, giving them the ability to build and edit sites. For ArcGIS Enterprise 10.6.1, any Level 2 member can be added to the Sites team. Sites caters to all types of users—those who want to drag elements onto web pages and those who are savvy enough with HTML that they can further customize the look and feel.

This new, interactive capability of ArcGIS Enterprise extends GIS to the whole organization, giving all users easy access to GIS data along with the power to navigate, download, and create their own geospatially focused apps on a Sites page.

Learn more about how to set up ArcGIS Enterprise Sites at **p.ctx.ly/r/8pi8**. Now, start changing the way your organization experiences GIS.



↑ Emergency management agencies can use Sites to showcase related organizations' GIS data.



↑ Sites allows users to create tailored web pages that feature key organizational data.

↑ Sites can feature maps and dashboards that matter to a user's stakeholders.

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Reducing the Risk of Avalanches with GIS and Machine Learning

customized version of the solution to gain a better understanding of how new snow, wind, and persistently weak layers of old snow contribute to the occurrence of avalanches.

"We use the components of SmartMountain that meet our specific needs and modified tools to cover areas much larger than ski resorts," said Mike Cooperstein, a CAIC avalanche forecaster. "The center's forecast area includes about 28,000 square miles of backcountry, as well as all the highway passes that avalanche paths cross."

Most of the avalanche hazard mitigation work along Colorado's highways is carried out by road crews who use explosives to test precarious, snow-laden slopes. Employing Scene Viewer in ArcGIS Pro, forecasters visualize avalanche paths in 3D so they can more accurately recommend where and when to discharge explosives.

With geoprocessing tools, scientists at CAIC can identify the elevation and degree of all the slopes within the surrounding terrain. Once the system processes that data, it outputs feature layers that can be used to display and query the data.

"Our Python machine learning algorithms dig into existing and newly collected field data," explained Cooperstein. "We can add much more data about the topography of the path and weather conditions that affect each path's own avalanche behaviors. Machine learning algorithms explore individual path data and calculate predictions."

The point at which conditions cause an avalanche release is what forecasters call the threshold value. To determine these threshold values, they rely on historic data about each avalanche path and the conditions present when the avalanche occurred. CAIC scientists have written Python scripts to determine threshold values as XML. They then color-code certain avalanche paths that will reach threshold within 12, 24, and 36 hours. Finally, CAIC scientists generate risk-level visualizations and distribute them online to CDOT's forecasters, who use them to see high-risk areas along Colorado's highways so they can target their mitigation activities.

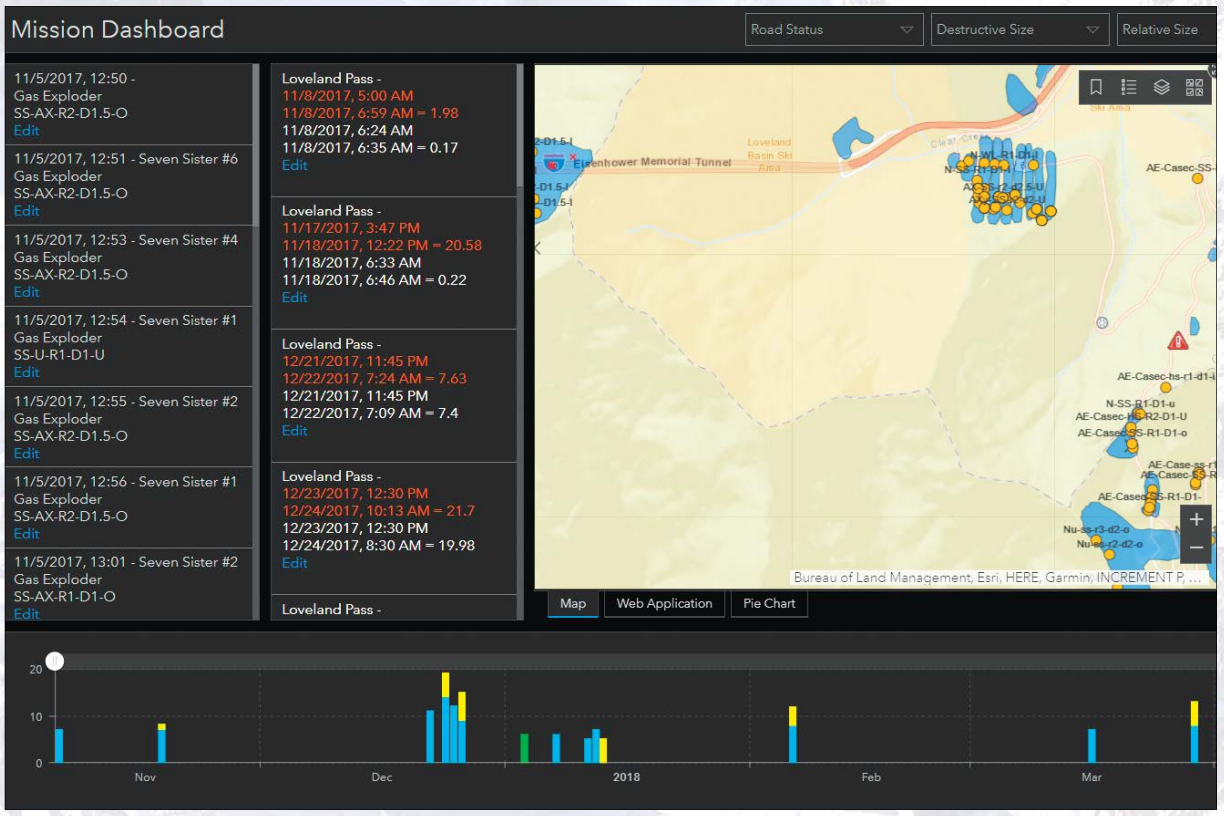
In the past, avalanche forecasters used pencil, paper, and clipboards to record avalanche occurrences. Now, field crews use Survey123 for ArcGIS to collect road closure information and document avalanche mitigation activities. They can record which explosives were used, the results of the detonation, and where an avalanche hit a highway.

"We have also been deciding what questions staff want answered and then building these into GIS applications," Cooperstein noted. "Forecasters answer their own questions without having to ask a GIS-trained person."

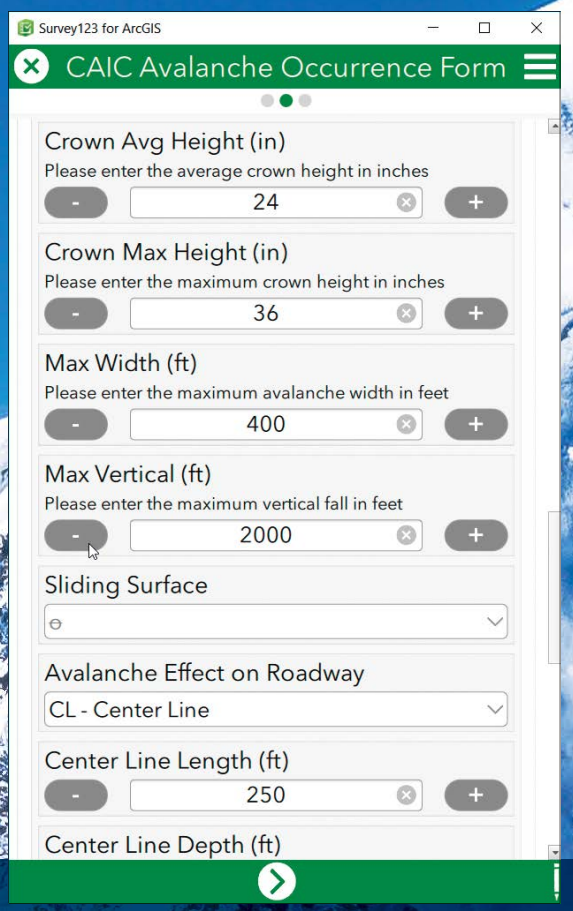
The center also uses Operations Dashboard for ArcGIS to run reports and show avalanche information in real time. The dashboard displays snow and water collection data from each highway pass, as well as several snow study plots. It flags road closures on a map and shows the number of avalanches that hit a highway both while the road is open to travelers and while it's closed for mitigation. CAIC also maintains a record of explosive inventory numbers, the date and place they were used, and by whom. The dashboard graphs the types of explosives used for avalanche mitigation and shows the outcome. This information is useful for meeting federal and state government reporting requirements.

"In the coming years, GIS will become a very important analysis tool in our industry," predicted Cooperstein. "The avalanche forecaster community is small and, therefore, able to share innovations that work in our centers. GIS applications for forecasting snow avalanche risk will be commonplace for highway and railway safety."

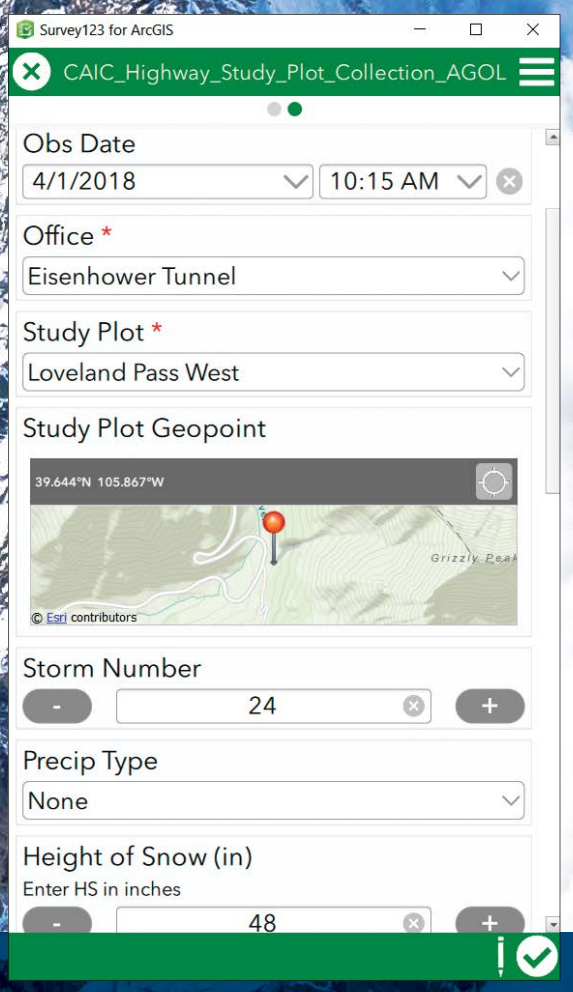
For more information, visit colorado.gov/avalanche, follow @COAvalancheInfo on Twitter and Facebook, or email Cooperstein at mike.cooperstein@state.co.us.



↑ CAIC uses Operations Dashboard for ArcGIS to display an array of avalanche data—including pertinent snow and water collection information, road closures, and details on which explosives were used for avalanche mitigation and where.



↑ While avalanche forecasters used to use pencil, paper, and clipboards to record avalanche occurrences, field crews now use Survey123 for ArcGIS to gather this information.



↑ The center has several snow study plots, where scientists now use Survey123 to record real-time information about how much precipitation there has been, how high the snow is, and more.

INTRODUCING THE GEOSPATIAL DATA ACT

The New Law Will Increase Collaboration and Improve Oversight

By Orrin Hatch, Former Senator from Utah

Former US Senator from Utah Orrin Hatch

About the Author

Senator Orrin Hatch, who retired on January 3, 2019, is one of the longest-serving senators in US history, having represented the state of Utah since 1977. He was president pro tempore and served as chairman of the Senate Finance Committee; the Senate Judiciary Committee; and the Senate Health, Education, Labor, and Pensions Committee.

For decades, the United States federal government has purchased, utilized, and produced a wide range of data tied to specific locations. This geospatial data plays a crucial role in ensuring national security, growing the economy, planning infrastructure investments, and responding to natural disasters. Many believe that the US government possesses the world's largest database of geospatial data. Accordingly, Congress has been developing strategies to best manage this resource.

Though geospatial data plays a meaningful role in nearly all government functions, federal efforts tied to collecting this data have historically lacked coordination and often been duplicative, resulting in billions of dollars in wasted resources, according to the US Government Accountability Office. In addition, poor coordination degrades the most effective utilization of federal geospatial data and assets, which has diminished the quality of resources available to agencies. For example, better integration of different datasets can improve disaster relief efforts by allowing firefighters to more quickly determine which roads will succumb to wildfire.

For these reasons, I joined with Senator Mark Warner of Virginia in 2015 to introduce the Geospatial Data Act (GDA) with the goal of improving collaboration across agencies, reducing waste, and providing oversight of the federal government's multibillion-dollar investments in geospatial data.

Over the last four years, in serving as sponsor of the GDA, I have had the opportunity to engage with individuals, state and local governments, companies, and trade organizations representing the full range of the geography and geospatial community. As with any significant bill introduced in Congress, these stakeholders have sometimes disagreed on important aspects of the legislation. But by working diligently and continuing to engage with geospatial data advocates from across the spectrum of users, we were able to forge a compromise supported by all the key players. That resultant consensus was reflected by the combined cosponsorship of 15 Republican, Democrat, and Independent senators.

In today's era of Washington gridlock, legislation that receives broad support is an increasingly fleeting achievement, and I am pleased that Congress was able to enact the GDA as a component of the Federal Aviation Administration (FAA) reauthorization bill. Securing passage of the law required the sweat equity of members of Congress, staffers from dozens of Senate and House offices, administrative staff from over 30 executive departments and agencies, advocates from over 50 stakeholder groups and industry partners, Congressional research staff and legislative attorneys, and more.

Backed by the authority of Congress, the bill expands the roles of the Federal Geographic Data Committee (FGDC) and the National Geospatial Advisory Committee (NGAC), two key panels that allow federal agencies, the private sector, nongovernmental organizations, state and local governments, tribal representatives, licensed professionals, and others to deliberate significant issues related to federal management of geospatial data assets. These committees and their cochairs at the Department of the Interior and the Office of Management and Budget will play a vital role as the GDA is implemented over the next five years and beyond.

The Geospatial Data Act expands the roles of the Federal Geographic Data Committee (FGDC) and the National Geospatial Advisory Committee (NGAC).

The legislation also formally clarifies the roles of the National Spatial Data Infrastructure (NSDI) and the National Geospatial Data Asset (NGDA) and sets geospatial data standards for covered agencies. Perhaps most importantly, this will foster greater public and private sector access to federal geospatial data. By ensuring that public geospatial data is properly accounted for and managed, state and local governments will be able to allocate their scarce resources more effectively.

Moving forward, federal procurement of geospatial data and services is a critical issue that will be discussed extensively with the stakeholder community and my colleagues in Congress. Based on my experience, it is abundantly clear to me that federal agencies are best served by working with the entire, vibrant geospatial community as they undertake geospatial procurements. The geospatial technologies field is one of the fastest-growing industries in the United States, and it would do a disservice to American taxpayers if the government failed to partner with the private sector entities, innovators, data users, organizations, scientists, researchers, licensed professionals, and many others who make the community so strong.

In working on the GDA, it has always been clear to me that the full range of geospatial data users and advocates understood the importance of enacting robust legislation. The final text is evidence of my longstanding commitment to honor the views of all stakeholders and to work with congressional colleagues on a bipartisan basis. As public law, it establishes a strong foundation for federal geospatial policy for years to come, in a manner that delivers meaningful wins for all geospatial stakeholders. I am confident that the GDA will reduce waste; improve federal management, coordination, and utilization of geospatial data; strengthen infrastructure planning; and improve emergency response capabilities.

As we turn toward implementation, the FGDC, NGAC, federal agencies, and my colleagues in Congress will need the help of Esri, its users, and the entire geospatial community to ensure that the government is best served by its significant investments in geospatial data. Thank you for your help as the bill was negotiated on Capitol Hill and for the leadership I know you will provide in the months and years ahead.

Crossing Borders

A column by Doug Richardson
Executive Director, American Association of Geographers

GOOD NEWS FOR THE GIS USER COMMUNITY

After years of gestation, Congress passed the comprehensive Geospatial Data Act (GDA) of 2018 into law on October 5, 2018. While the GDA primarily addresses geospatial data management and coordination for federal agencies, it will also have far-reaching implications and benefits for the broader GIS user community.

Those of us in the GIS research and user communities have long recognized the need to better organize and manage geospatial data among federal agencies, the federal government, local and state authorities, the private sector, and academia. The GDA contains provisions to improve the extent and efficiency of that coordination. The bill codifies and expands the role of the Federal Geographic Data Committee (FGDC) and formally supports the goal of creating a robust National Spatial Data Infrastructure (NSDI), which is defined in the new law as "the technology, policies, criteria, standards, and employees necessary to promote geospatial data sharing throughout the Federal Government, State, tribal, and local governments, and the private sector (including nonprofit organizations and institutions of higher education)."

Significantly, the GDA also requires all federal agencies responsible for geospatial data to conduct an annual inventory and assessment of their geospatial data assets. This process should generate substantial new data collection and upgrading and stimulate more forward thinking about the long-term value of GIS in government operations. Additionally, the GDA provides a mandate and support for the FGDC to operate "an electronic service that provides access to geospatial data and metadata"—known as the GeoPlatform—for GIS users and the general public.

The implementation of the GDA during the next few years will need to rely on the services and tools from our world-leading network of GIS and IT mapping communities and companies, which are already powering sustained growth in new technologies and US jobs. As our vibrant GIS community continues to expand, it has further raised awareness and recognition by Congress of the importance of GIS as a crucial tool for US infrastructure development and the defense and security of our nation, as well as a management tool for governments and major businesses throughout the world.

More Good News: No Exclusionary Procurement Provisions

For the broader GIS user community, what is not in the GDA may be even more important than what is. The earlier version of the Geospatial Data Act of 2017 (S.1253) contained language that would have imposed a system of exclusionary procurement that would have thwarted competition and innovation. It would have prevented most companies and GIS organizations in the dynamic and rapidly growing GIS and mapping sector from receiving federal contracts for mapping or GIS activities, including GPS field data collection, GIS analysis, Internet mapping, location-based services, remote sensing, and digital or manual mapmaking of almost any type.

I am pleased to point out that the GDA of 2018 was passed without the damaging exclusionary procurement provisions that were previously in the bill. After considering input from a variety of stakeholders, House and Senate congressional committees finally settled on a streamlined GDA bill stripped of the language that would have limited federal procurement of geospatial data and services to a small segment of the geospatial community. The Association of American Geographers (AAG) is proud to have taken the lead on helping to create a balanced approach for the GDA, resulting in a bill that is inclusive of the broader geography and geospatial communities.

AAG has been monitoring and providing expertise regarding the GDA for many years at the request of congressional members. We thank the bipartisan efforts of the bill's cosponsors, Senators Orrin Hatch (R-UT) and Mark Warner (D-VA) and Congressmen Bruce Westerman (R-AR) and Seth Moulton (D-MA), for the opportunity to work together to shape and pass an excellent Geospatial Data Act. This legislation will save US taxpayers millions of dollars, as it allows government agencies to better coordinate with one another to prevent duplication and acquire geospatial expertise, technology, services, and data from across the full range of a dynamic and flourishing US geographic and geospatial community.

Implementing the GDA with Help from a Well-Rounded Workforce

The implementation of the GDA will require not only continued research and development of new GIS and related geospatial technologies but also a well-rounded geography and GIS workforce. Education has always been a key component of our geospatial ecosystem, and the AAG's 12,000 members play a key role in educating the next generation of geographers, GIScientists, geoscience researchers, and GIS users.

As GDA cosponsor Congressman Westerman stressed in a GIS Day speech shortly after the GDA passed, "Education and understanding geospatial data is an increasingly important skill in today's world because it's widely used every day." AAG's Candice Luebbering, speaking at the same event, added, "Geographic and GIS literacy and spatial thinking are universal skills. If you learn this technology, it doesn't pigeonhole you into one career."

We look forward to supporting the implementation of the GDA in the future—in partnership with you, the GIS user community.

Contact Doug Richardson at **drichardson@aag.org**.

Bringing Digital Transformation to the Catholic Church

"In the history of civilization, there likely hasn't been anything that has caused more conflict than either land (and who controls it) or religion. And part of that is because these are two of the most powerful leverage points for change in a civilization."

That's what Molly Burhans, the founder and executive director of a nonprofit called GoodLands, incisively pointed out during a recent interview. And she would know: her organization, with help and support from Esri, is currently mapping out all the land owned by the Catholic Church.

"The way we use our lands has a moral dimension," said Burhans, who was exploring becoming a nun in college when she first noticed that the Church was unwittingly overlooking its most financially and politically powerful asset—its land. "The environment is the spatiotemporal matrix where all our good works play out. You can be a person who cares about the earth, and you can ignore the poor and ignore all the vulnerability in society. But if you're a person who cares about the poor and the sick, you can't ignore the environment."

The way landscapes are constructed has a profound influence on everything, she remarked, from child development and asthma to education and economic status.

"The environment is critical for almost every mission of the Church," Burhans added. "How we use our land can change the world. But we need maps to make smart decisions about it."

While nobody really knows how much land the Church owns, it is certainly one of the largest private landholders in the world. Considering that it runs the most extensive network of health-care institutions and nongovernmental schools around the globe, it would be no surprise, according to Burhans, if the Catholic Church did control the largest amount of land on earth.

But the last maps the Catholic Church made of its landholdings date back to the Holy Roman Empire. Burhans and her team at GoodLands—which now consists of herself, 14 part-time employees and volunteers, and a network of about 50 technology contractors—essentially had to start from scratch. The data that is needed to create a high-level map of the Church's geo-religious boundaries is scattered all over the world—from libraries in Connecticut to street-side posters in Hyderabad, India. But because Burhans possesses an exceptional capacity to think about the big picture while not letting any of the details slide, this truly monumental project is making progress, producing the most expansive yet comprehensive map and dataset of Catholic-owned land the world has ever seen.

Seeing the Whole but Not Overlooking the Parts

It seems that Burhans has always been able to consider broad strokes and minutiae concurrently. The daughter of two scientists, she started dabbling in scientific illustration when she was 14 years old. At first, she just did it for them. But then their colleagues began reaching out to her with projects, so she made illustrations in exchange for their lecture notes and syllabi.

"When I was younger, I was so interested in how the human body worked, but it seemed so complex," she recalled. "I drew on this big sheet of paper this massive, empty human body, and I used layers of tracing paper to fill it in with all its parts."

Using intricate layers to fill in a blank slate and distilling complex ideas into a visual display, Burhans unsurprisingly sees a direct correlation between scientific illustration and cartography.

"If you're putting an illustration together of a human ear, that's just like the layers of a map," she said. "My brain was already in this space to be thinking just like GIS when I encountered it."

But that didn't happen until she went to graduate school. First, she took a few years after high school to travel and work with nongovernmental organizations before attending Canisius College in Buffalo, New York, where she majored in philosophy. While there, Burhans cofounded her first company, GroOperative, an indoor vertical farm that grows food in stacked layers and turns all its profits over to farmworkers. This is also when she spent time at a Catholic congregation in the northeastern United States, getting to know the ways of its nuns. It was here that she observed the Church's shortcomings in land management.

"I saw that these sisters were some of the most holy, good people in action. I mean, they were getting rival gang members to bake bread together. But they had a lot of houses in the inner city that were underused, and their mother house in the country had unkempt swaths of forest and acres of mown lawns," Burhans recalled. "I thought I should help them figure this out before seriously considering joining any specific religious community. Along the way, I discovered that no one was really helping the Church manage its real estate in a way that's aligned with its mission."

With this in mind, Burhans entered a graduate program in ecological design at the Conway School, a unique program in Northampton, Massachusetts, that emphasizes teaching whole-systems theories for sustainable landscape planning and design. That's where Burhans first encountered Harvard Graduate School of Design professor emeritus Carl Steinitz's work and was able to apply the concepts of geodesign to the real world via the client projects she and her classmates had to do.

"I had this really amazing, very flexible education that allowed me to explore and live the geodesign methods in practice," said Burhans.

While the majority of students who graduate from Conway go on to found their own landscape companies, Burhans took a bit of a different approach to her entrepreneurial aspirations. She decided that geodesign was the way she could parlay her landscape design-based education and interest in cartography into a venture that could help Catholic dioceses—and those nuns she so greatly admired—more sustainably manage their land and real estate holdings.

"I took less than a week off between finishing grad school and founding GoodLands," she said.

From One-Off Projects to a Worldwide, Cloud-Based System

Once Burhans set up GoodLands, she wanted to do a complete land analysis before getting any contracted jobs. Working out of the Hartford Public Library in Connecticut, she used the Hartford Archdiocese as a prototype.

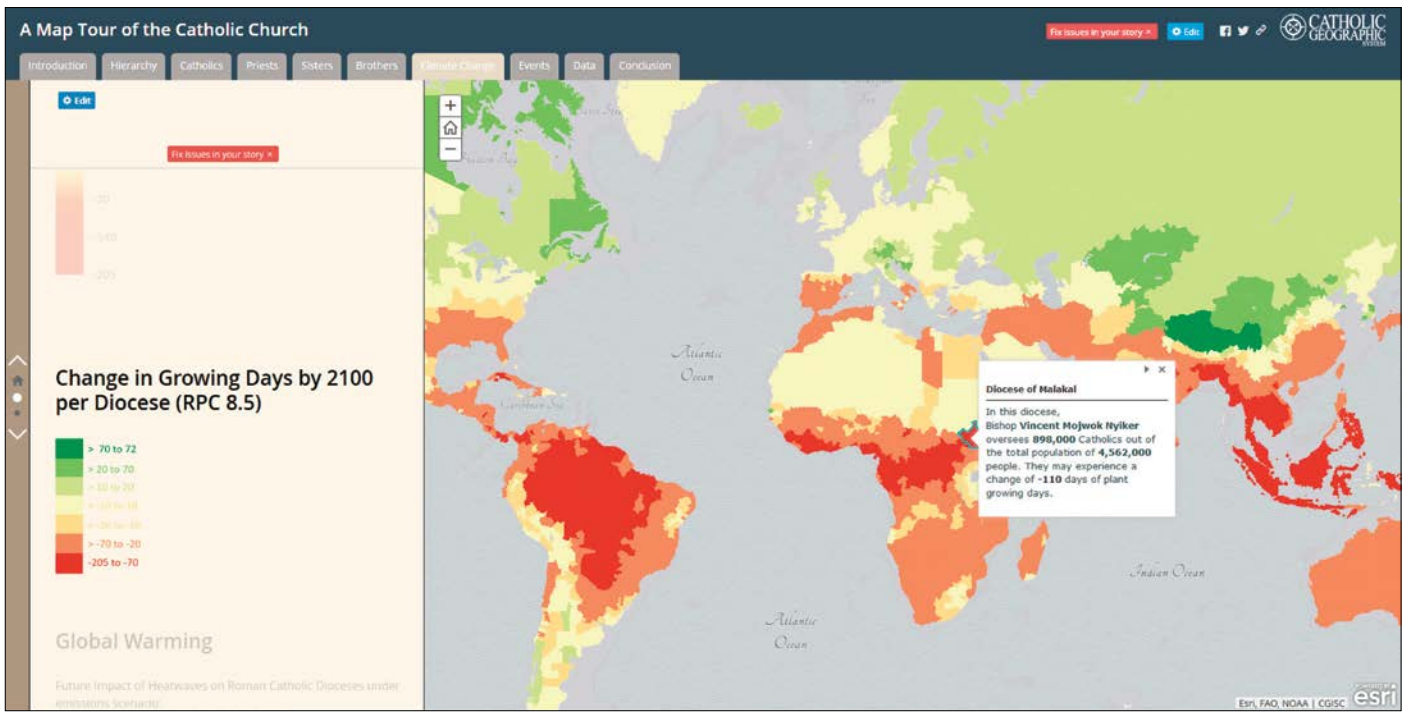
"I wanted to work through what a project would look like and then pitch it to them," she said. "I started to just map out all the information within the archdiocese that I could find."

She used a lot of data from the University of Connecticut, the state, and local municipalities to see what was there and then did an environmental analysis of everything the archdiocese owned. Burhans quickly learned that her organization needed to offer broad solutions that encompass three key domains: the environment, financial concerns, and social issues.

This project also gave Burhans an inkling of what Catholic land looked like around the world, so she started thinking bigger than doing one-off projects for individual dioceses. What if she could build a global database of all the land the Catholic Church owned to help members and leaders of this major world religion understand the environmental value of their property and how it relates to space? She could not only educate dioceses on how to conserve portions of their land to protect threatened species, but she could also formulate a comprehensive overview of how the Church can use its land to help tackle huge problems such as climate change and mass migration.

With this outlook, the fledgling organization grew in importance fast. Not even a week after launching the GoodLands website, *Landscape Architecture Magazine* reached out to Burhans to do a story on her and her project. That was

↑ Molly Burhans is the founder and executive director of GoodLands.



→ GoodLands is formulating a comprehensive overview of how the Church can use its land to help tackle bigger problems, such as climate change and mass migration.

the first piece of press ever about GoodLands, and after its release in December 2015, the momentum kept building. Pope Francis had released his encyclical on the environment, *Laudato si'*, earlier that same year, which prompted the formation of a global community to figure out how the Church relates to sustainable development and environmental challenges. Additionally, the 2015 United Nations Climate Change Conference, COP 21, took place in Paris around the same time the *Landscape Architecture* article came out.

"The timing was perfect," recalled Burhans. "I just felt it. The fact that we are faced with this massive, daunting challenge not only of our environment being destroyed around us… but also of migration inevitably increasing in the coming decades, I knew that a project like GoodLands needed to happen."

The following month, Burhans and two of her mentors flew out to Redlands, California, to give an executive briefing to Esri president Jack Dangermond and his advisory team about mapping the Catholic Church's boundaries worldwide.

"We got a small grant from Esri, and then *[Dangermond]* opened up the Esri Prototype Lab to GoodLands, which was invaluable," said Burhans.

She spent time at Esri as a visiting researcher, working with the Prototype Lab to create a dynamic map of all the land the Catholic Church oversees. Burhans also worked with Esri Professional Services to start designing a spatial data infrastructure (SDI) for the Catholic community. And the cartography team helped her make web maps for a map exhibit in the Vatican's Casina Pio IV villa as part of the Vatican Art and Technology Council.

Around the same time, Burhans visited Vatican City and met with the Secretary of State's office to see if she could obtain any global boundary datasets the Holy See had for Catholic parishes, dioceses, and conferences around the world. There were none.

"They hadn't had a map update since the Holy Roman Empire," recalled Burhans. "I asked, 'Is there any reason why this hasn't happened, and do you mind if I do this?' They looked at my prototypes and said that, yes, global boundary sets would be useful."

With tacit approval from the Vatican to continue with the project, Burhans set about expanding GoodLands' offerings. The organization does a range of specialized projects for individual dioceses and other landowners: coming up with holistic master plans for how to best use land and real estate, doing climate change risk assessments, developing map-based communication systems, and building GIS-based data structures. It is also weaving this into a larger network of spatial data that Burhans hopes can bring the Catholic Church's maps into the twenty-first century.

"A lot of the Church is still pre-digital transformation by hundreds of years," said Burhans. "I am so excited about the possibility of getting the entire Church into the digital age because I think it has a really important role in multiple ways—one of them being understanding a healthy relationship with technology and another being how we can ensure the intelligent and respectful use of data," which could be akin to formulating a sort of digital canon law.

The map of the boundaries of Catholic-owned lands is the basis of all GoodLands' work, but there are hundreds of maps buttressing that. GoodLands has close to 1,000 maps in its back end, both on- and offline, that stem from various projects, including client work and activities with the Vatican. And Burhans and her team employ a range of ArcGIS technology to execute their groundbreaking mission—from ArcMap, ArcGIS Pro, and ArcGIS Enterprise for doing heavy mapping and data management to Survey123 for ArcGIS for data collection, Esri CityEngine for 3D modeling, and GeoPlanner for ArcGIS for planning and design. Burhans hopes to soon incorporate ArcGIS Hub into the stack to help individual dioceses manage and share their data on their own.

"I don't want to give people a master plan that sits on a shelf," explained Burhans. "I want to give people their maps, their entire plans, in a cloud-based format that they'll use."

And that's exactly what a robust GIS can do.

Stewarding This Invaluable, Groundbreaking Data

Burhans has met Pope Francis three times since founding GoodLands. Once, she presented him with a version of the master boundary map, which he received with a lively smile. When she met the pope again this past summer, it set in motion a venture that Burhans never could have imagined.

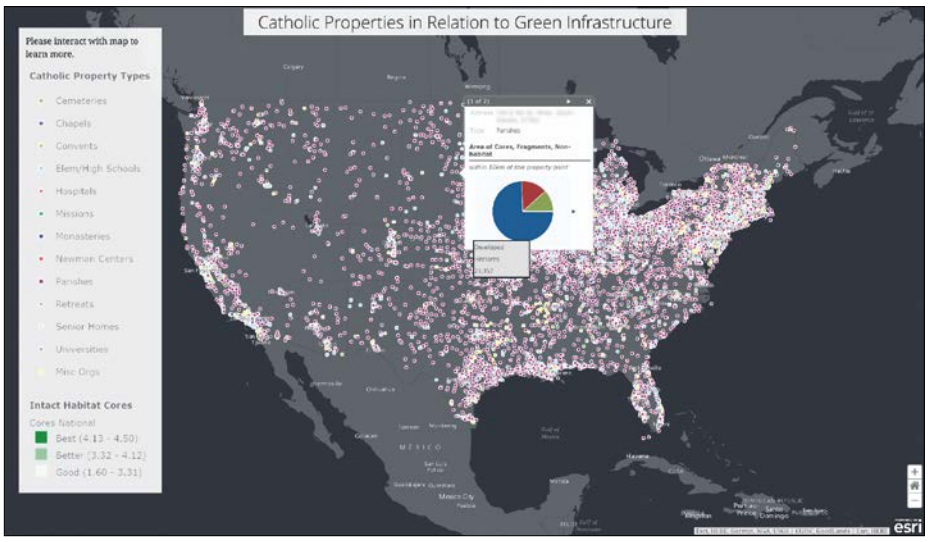
"I received some permissions to establish a test-run cartography institute in the Vatican under the Pontifical Academy of Sciences," said Burhans. "While we have initial approval, we are all deliberately moving slowly."

Discussions are ongoing around how the institute could work to be most beneficial to the Church's current needs, while Burhans and her team proceed with side projects and research that are relevant to the Vatican's goals.

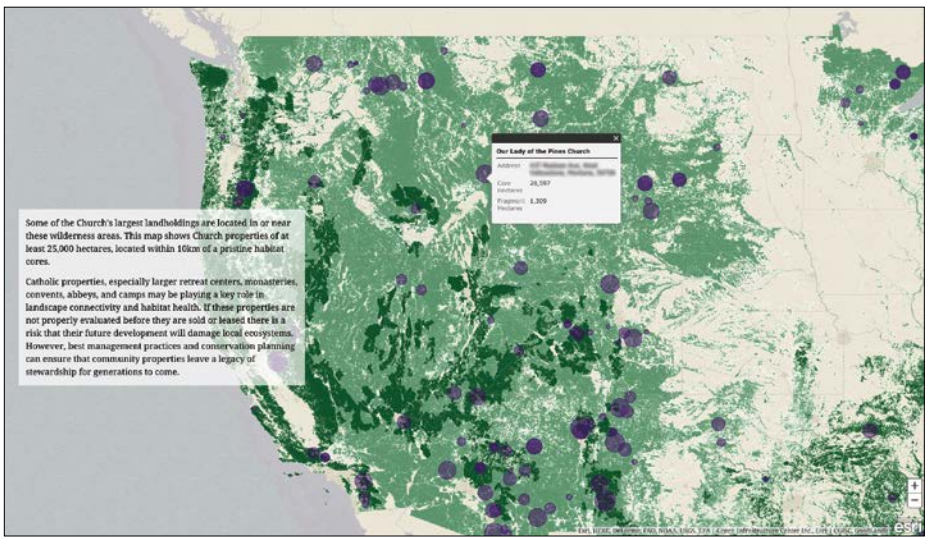
"This would be the first scientific institution founded in the Holy See since the Vatican Observatory," Burhans pointed out.

It was that observatory that ushered in the Gregorian calendar, which much of the world uses today. And that calendar was approved by Pope Gregory XIII. So Burhans understands how consequential this new institute could be and how far papal approval can take something.

"GoodLands has the only global boundary dataset for the Church and a growing catalog of information about its property assets around the world," said Burhans. "Because we have this, I'm hoping we can help establish the cartography institute's structure and then let it go from GoodLands and have it become part of the Holy See. From the institute, in the long run, I feel like we could see the emergence of the authoritative boundaries of the Church."



↑ Burhans has employed geodesign and the concepts of green infrastructure to help Catholic dioceses more sustainably manage their real estate holdings.



↑ GoodLands educates dioceses on how to conserve portions of their land to preserve habitats and protect threatened species.

For now, however, the global boundaries are being mapped and released cautiously, so far only available via video demonstrations that don't allow users to interact with the data. This is intentional. Burhans wouldn't want to pinpoint where every Catholic Church is in environments that are hostile to Christianity and then have people get hurt because of that.

"This is the first time any major world religion has been mapped around georeligious boundaries," she said. That carries with it a great responsibility, which Burhans is well suited to shoulder.

"I don't know why I am the person who ended up in this position…but I'm really grateful that I have had this mind-set of looking at the big picture," she reflected.

Burhans does expect that within the next 5 to 10 years, a public version of the boundaries will be released. But she's looking toward the Vatican to steward that data. Then, who knows how far it could go in helping nonstate actors—the Church, businesses, and nongovernmental organizations—manage complex issues, from climate change and food security to migration and so much more.

For more information about GoodLands, visit good-lands.org, explore the Making Land Work for Good (arcg.is/00iSGj) and Map Tour of the Catholic Church (arcg.is/1OvKPT) story maps, or email info@good-lands.org.

↑ A lot of the Church is still pre-digital transformation by hundreds of years, but Burhans is trying to help bring its maps into the twenty-first century. She is pictured here holding one of her maps in the Third Loggia of the Apostolic Palace at the Vatican.

↑ Esri president Jack Dangermond (left) and CEO of Autodesk Andrew Anagnost jointly announced the Esri-Autodesk partnership at Autodesk University 2017.

Esri-Autodesk Partnership

Year One of a Bold Partnership That the World Needs

By Gavin Schrock, *xyHt*

Esri president and cofounder Jack Dangermond and Autodesk CEO Andrew Anagnost both agreed to provide insights on the Esri-Autodesk partnership, now entering its second year. They discussed the specific fruits of the collaboration to date, but they focused on the motivation and impetus for this historic handshake.

If you've ever had to work with one foot in each of the worlds of CAD/CAE (computer aided drafting/design and computer aided engineering) and GIS, you know this partnership is a very, very big deal.

You cannot design in a vacuum.

You cannot build in a vacuum.

You cannot operate and manage infrastructure and assets in a vacuum.

The world—the built environment we inhabit—is growing so rapidly that legacy methods and resources serving architecture, engineering, and construction (AEC) simply will not be able to meet demands. It has always been true that you cannot design/build/operate/manage in a vacuum, but in the present day—and every day moving forward—those burdens will increase. But so will the opportunities.

GIS and CAD, CAD and GIS: there is no way to disconnect the two as essential in growing and managing the built environment. During the decades when both grew to be the essential tools we use today, they were somewhat disconnected. Many of us have had to learn two systems and work with two departments within two sets of disciplines that have at times (to be frank) seemed adversarial.

Despite the apparent disconnect, over the years there have been many key areas of collaboration between the two global leaders for GIS and CAD/CAE. Remember ArcCAD?

What's so different this time? How might this partnership solve persistent problems? It might seem like we are sensationalizing it by saying that a kind of "cold war" is over, but that's part of the story.

The key takeaway we see is that this partnership may be a harbinger of a change in mind-set and a reaction to an imperative for change.

ANYWHERE, ANYTIME

The most recent collaboration between these two geospatial giants began about three years ago under then-Autodesk CEO Carl Bass (details are in the WHO ASKED WHOM? section on page 16). Since Bass's departure in 2017, Anagnost as CEO has overseen the partnership on the Autodesk side. Anagnost is an engineer in aeronautics and manufacturing with a doctorate from Stanford. He has had many roles at Autodesk in his nearly two decades with the company, most notably shepherding the development of Autodesk Inventor.

Like Jack Dangermond, Anagnost exhibits seemingly boundless energy and passion for his company and the future. Behind his stand-up desk in his sensible and efficient office at the company headquarters in San Francisco, he has a poster diagramming the flight paths of all spacecraft and probe missions throughout the solar system and beyond. Among his other passions is the commercialization of space.

The interview ranged all over the place, but in a good way: automation, licensing, the cloud, challenges and opportunities for surveyors, and more. The focus of the following conversation was the partnership.

Gavin Schrock (GS): The partnership had been germinating for a while. What was your reaction when you first heard about it?

Andrew Anagnost (AA): My reaction was: it's about time. This is the kind of partnership that needs to happen. You know when we *[Anagnost and Dangermond]* talked about it on the main stage *[at Autodesk University 2017]*, we talked about this as our vision to be able to *make anything anywhere*: a little tag line we put on it.

It is super important; it is super exciting. If you look big-picture-wise where things are going, people are trying to manage and evolve the design of urban environments and infrastructure in more sustainable, reliable ways, where they can build a lot more things under the same kind of budget and constraints they have today.

We know we are all living in a world right now where there is not enough funding, resources, or capability to build all of the infrastructure: that which needs to be rebuilt in the mature world and all of the infrastructure and cities that need to be built in the maturing world.

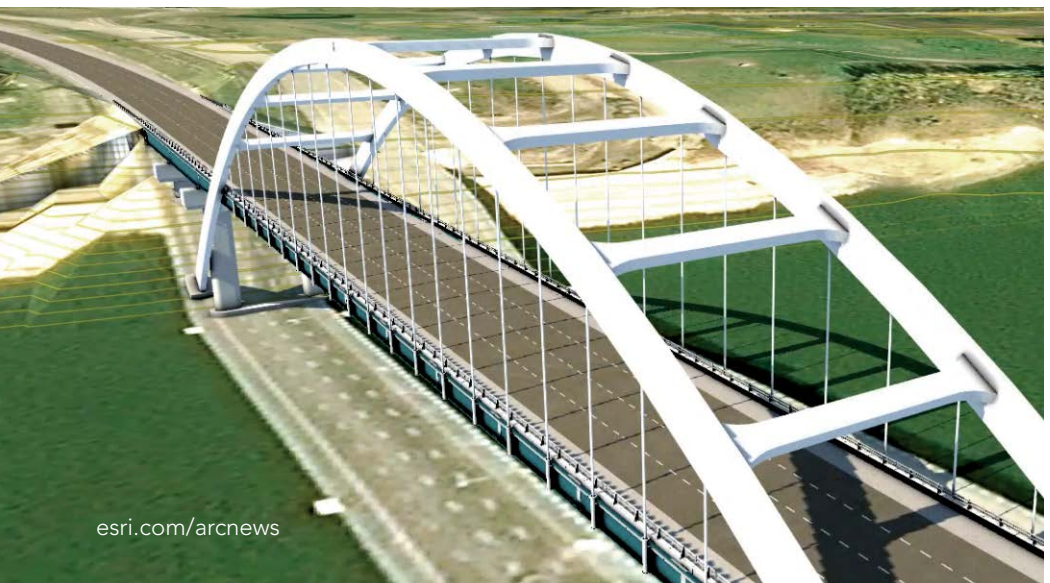
At Autodesk we see this as a fundamental capacity problem. City planners, and people trying to build a city or an infrastructure project that connects a city, they want to visualize the whole thing in context. They want to see the as-planned, the as-designed, and as-built state in a dynamic, intelligent, useful, and persistent city model.

Esri owns the planning, city-facing context view of what the whole city looks like and the associated data at that scale, and we own the content that shows up inside the models: the buildings, the roads—all of these things.

We need the information from that system to create the correct context for the things we're designing inside of Autodesk's InfraWorks, inside of Civil 3D, inside of Revit—all sorts of applications. And they need the actual as-built or as-designed entities to sit intelligently inside their view of the world. We should be seamlessly sharing this information back and forth in such a way that most people never notice that it is from shared applications.

Esri and Autodesk were once considered competitors, but that didn't make any sense at all because our core competencies were in completely different areas.

Both companies are strongly committed to supporting these needs and contributing, in concert, respective essential pieces of the whole. This is something the world needs right now for better planning, for better resourcing, for better understanding of what needs to be built and when.



← Autodesk users needed ArcGIS to create the correct context for what they were designing in Autodesk's InfraWorks, Revit, and other software. Now with the partnership between Esri and Autodesk, this is how a model of a structure is presented in 3D in InfraWorks.

DIFFERENCES THAT UNITE IN PURPOSE

What distinguishes the different core competencies of the two companies is not as simple as the difference between CAD and GIS (if viewed simply as software), but those structural differences drove some of what would later become discipline-level divisions. To understand the impetus behind this partnership, we also must understand those differences and how the recognition of strengths of the other fostered collaboration.

The best explanation I know contrasting CAD/CAE and GIS is from Jack Dangermond in our recent interview at his office in the Esri headquarters in Redlands, California. Dangermond, who cofounded, with his wife Laura Dangermond, Environmental Systems Research Institute, Inc. (Esri), in 1969, did not originally intend it to be a software startup. His background and education were in landscape architecture.

During the course of Dangermond's studies, an amazing opportunity changed his plans: to study and work in the Harvard labs on the emerging fields of computer graphics, spatial analysis, and quantitative geography. After Dangermond founded Esri postgraduation, the company was at first a provider of services on a project basis, but later, so many people, governments, and companies recognized the power of what Dangermond and his team could do that they pressed him to make his software a supported product.

During our recent interview, Dangermond outlined that history, as well as the evolution of both Esri and GIS in general.

GS: How would you describe the differences between CAD and GIS?

Jack Dangermond (JD): Let's start with the core technology. In 1985 I wrote an article, "CAD vs. GIS for Mapping." CAD is just a fabulous technology, Autodesk's AutoCAD being the leader, but its architecture is a data model which manages and displays graphics. You store in a display list, in a file, all the little graphic elements.

In GIS you store geographic features rather than graphic features. You would display the geographic features—points, lines, and polygons—by generating them from a database and associating the geographic features on the fly. *[That]* was so much slower in the 1980s.

But the distinction *[with GIS]* was that you could do analytics on these simple georelational tables: polygon overlay, buffer zones, and hundreds of others, whereas you couldn't do those analytics on a graphics-only file. Also *[in GIS]* you could make multiple views of the data model all from a single database.

It was *[a]* fundamental difference in the technology—at that time. The advantage of CAD was that it had lightning speed, and still does, of course, in graphics display. So, the engineers used it as a graphic engine. People would build add-ons to add a little geoprocessing to the CAD files, but the core differences in technology remained.

[For a period of time] Autodesk was very ambitious about the idea of getting into the geoprocessing world, so they bought a series of companies and tried to extend the AutoCAD technology in the GIS space. I think the evidence is that this did not work out. I think they were very right in doing it, but their main core business has been in the workflows of engineering design, architectural design, civil engineering, and surveyors.

GS: There seemed to be two distinct communities—will it always be that way?

JD: A lot of it has to do with just not having enough capacity to learn multiple sets of tools and not having the capacity to be both an engineer and planner at the same time, and so then little weird things begin emerging: them versus us.

If we are really talking about successful urban management and making cities more livable, operating more affectively, making better investments in infrastructure, we need the opposite—we need to try to break down barriers between professionals so they can easily and seamlessly use each other's data.

continued on page 16

continued from page 15

Esri-Autodesk Partnership

WHO ASKED WHOM?

When we write about partnerships in the geospatial industry, we always try to find out "who asked whom to the dance." We spoke with Chris Andrews, senior product manager in Esri's 3D product management group: a major player in bringing the two together and widely recognized as the author of this partnership.

GS: You had worked at a number of GIS firms, then worked at Autodesk, and now at Esri. Was having experience in both worlds a major influence in your initiative to foster a partnership?

Chris Andrews (CA): When I joined Autodesk in 2007, because of my familiarity with the GIS market business partner programs and tech, I was tasked with advising partners and development teams at Autodesk in how to be competitive in the GIS space. I moved into the role as technical product manager on the digital cities effort there and was involved from scratch in Infrastructure Modeler (now InfraWorks), originally built as a competitive city planning-based concept application to go into the market against other GIS solutions.

I left Autodesk after being there about seven years and ended up at Esri. I was approached by one of my *[former Autodesk]* colleagues and asked if we should start up a conversation about bringing together Esri and Autodesk, both knowing how compatible our marketing strategies had become. But I said we should hold off awhile as I was new.

About a year of my time focused on the ArcGIS Earth effort, which was really important for not only our defense and intelligence community customers, but our beta user stats revealed that 40 percent of those users self-identified as being from AEC disciplines. That was a pretty big surprise to a lot of folks: more indication that working with Autodesk in the AEC arena would be a good idea.

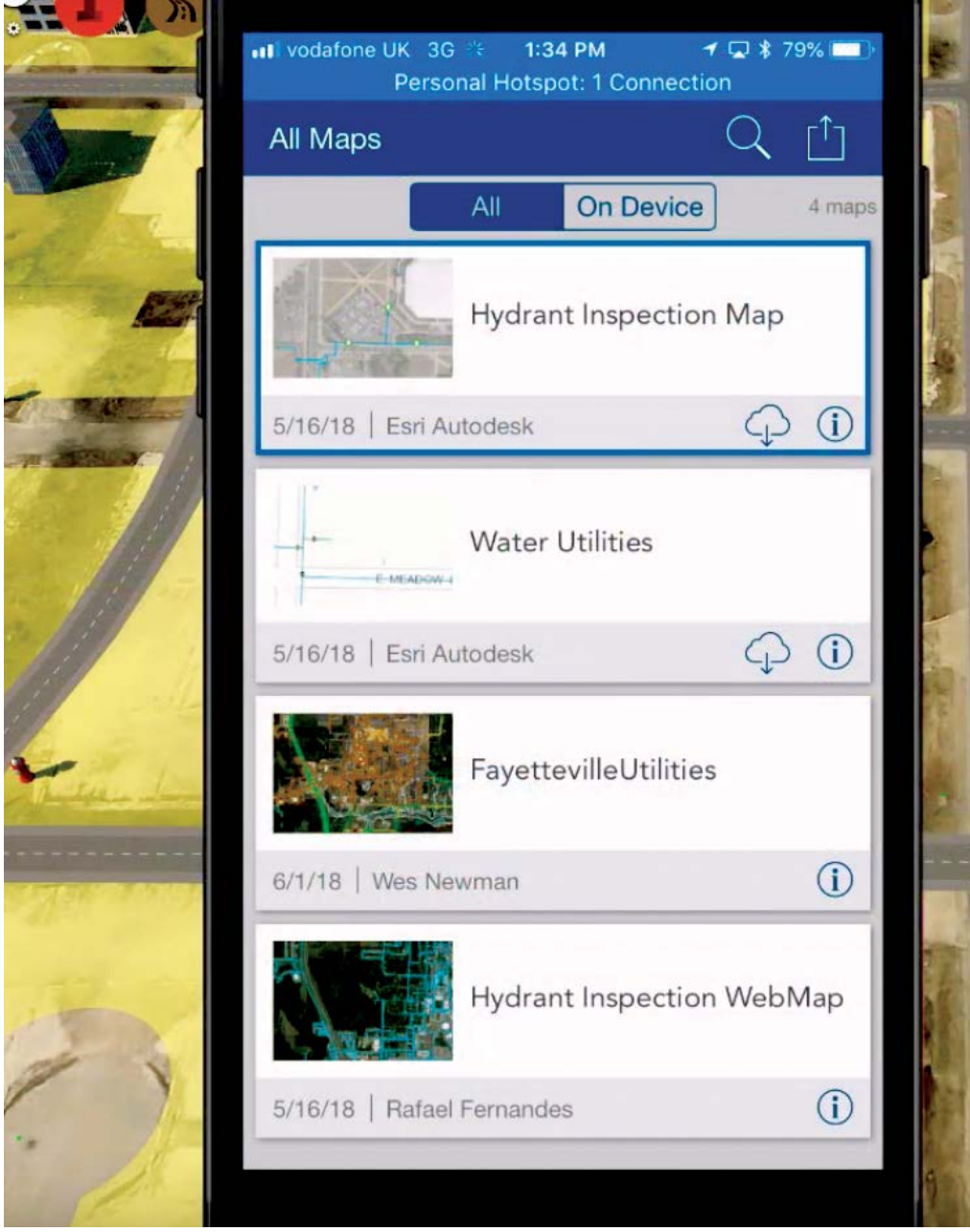
↑ Anagnost, the new CEO of Autodesk, rose from within the company after 20 years of holding key roles.

Then I reached out to a VP at Autodesk, my former boss, and was connected to Theo Agelopoulos *[director, infrastructure business strategy, and marketing]*. We traded emails. I went up and visited San Francisco *[Autodesk's headquarters]*, put together a slide deck, talked to Jack *[Dangermond]* and some directors, and tried to manage expectations.

Theo and others continued friendly conversations, and that fall Carl Bass *[then Autodesk CEO]* came to visit Jack *[Dangermond]* in Redlands. A real career highlight was to be part of that meeting with them for four to five hours.

Fascinating to me was: the things I thought they would focus on were different from the topics that they actually spent the most time on. They did follow the thread of the planned discussion, but, considering the history, I thought the conversation around potential Civil 3D integration with ArcGIS would be really hard. I think they jumped through that in five minutes.

As the meeting progressed, it was clear that we both wanted to provide frameworks and platforms so that our users could both benefit from an improved experience that could bring the value of location awareness into the engineering workflow and engineering data back into asset life cycle management processes.



↑ In InfraWorks, live utility data can be sourced from ArcGIS via the Autodesk Connector for ArcGIS. As features are updated in the ArcGIS source—with Collector for ArcGIS, for instance—the changes are reflected in the connected project in InfraWorks in real time.

A YEAR OF PROGRESS

Initial collaborations mostly build off the same kinds of tools available to the respective developer communities for each company—open APIs (application programming interfaces)—but each with some direct guidance from development counterparts of the other.

Agelopoulos said that both companies did not want to simply say that it is a great partnership without substance. They wanted to deliver beneficial outcomes for the shared user experience in the first year. The most logical first step for Autodesk was to enable InfraWorks to read data from Esri sources. The result is the recently released Autodesk Connector for ArcGIS.

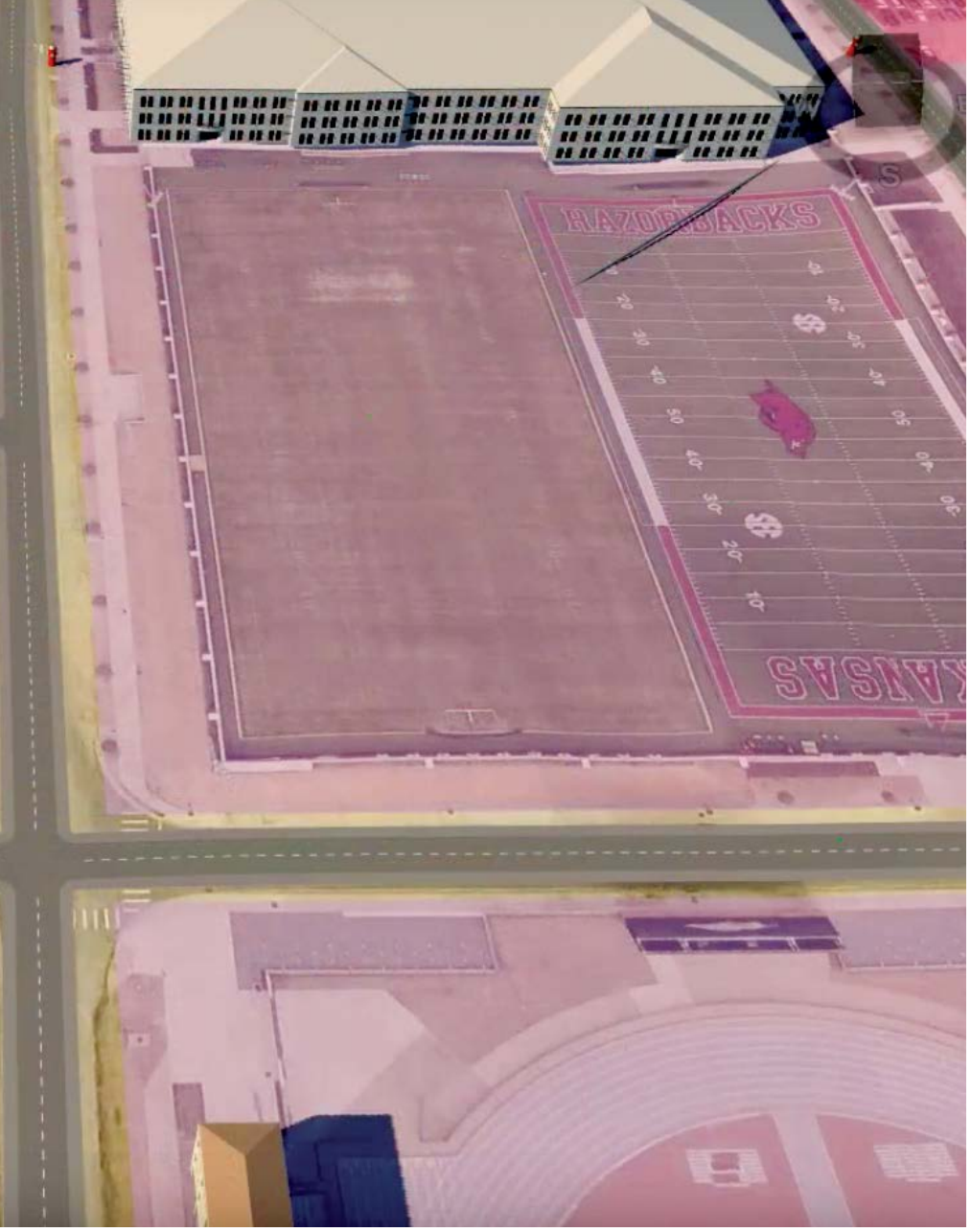
At the 2018 Esri User Conference, Wes Newman, senior technical marketing manager at Autodesk, took us for a test-drive.

"Bring up a map, and this creates an area of interest from your current project extents," said Newman. "A familiar look and feel for an ArcGIS user. We select by features we would see in web maps, so both will show as componentized toolsets within Autodesk.

"Select the data types we want. For instance, we can select water utilities, a feature service with a bunch of feature services underneath; select valves and tell them they'll be like pipeline connectors; select laterals and mains and tell them those will be pipelines. And then they are live connected *[not an import per se]*."

When I asked about updates, Newman pulled out his phone, opened Collector for ArcGIS (the popular field asset mapping app), and added a new survey monument to the corresponding feature in ArcGIS in the cloud. And that, in turn, showed up in the InfraWorks instance.

Initially, key developments from the partnership for the Esri community revolve around the ability to integrate Autodesk Revit models. The data-rich Revit BIM (building information models) will be able to feed essential interior elements to the soon-to-be-released ArcGIS Indoors mapping system and will be useful for fleshing out corresponding buildings in ArcGIS Urban, also forthcoming.



SERVICES AND SCENES

The ability to manage, almost without limitation, the data and models for an entire city, down to the interior of each building, is something that legacy CAD could not do and certainly that legacy GIS could not. But the way geospatial data is now handled, more as services, has revolutionized that in GIS. We are no longer hobbled by having to do full translations of data with different tools for every data type and source. We asked Jack Dangermond to explain.

JD: Part of the reason why this relationship is comparatively and relatively easy to implement is because we have moved from client-server to an everything-as-services-in-the-cloud platform.

Modern GIS today is all services based; every client talks to the database through services. So if I'm on a desktop, I'm in ArcGIS Pro, I'm talking to an ArcGIS server through a services connection and a REST (representational state transfer) endpoint. I find it, connect to it; I'm never really dealing with the record change, I'm dealing with a view of the record change. And that means different clients can operate through REST endpoints, and those are open APIs. We can have distributed servers that are interconnected, and my clients can talk to those distributed services.

If I have imagery, my clients and apps talk to the images by way of something called a web map, or a web scene that is a 3D technical specification, or a web layer which is like shapefiles of the old days. We've taken hundreds of individual formats that live all over the Internet and can now connect to big data, or real-time data, many types of 3D data, vector data, unstructured data—but we always talk to them through a service.

In IT parlance, this is a miracle. There was a phase during the 1990s where enterprise service buses were created, and there was a whole bunch of them. With the advent of web services and REST, all that went away.

The ArcGIS portal creates a common language by abstracting multiple geospatial datasets into common view. That means the clients can talk to this distributed geospatial environment through a common set of specifications. And it is completely open. This common language of any kind of geospatial data allows an individual to create a web map and then view it and share it with a community.

To create smart cities, it turns out that you need a scene, or what we call a multipatch. A scene is a 3D dataset; we invented this about 15 years ago, and it turns out that *[a]* 3D smart multipatch dataset really scales well, so I can fly around like you *[do]* in a Google-like environment, which is a different type of model, but you also have a smart feature database with millions and millions of features.

WARP SPEED

I had heard Autodesk referred to by some as the "Starship Autodesk," and now, with Anagnost at the helm, there does appear to be a new mood afoot there, this new partnership as evidence of that. I asked Anagnost about the changes in the culture of Autodesk he has observed in his years there.

AA: Over the last couple of years we moved to a world where 60 percent of the employees have been here less than five years. The company is 9,000 people now; you can't grow that fast without having a whole new infusion of talent and capability, and this is absolutely evolving the culture.

But there's a few things that will never change. The thing that attracts people to Autodesk and keeps people at Autodesk is the cool amazing work our customers do. Our people see the impacts of their work in their daily lives—bridges, buildings, entertainment, *[and more]*.

This passion for impact hasn't changed at Autodesk. The new generation we are bringing in—they are just as passionate about those impacts as the previous generation.

GS: What would you like to see next from this partnership?

AA: I would like to see us creating a seamless opportunity in the cloud for our shared data—customers to have digital representations of the planning state, the in-process state, and the as-built state and be able to feed that information back into the next design. To have a closed loop, they are pulling data, using it, moderating it, and getting it from a central place where our respective technologies are feeding that location. And it's two-way: you can push info in and pull it out, you can take info from the current state to the digital representation and use it to inform the next revision of what you are trying to do.

THE IMPERATIVE

Staff from *xyHt* presented each of these two leaders token gifts from the days of geospatial past—long before anything was called geospatial. Jack Dangermond, who has often spoken of his appreciation of surveyors and surveying, received an 1870 Gurley surveyor's transit. To Andrew Anagnost *xyHt* presented a 1936 K&E catalog featuring beautifully drawn figures of the drafting supplies of that era.

That instrument and the supplies in the catalog represent the state of the art in those eras. But those would be nearly impractical to try to use in today's accelerated world. Change and modernization are imperative.

The gifts emphasize how accelerated our world has become by necessity. Since the publication of that catalog in 1936, the population of the world has more than tripled, and since 1870, the year of the manufacture of that transit, the world's population has more than quadrupled. Progress in AEC, geomatics, and geospatial tools and solutions has mostly kept up. But it will get tougher, especially if we continue with legacy compartmentalized design/build/operate/manage processes.

This partnership is significant on many levels; there were multiple imperatives for it to happen.

This article was reprinted and lightly edited, with permission, from *xyHt* out of its November 2018 issue. *xyHt* is a monthly publication that covers a range of geospatial topics, from land surveying and GNSS to UAS and 3D imaging.

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About the Author

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District in Northern Ireland Uses GIS to Install Road Signs Quickly, Safely

With ArcGIS technology, the council was able to ascertain how many signs it was going to need before the installation work even began.

It is a sign of the times that local authorities are now relying on GIS technology to address challenges of sizable scale and complexity. This is certainly the case in Fermanagh, Northern Ireland, where the council is using the ArcGIS platform to put up more than 4,000 road and townland signs.

From 2013–2016, Fermanagh and Omagh District Council completed an initiative to give 15,000 rural properties in the county official addresses for the first time. This required identifying every property in Fermanagh with a number, road name, and townland (a small region in Ireland that holds cultural and historical significance).

The new addresses were recognized by Royal Mail and searchable on computer databases. So the next step for the council was to install road and townland signs on hundreds of roads across the county. The objective was to do this as quickly, safely, and cost-effectively as possible.

Rather than surveying up to 3,970 kilometers (2,500 miles) of road by vehicle, Fermanagh and Omagh District Council analyzed its road network digitally. Using its existing ArcGIS software, including ArcGIS Desktop and ArcGIS Online, together with street data and aerial imagery from Ordnance Survey of Northern Ireland, the council examined the routes of newly named and renamed roads, counted road junctions, and identified all the locations that needed road signs. This GIS-driven approach enabled the council to accelerate the planning phase, as it reduced by half the number of on-site surveys staff had to complete, saving many weeks of time.

Furthermore, the use of ArcGIS allowed the council to ascertain, with a high degree of accuracy, how many signs it was going to need before the installation work even began. It could therefore purchase precisely the number and types of signs that would be required rather than rely on its original business case estimates. Not only did this improve precision and prevent waste, but it also saved the council money—potentially upwards of £100,000 (more than US$125,000)—and reduced nugatory work.

After the appropriate signs were purchased, Fermanagh and Omagh District Council used ArcGIS Desktop and ArcGIS Online, along with an app built with Web AppBuilder for ArcGIS, to perform a thorough risk analysis to ensure that staff and contractors would be safe while installing the new signs. For example, the council acquired asset information from British telecommunications company BT Group and electricity providers in Northern Ireland. It then used ArcGIS Pro and ArcGIS Enterprise to overlay this geospatial data onto its own street data to identify any potential risks from buried or overhead cables at the proposed sign locations.

Installation of the new signs commenced in May 2018, and Fermanagh and Omagh District Council is now using Collector for ArcGIS along with ArcGIS Enterprise to monitor how contractors are progressing through this three-year project. Additionally, the council is using web maps and apps in ArcGIS Online to communicate with the contractors. Council staff can tell them where each sign needs to be installed and how to get to the location, and the contractors update the council on whether or not the signs have indeed been installed.

The council is also using ArcGIS Enterprise to build and record a maintenance database

↑ Using its existing ArcGIS platform, together with street data and aerial imagery from Ordnance Survey of Northern Ireland, the council examined the routes of newly named and renamed roads, counted road junctions, and identified all the locations that needed road signs.

for the signs. Each one has a unique ID number, and the database notes any particular hazards or points of interest—such as where there are telephone poles, occluded sight lines, or vegetation—at every location. Inspectors can upload information and images of the installed signs to the council's GIS portal, which is building up a comprehensive asset inventory.

Fermanagh and Omagh District Council anticipates that the GIS-led approach it used for this project will deliver further cost and time savings in the future and more efficient asset management. That's because council officers will be able to view sign information via the council's in-house ArcGIS portal; see images of the signs as they were originally installed; and order replacements of exactly the right size, quality, and standard. Most importantly, the council will be able to ensure that all roads have the appropriate signs at all times.

The Rural Road and Townland signs project is now inspiring other council service areas to explore new ways of using ArcGIS across a wider range of projects—in particular for sharing data and collecting it remotely out in the field. Indeed, it is a sign of just how versatile GIS is that multiple council services are looking to create new GIS-based initiatives and projects to help them operate more cost efficiently and deliver better services to the citizens of Fermanagh and Omagh.

Getting Students Back on the Bus

And Showing a Strategic Supply Chain Management Class the Value of GIS

Three years ago, weekend bus ridership in Harrisonburg, Virginia, had dropped, and the Harrisonburg Department of Public Transportation (HDPT) had no idea why. In 2009–2010, HDPT's buses served 192,766 passengers from Fridays to Saturdays, but by 2015–2016, this bus ridership had fallen to 40,283 passengers, according to HDPT.

Students at James Madison University (JMU) make up a large portion of HDPT's bus passenger base. So figuring out a solution to this drop in weekend ridership was an excellent project for Dr. Bill Ritchie, a professor of management in the College of Business—not least because he could use it to illustrate to his supply chain students the benefits of using GIS for transportation and logistics.

There were two objectives: first, to figure out which alternative modes of transportation students were using besides buses, and second, to find the primary locations where students were relying on alternative forms of public transportation. Ultimately, Ritchie wanted his class to learn how ArcGIS could be used to identify routes that would be more in sync with students' transportation needs. And if HDPT got a new bus route out of it, that would be outstanding.

Digging into the Data

It didn't take long to figure out that the decline in bus ridership was only part of this story. The university has a service called SafeRides, which relies on volunteers and a fleet of six cars to offer students free rides home on Friday and Saturday nights. Over a three-semester period, SafeRides received nearly 10,000 ride requests and served 28,000 riders. However, only 62 percent of the students who requested rides received them due to limited capacity and delays. Other transportation services, such as Uber and a Sober Rides Facebook group, are available as well, but some students have indicated that they don't always feel safe with these alternatives.

To address these concerns, Ritchie teamed up with JMU sustainability analyst Avery Smith and JMU sustainability coordinator Mike Dalmolin to develop plausible solutions using ArcGIS technology. Smith and Dalmolin provided Ritchie with multiple spreadsheets of SafeRides data that included where trips originated, their destinations, and the pickup and drop-off times for more than 27,000 ride requests spanning multiple semesters.

The first challenge for Ritchie was to convert much of that raw data into usable addresses, since location records were often listed by residence hall or apartment building name rather than street address. Working with a team of graduate assistants, he cleaned and geocoded the data using both ArcGIS Desktop and Microsoft Excel's VLOOKUP function. He then presented this geocoded data to his supply chain class to illustrate initial transportation logistics problems. For that, Ritchie used the Kernel Density tool in ArcGIS, which calculates magnitude per area from point or polyline features, and the Optimized Hot Spot Analysis tool, which shows statistically significant hot and cold spots on a map.

Analyzing Ridership Movement

To determine how the information from SafeRides could potentially inform the optimization of late-night bus routes, Smith and Dalmolin dived deeper into the data.

First, they wanted to see if there were any patterns and trends in ridership that occurred in similar spaces over the same periods of time. Using ArcGIS Pro, they created a Space Time Cube to visualize, in 3D, all the rides that occurred within a 1,500-square-foot area over a 30-minute time scale from 10:00 p.m. to 3:00 a.m. This way, they could see how a location's ridership changed over time.

Next, the two engineers used the Network Analyst extension for ArcMap to graphically create routes for all 10,000 requested SafeRides trips. With this, they were able to estimate average drive times and distances and then configure optimal routes, which would help decision-makers determine where new bus routes needed to be created and where existing ones could just be altered.

The most crucial analysis, however, came from an origin-destination (OD) pair table that conceptualized SafeRides movements across Harrisonburg. With this, Smith and Dalmolin sought to discover the main origins and destinations taken by riders. Their central questions for this analysis were as follows:

1. Given a specified location, how many people, on average, arrived from or left to go to other respective locations in the city at night?
2. How do these movements change between 10:00 p.m. and 3:00 a.m.?

Smith and Dalmolin created a stand-alone Python script that aided in building the OD table. They digitized all the main student housing complexes, campus zones, the downtown area, and commercial districts in Harrisonburg to form a polygon feature class in ArcMap. Then, they assigned each polygon a unique identification number and joined them all to two new point feature classes that represented SafeRides' pickups and drop-offs, respectively. As a result, each pickup and drop-off point captured the unique identification number of its related polygon. Additionally, in the original SafeRides spreadsheet data, the engineers had preassigned every related pickup and drop-off point a unique travel code to show a completed trip. Thus, even though the shapefiles for pickups and drop-offs were separate, since they necessarily occur in different locations, the matching code made it easier to identify full trips. The Python script used the unique IDs and codes to tie trips and requests to two locations—the origin and the destination—as an OD pair.

Getting Precise with Modeling

With all this, Smith and Dalmolin were able to do finer-scale ridership modeling at various locations. For example, ridership to and from downtown Harrisonburg was, in general, known to be moderately significant. But with the Space Time Cube, the team could see that the western section of downtown experienced more active ridership between 12:00 a.m. and 1:00 a.m., while the eastern side of town barely saw any. This was an important find. It would enable city planners to match bus frequency proportionally to the ridership for different sections of downtown. This would lower headways—the amount of time it takes between bus service stops at any one location—by eliminating travel to areas that don't need bus service.

In addition, the Space Time Cube revealed that 12:00 a.m. to 1:00 a.m. is the most active period for nighttime ridership in the city. This was significant because it revealed when and where students' travel needs were the greatest. Several student housing locations stood out when it came to evaluating travel volumes and times. For instance, The Harrison and Sunchase apartments had high levels of movement consistently from 10:00 p.m. to 1:00 a.m., while other apartment complexes, such as Pheasant Run, and campus dorms only showed significant travel at midnight.

Based on the network analysis, the team discovered that the average SafeRides trip time was 3.9 minutes, with the longest trip being 11 minutes. The average distance for trips was 1.9 miles, and the maximum distance traveled was 5.4 miles. These findings assisted in understanding students' expectations when it comes to travel times and how far they're willing to go.

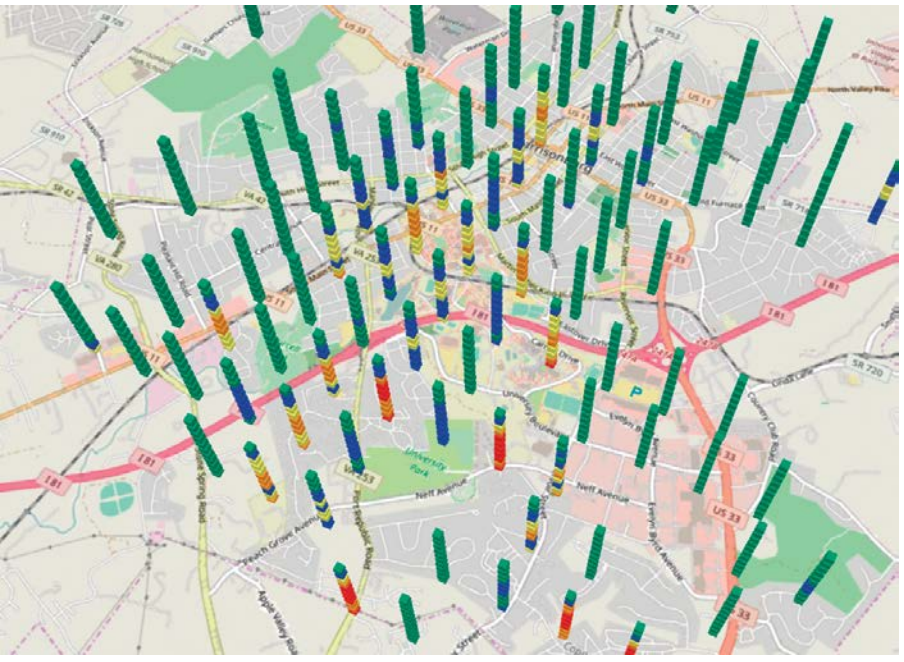
One of the most valuable pieces of information that the OD analysis revealed was that student travel between off-campus locations accounted for 51 percent of all SafeRides trips, while only 32 percent of these rides occurred between on-campus and off-campus locations. This was a crucial discovery, since four out of the five active HDPT bus routes included travel between on-campus and off-campus areas. Meanwhile, the other route traversed campus and downtown Harrisonburg, which only accounted for 4 percent of SafeRides ridership. Without a single route that provided travel among off-campus housing locations, student ridership was bound to be down.

A New, Optimized Bus Route

After Smith and Dalmolin completed their analysis, they designed a new HDPT bus route and presented it to city planners. The proposed route would directly serve the highest-volume movements among student housing facilities, and it would only have a 22-minute headway, taking significantly less time than the existing bus routes.

City planners accepted the proposed route with minimal changes. Hopefully, this means that bus ridership in Harrisonburg will pick back up and that JMU students feel like they have safe transportation options both during the day and late at night.

For more information about integrating ArcGIS logistical functions into a university supply chain course, contact Ritchie at ritchiwj@jmu.edu or 239-218-9759. For more information about the routing analysis conducted in this study, contact Smith at smit23ac@jmu.edu or 540-568-6798.



↑ Students at James Madison University (JMU) make up a large portion of Harrisonburg Department of Public Transportation's (HDPT) bus passenger base.

← The engineers visualized in 3D how ridership changed over time in particular locations. Red indicates very high movement among riders, while green indicates low movement.

GIS: A STRATEGIC COMPONENT OF
EXTENSIVE MODERNIZATION AT LAX

Century Boulevard runs as straight as an arrow through a 10-mile stretch of south Los Angeles before terminating at the horseshoe-shaped Los Angeles International Airport (LAX) terminal complex. Despite seemingly easy access from this major LA thoroughfare and the city's widespread freeway network, congested vehicular traffic has plagued the airport for many years.

With 4 million people living in the city and the automobile as the preferred method of transportation, traffic congestion in and around LAX is an accepted nuisance—particularly when considering that it is the world's fifth-busiest airport for passenger traffic, having served more than 84 million people in 2017.

Incremental improvements to the airport and the transportation network that serves it have failed to keep up with its growth over the years. But in 2010, a major capital improvement plan, known as the LAX Development Program, was implemented. The $15 billion project is being constructed in three phases and will be completed in 2028. It is the largest public works initiative in Los Angeles history. And it is leveraging GIS strategically, not only to streamline the workflows of multiple construction projects but also to ensure that 24-hour-a-day airport operations proceed smoothly.

Managing This Multiyear Capital Improvement Plan

Major upgrades coming to LAX include significant terminal renovations, a midfield satellite terminal concourse, and a new central terminal area that will consist of streamlined passenger processing, updated utility plants, an intermodal transportation facility, an automated people mover system, and a consolidated rental car center.

"Right now, we have about 130 different projects going on at the airport and anticipate another 80 to 90 in the future," said Don Chinery, the program controls manager for Los Angeles World Airports (LAWA). This ranges from a new terminal to improving a tenant facility within a terminal.

All projects included in this capital improvement plan must be carefully managed so that one doesn't interfere with another or severely impact operations. For example, when Delta Airlines moved to a different terminal in 2017 as part of the redevelopment program, it caused several other airlines to move as well. This had to be carefully orchestrated to minimize passenger and staff disruptions because airport operations obviously can't be shut down at LAX, which handles more than 1,500 takeoffs and landings every day, according to Chinery.

"We used GIS to manage the Delta move for space and time coordination," he said. "For example, if we shut down an elevator at a certain location, what else is going to be impacted at that location because of the shutdown? How can the passengers get through a certain route that is also under construction at the same time? GIS is a critical part of our logistics management."

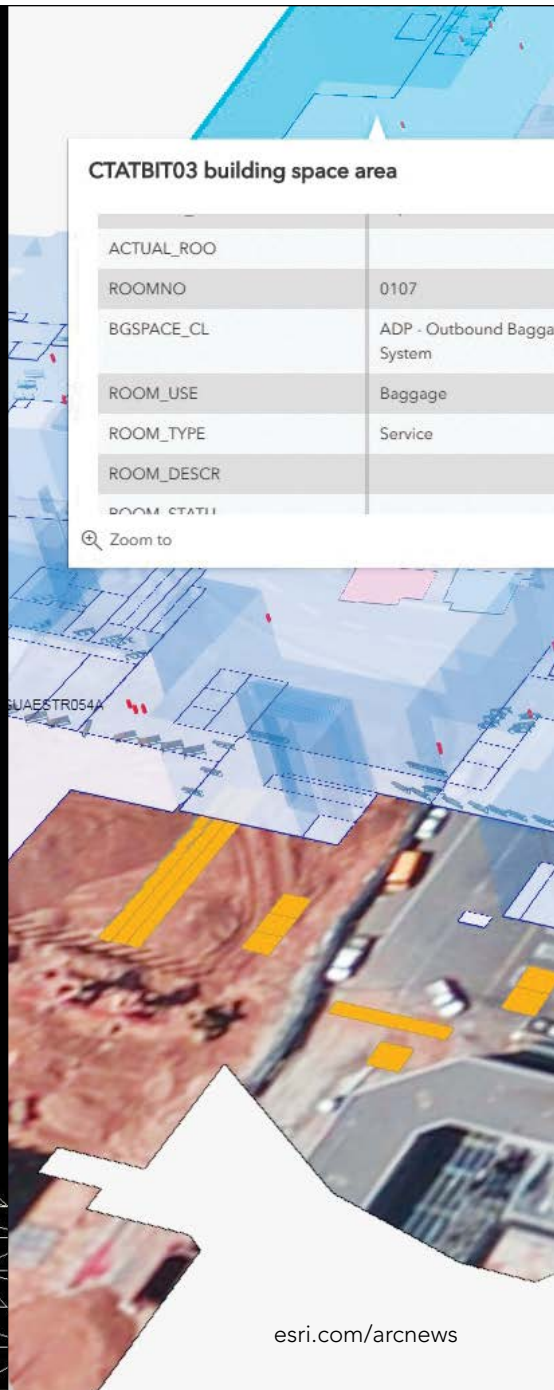
Central to managing the multiple construction projects at the airport is Coordination and Logistics Management (CALM), a Microsoft SharePoint-based GIS integrated with Oracle's Primavera P6 solution for project management. Collected data is made available for review to internal stakeholders through OpenText, an enterprise information management software. The system currently maintains more than 500,000 documents.

"We've built an integrated process that we call ETL—extract, transform, and load," said Chinery. It is essentially a script that runs in Microsoft SQL Server. It pulls data from the P6 application on a nightly basis and populates an ArcGIS geodatabase with that data.

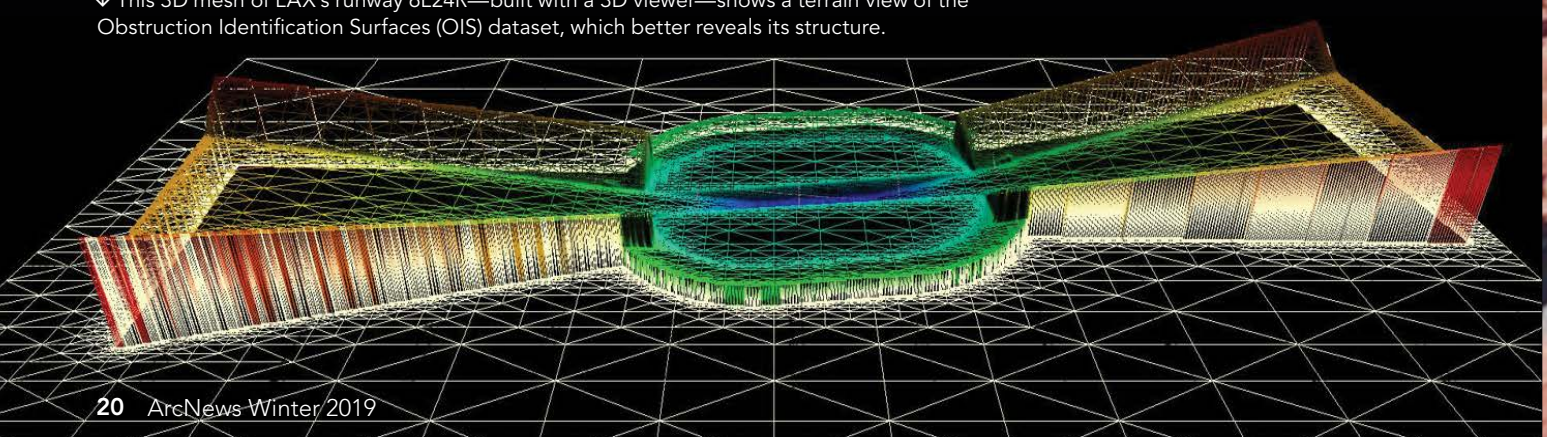
"Because of the large number of projects we are involved in at any one time, CALM also represents our mission statement: 'Minimizing construction-related impacts to passengers and tenants while maintaining a positive guest experience,'" said Chinery. "We use SharePoint for internal document management because it is a versatile and secure platform. The system manages all of our scheduling and locational information and tracks all of the projects from planning through design and construction. It also maintains the coordination and logistical schedule for our projects, which we publish monthly."

The CALM GIS development team also built an interactive mapping app, called CALMShare, that shows the locations of all LAX projects—including those that are currently active and ones that are planned for the future—to reveal any time and space conflicts

↑ At Los Angeles World Airports (LAWA), the GIS support and services division uses the ArcGIS for Aviation: Airports extension to create Airfield Imaginary Surface Areas, which show approach zones, transition zones, primary zones, and more, to help the airport determine how high it can build things without causing airspace obstructions.



↓ This 3D mesh of LAX's runway 6L24R—built with a 3D viewer—shows a terrain view of the Obstruction Identification Surfaces (OIS) dataset, which better reveals its structure.



among those projects. Pulling all this data from CALM's geodatabase, the app also provides maps for logistical coordination.

"The contractors don't have access to *[any sensitive information]*, but prior to construction, each is required to submit a phasing plan," said Chinery. "This indicates where they'll be working and at what time. Throughout the phases of the project, they are required to continue to update that information with us. They also submit a site logistics plan that specifies details about their work site and how they are getting to it. What roadways are they using? Where is their laydown area to store the materials they will be using for construction? How are they getting onto the airfields? Where are they parking? Where is their project management office? So all that information from the contractor is vetted by my team and then put into our CALM system."

Modeling Proposed Construction Projects and Environmental Concerns

Before these projects even began, LAWA relied on a large stack of ArcGIS software within its Airport Enterprise GIS (AEGIS), including ArcGIS Desktop, ArcGIS Server, Portal for ArcGIS, ArcGIS Online, Web AppBuilder for ArcGIS, ArcScene, and the ArcGIS maps used with SharePoint. Now, with the LAX Development Program in full swing, LAWA's GIS support services division has begun experimenting with a 3D interactive modeling simulator.

Using ArcGIS Pro, staff in the GIS support services division can create 3D models of indoor construction projects in the airport complex. These scenes include ticketing areas, public lobbies, passageways, and baggage areas, as well as the locations of defibrillators and fire extinguishers. The model can provide multiple vantage points, including bird's-eye, ortho, and perspective views, so projects can be fully examined.

"The 3D modeling simulator allows us to provide construction and airport management with images that can be quickly understood and modified for further review, if necessary," said Abdel Khineche, GIS supervisor II at LAWA. "Another important use of our AEGIS is to create Airfield Imaginary Surface Areas using the ArcGIS for Aviation: Airports extension. They represent the hypothetical surfaces above and around an airfield where there are height restrictions that prohibit obstructions to navigable space and are a requirement of the Federal Aviation Administration."

These surfaces include approach zones, transition zones, primary zones (which are centered on the runway), horizontal zones (a plane 150 feet above the established airport elevation), and conical zones (which extend up and out from the outer limits of the horizontal zones). They are described by specific heights, width, length, and slopes.

"The models are based on each runway specification and built on criteria specific to the type of airport (civil, military, etc.), as well as the visibility conditions and the type of equipment in place at that airport," explained Khineche. "The generated surfaces are superimposed over potential ground obstacles that might interfere with flight paths and usually extend far beyond the airport boundaries. For the runways at LAX, we use the precision instrument *[runway]* approach criteria that is specified by our airfield team."

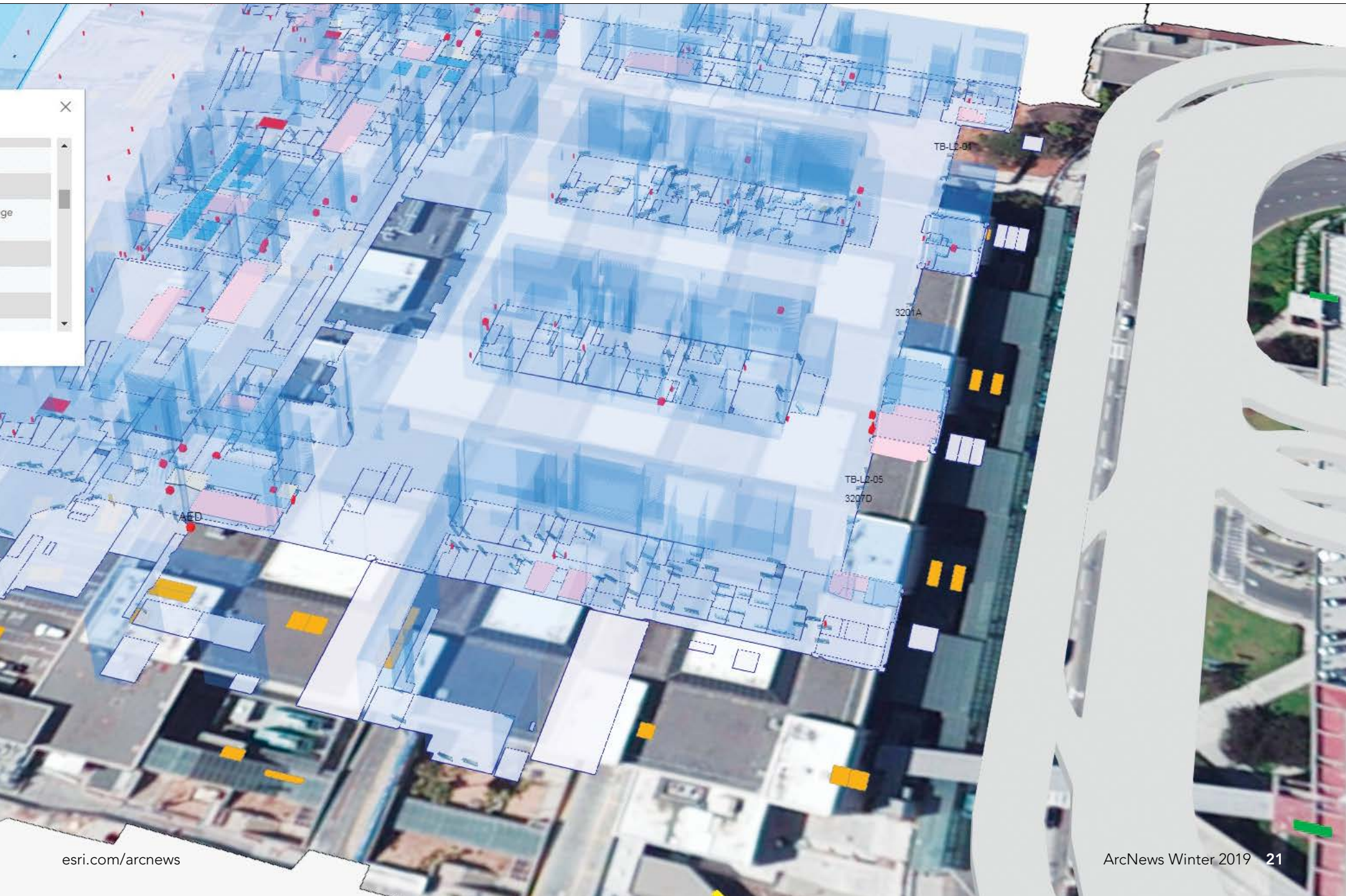
Recently, LAWA needed to place an 80-foot-high antenna in the airfield area of LAX and do it on very short notice.

"The chief airport engineer at LAX wanted to quickly determine if the antenna would interfere with the path of an approaching aircraft," continued Khineche. "I calculated that the height of the surface area at the proposed location of the antenna was 210 feet, which permitted the construction of the antenna without interference of any aircraft flight path."

The workflow LAWA has developed using P6 along with ArcGIS and SharePoint ensures that LAWA, its airport planning and development group, the construction inspection division, project teams, contractors, tenants, and other stakeholders can communicate efficiently and accurately.

"Because the information is updated daily and is easily accessible, it has been particularly useful in the weekly executive capital strategy meetings," said Chinery. "In addition, the system improves coordination and planning throughout the entire LAX Development Program by resolving potential construction conflicts early in the process, which eliminates expensive redesign."

↓ Staff in the GIS support services division use ArcGIS Pro to create 3D models of indoor construction projects in the airport complex, including ticketing areas, public lobbies, passageways, and baggage areas.



Smart City Hub Meets the Needs of Modern Citizens

By Mark Hébert, City of Coral Gables, Florida

Coral Gables, Florida, situated along Miami-Dade County's bayfront coastline, was one of the first planned cities in the United States. Established in 1925, it was inspired by the City Beautiful movement of the late-nineteenth and early twentieth centuries—an urban design concept that maintained that a community's design couldn't be divorced from its social issues.

In continuing to heed this vision, the tree-dotted, Mediterranean-style community is applying smart city concepts to improve the services it offers to citizens, businesses, and visitors. To achieve that, Coral Gables recently launched an open data site on ArcGIS Hub that it uses to provide convenient access to city data and services, advance important initiatives, and improve quality of life for residents and tourists.

A World-Class City with a Smart Hub

Coral Gables has been long acclaimed for its beauty and livability. Given its stature as a leading planned community, the city is embracing technology and innovation with the aim of becoming a truly smart city.

For the past three years, Coral Gables has been working to align its road map and strategic plan with its mission: being a world-class city with a hometown feel. To that end, the city's IT department has been busy building a digital ecosystem of people, businesses, organizations, systems, and other things that contain, promote, and sustain that smart city culture.

In early 2018, IT staff used ArcGIS Hub to launch an open data site (coralgables.com/smartcity) for Coral Gables. Now, anyone can view the city's financial, legislative, permit, and other public records easily via a variety of new and existing services. Introduced in April, the Coral Gables Smart City Hub receives more than 300 visits per day.

The hub's purpose is to simplify how people access city services and information that would typically require a call or visit to one of the city's offices. It is just one of several interconnected and interoperable elements—including other data platforms, the Internet of Things (IoT), and robust high-speed communication networks—that is beginning to transform how the city and its citizens communicate with each other.

The glue that binds all this together is GIScience, which enables Coral Gables' IT department to horizontally integrate apps and data—removing data from silos, finding and filling data gaps, and resolving redundant and duplicate data. Additionally, IT staff employ hybrid clouds and hyperconverged infrastructure to enhance the hub's capabilities for artificial intelligence (AI) and machine learning.

New Ways to Engage the Community

An advantage of having ArcGIS Hub is that the City of Coral Gables can put a variety of community engagement initiatives in the platform.

One of the city's first ArcGIS Hub initiatives is a collaboration with the University of Miami's School of Architecture and Center for Computational Science that invites participants to design their own smart city solutions for Coral Gables. The initiative, accessible at smartcities.miami.edu/competition, provides contestants with access to datasets and a platform that teams can use to collaborate on their designs. Participants are asked to create prototypes of technology solutions and apps for known transportation and traffic issues with the aim of improving residents' quality of life and visitors' experiences.

"Bringing more convenience and better quality of service *[to]* our citizens, that's the main driver" behind the hub, said Raimundo Rodulfo, the IT director for Coral Gables. "It's quality centric."

That's something that a lot of communities, not just Coral Gables, want to provide for their citizens. Implementing ArcGIS Hub helps residents communicate their concerns with city stakeholders and collaborate more effectively with them to come up with solutions. In turn, this makes it easier for cities to implement technology that can make discernible improvements in safety, transportation, convenience, and government processes.

Advancing Public Safety Initiatives with Hub Technology

As with most cities, ensuring public safety is paramount for Coral Gables. With ArcGIS Hub in full use, the city now has an array of collaborative policing and emergency preparedness tools that it didn't have before.

Smart policing is one public safety initiative that has benefited tremendously from using hub technology. Citizens can access police data through the Smart City Hub, and the GIS layers available via the hub can be referenced by or integrated with Coral Gables' smart policing systems.

The Crime Intelligence Center (CIC), for example, uses a stack of GIS-based and GIS-reliant technology to help reduce and prosecute crime within and near Coral Gables' boundaries. Built by the city's IT department, along with the police department and other public safety teams, the CIC employs closed-circuit television (CCTV) to find and track suspects within the city; a video analytics tool, called BriefCam, that compresses all the video data and uses AI and machine learning to find patterns; and CrimeView, an app based on ArcGIS, to map and analyze crimes. Top officials from all city departments engage with the data from these sources in biweekly strategy sessions, where they discuss how to respond to and plan for various types of crime. The use of these technologies in concert with one another has contributed to a 30 percent decrease in crime in Coral Gables over the last two years. And citizens have access to more information about all this via the Smart City Hub.

Hurricane preparedness is another public safety issue that has benefited from having hub technology. When tropical storms come through Coral Gables, city staff, citizens, and visitors work together to gauge the threat, commit adequate resources to it, assist in safeguarding lives (by conducting evacuations and identifying shelters), and ready robust responses. ArcGIS Hub makes it easier for people to gain access to vital mapping and data tools so they can collaborate in managing these environmental events.

Driving Sustainability Efforts

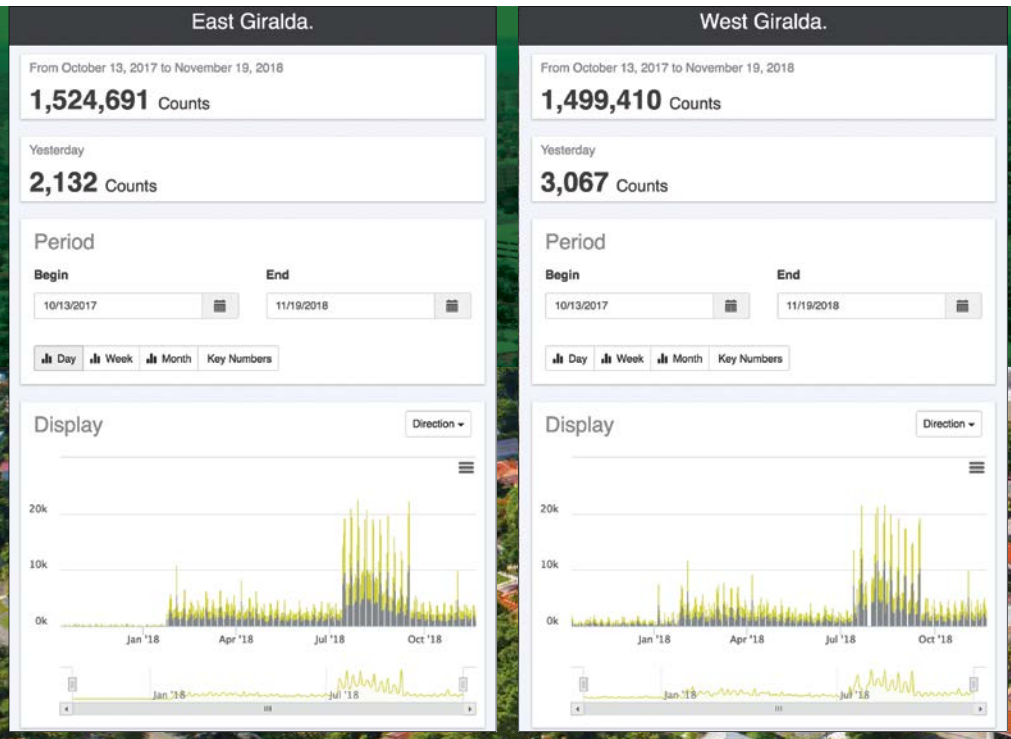
Planning for and managing an innovative and sustainable city require stakeholders from various departments to agree on targeted actions, adhere to schedules, properly allocate resources, and acquire adequate funds. For Coral Gables, its Smart City Hub is becoming an integral part of that process.

In 2015, for instance, the city embarked on an ambitious sustainability plan to minimize energy expenses and gain energy efficiency. Some of the objectives of this plan include converting the city's public service fleet (e.g., sanitation vehicles) to electric to reduce gasoline consumption, making water-saving upgrades to green space and landscape irrigation systems, and advancing Leadership in Energy and Environmental Design (LEED) building practices. In three years, this plan has had some concrete successes. For example, under the Property Assessed Clean Energy (PACE) program, which helps homeowners and business owners finance renewable energy and energy efficiency upgrades, Coral Gables has completed more than 200 energy mitigation and building improvement projects at a value of nearly $7 million.

Soon, the City of Coral Gables will be able to report these metrics and the impacts of these newfound efficiencies dynamically via the Smart City Hub. All the information will be available on dashboards, which local citizens, business owners, and even visitors will be able to use to see where these improvements have taken place throughout the city and how they have affected critical resources such as air and water quality.

"All that *[statistical]* data becomes actionable information—for business development and commercial purposes but also for regular citizens and those who know metrics and data," said Rodulfo.

The goal is for that to drive additional engagement from stakeholders and continue to stimulate innovative sustainability efforts.



← Data platforms, robust high-speed communication networks, and Internet of Things-powered devices—such as the pedestrian sensors deployed on the promenade in Giralda Plaza—are transforming how the City of Coral Gables and citizens communicate with one another.

About the Author

Mark Hébert is the GIS manager for the IT department at the City of Coral Gables, where he manages all GIS enterprise services and support. Hébert has worked for the city doing GIS since 1998. In 2016, he moved the city's GIS operations into an enterprise licensing agreement with Esri to broaden the reach of GIS across all city departments. He is currently completing his MGIS degree from Pennsylvania State University.

Responding to a Hurricane from the Woods, and Being Ready for the Future of GIS

To help Pasco County, Florida, prepare for, respond to, and recover from Hurricane Irma when it struck in September 2017, Jeremy Edwards, the county's GIS supervisor, pulled several 16-hour days in the emergency operations center (EOC). Totaling 160 hours in two weeks, Edwards had hardly seen his family or been outside.

"I needed two days off because my head was about to explode," he remembered. "I wanted to go walk in the woods and take my dog and family out. So we went to a water management area where they have a lot of trails."

Edwards, his wife, their son, and their dog were 30 minutes away from home and a couple miles into the woods when the head of the EOC called. One of the last things Edwards had done before he'd left was create a simple app with Survey123 for ArcGIS to record the donations that were being received at donation centers set up throughout the county.

"I didn't really know if they were going to use it, but I thought I could whip it together pretty quickly and leave them with an option other than pen and paper," he said.

The county had used it. And now county commissioners were just hours away from giving a press conference where they wanted to show how many donations, and what kinds, had been collected.

"I let them know I was in the woods and that it would take a bit to get to the EOC," said Edwards. "I told them I would turn around and try to get back in time for the press conference."

But then he had a revelation.

In preparation for Hurricane Irma, Edwards and his team had made a Survey123 app for the public to use to report any damage to their properties. Residents could fill out the form with the details of the damage, upload photos, and input their addresses.

"By the time we were done, we got 15,000 entries within about two to three days," said Edwards.

But he was having a hard time downloading all the data and images. So he called Esri, and local government solution engineer William Meyers guided him through how to work with geodatabase replicas, which solved the problem. At the end of the call, Meyers showed Edwards how he could visualize all that data in a beta version of Operations Dashboard for ArcGIS. Edwards was only paying perfunctory attention.

"I'm doing a million things right now," he recalled thinking, "so I don't really have time to do that."

But in the woods, he thought: "They showed me how to do this dashboard thing. I've got my phone. Maybe I can do this on my phone. *[…]* If I do that, I don't have to leave; the commissioners get what they want, and more; and my wife does not kill me (double bonus)."

Edwards sat down on a fallen tree, logged in to ArcGIS Online, and started to create a dashboard. But the mobile version was different from the desktop version he was on when Meyers showed him how to use the app.

"I started sweating, thinking, 'I can't make it work,'" he said.

Then he saw a button labeled Open Desktop Site, so he tapped it and was taken to a screen that had all the controls he remembered seeing on his desktop. From here, he also had access to the information from the Survey123 form that he needed to build the dashboard: the types of donations, the amount of money, what foods were perishable, and more. He quickly made different graphs that displayed these details for each donation site.

"Within 10 minutes, I had created a dashboard using the Survey123 live data, published it, and shared it," Edwards said. "I emailed the link to the head of the Office of Emergency Management, Kevin Guthrie, and the EOC team and told them I would not be coming back in. ArcGIS Online, Survey123, Operations Dashboard, a phone, and 10 minutes—*bam*, day saved!"

Edwards said that while this may have been the coolest GIS project he's ever worked on, it's not the most important thing he's ever done.

A certified GIS Professional (GISP), Edwards got his start in CAD and was pretty good at it. He considered going into architecture, but he wanted to do more.

"As I was doing CAD, I thought, I don't want to draw a building; I want to draw the world," Edwards said.

He took geography classes while he was in architecture school at the University of South Florida, and the correlation between people and space piqued his interest. So he got a bachelor's degree in human geography and a master's degree in technical geography.

"I just ended up being really good at it," he said.

Edwards then landed a GIS job at the university's Center for Urban Transportation Research. While he was looking for data one day, he must have submitted a job application to Pasco County (though he doesn't remember doing that) because they called him and asked him to interview for a GIS analyst position. He eventually agreed to go in, so as not to burn any bridges in the small world that was GIS at the time, and he ended up taking the job.

"I like doing things that help the community," he said, "and this is a good way to do it."

Edwards was a GIS analyst with the county for about five years before he became a supervisor. In his time at Pasco, he has shepherded GIS from a make-me-a-map venture to an analysis-heavy endeavor. Whereas the EOC used to put GIS personnel on phone duty during hurricanes, GIS is now instrumental in responding to natural disasters.

"Every storm we've had over the last few years, we've done a little bit more," said Edwards.

His team began contributing sincerely to disaster response activities in 2012 by using ArcGIS Server to make printed maps. The following year, Edwards and his team created web maps and apps. Next, they used Survey123 internally, and finally they rolled it out externally.

Now, the public uses Survey123 to report damage, and Pasco County staff can see relevant geospatial information about each property—including parcel value, commission district, and ZIP code—on a dashboard. Edwards has convinced field personnel to use Collector for ArcGIS and building inspectors to employ Workforce for ArcGIS. He and his team have streamlined disaster operations so there's no duplicate data, and the Survey123 forms they use for hurricane damage assessments match what has to go to the Federal Emergency Management Administration (FEMA) for disaster assistance.

Edwards really enjoys working in the EOC because he feels like he can make a difference. But he also likes the programming side of GIS.

One of his most valued projects is the map package creator he made for Pasco County's Environmental Lands Acquisition and Management Program (ELAMP). When Edwards took over as supervisor, one of the jobs GIS analysts had to do was create a set of nine maps for ELAMP that showed things like what the land is currently being used for, soil types, and whether there are any archaeological artifacts in the area.

↑ Edwards sent the emergency operations center (EOC) a photo of himself with his son and their dog in the woods, showing off the dashboard app he'd just made on his phone.

"It was something that really could have been automated and was a fun project to do," said Edwards.

He used ModelBuilder and ArcPy to automatically populate parcel numbers, project names, and intersects in the maps. To pinpoint specific soil types or zoning, the program zooms to the relevant areas, makes a PDF, zips all the PDFs up, and creates a map package. What used to take a whole day now takes 20 minutes.

As GIS supervisor, Edwards also oversaw the conversion of addressing from mainframe to GIS. And when the county implemented a new 911 dispatch program, he and his team had to make sure sheriffs and police departments could see where roads changed from paved to dirt, where there were gates, and other details. But the GIS team's addressing was intersection to intersection, and Edwards didn't want to keep two sets of geography.

"So I scripted that and was able to put it together," said Edwards.

He used linear referencing to locate each event (a change in road structure, a gate) along the centerlines, measured these features, and modeled the topology to get the 911 dispatch program what it needed. And none of this affected his team's set of geography.

"Nobody sees this, but without it, 911 calls don't get to where they need to go when you dispatch somebody," said Edwards.

It's this kind of behind-the-scenes tinkering that electrifies Edwards and keeps him inspired.

"Learning GIS at the command line level, where you really just get into the nuts and bolts of it, I've learned a lot," he reflected.

In the future, he said, "GIS is going to be where you need it, when you want it."

Having made a dashboard app in the woods on his phone, Edwards is unquestionably well prepared for that.

Digital Trail Map Gets First Responders to Trail Rescues Fast

Together with Explorer for ArcGIS, New Trail Markers Make It Easier to Find Hikers

If someone falls and hurts themselves or gets sick on a 1.14-mile hiking trail in Cold Spring Harbor State Park on Long Island, New York, local police officers, firefighters, and emergency medical technicians (EMTs) come to the rescue.

But for many years, it was difficult to find someone who was injured or sick on the hilly, wooded trail in the midst of the 40-acre park in the Town of Huntington, a community of 200,000 people that includes the hamlet of Cold Spring Harbor. People who called 911 to report these kinds of medical emergencies often were unable to pinpoint their exact location in the woods.

"They just report being on the trail," said James Garside, a Suffolk County police officer who patrols the area. "There was no point of reference. It did leave us with a guessing game."

But thanks to a new system of numbered trail markers erected in the park and a companion map that shows the coordinates of each marker, locating someone who is injured or ill is much easier than in the past. Emergency callers from the trail can now report the number of the trail marker closest to them. And first responders can consult a digital trail map on an Explorer for ArcGIS app to obtain the marker's geographic coordinates and additional information that will aid in the rescue.

The information the map provides to first responders shaved about 10 to 15 minutes off the response time to a medical emergency that occurred on the trail, said Garside, who spearheaded the effort to install the trail markers.

On October 15, 2017, a 47-year-old man suffered a heart attack on the trail, according to Garside. The man collapsed at marker 108, one of 15 small signs placed less than one tenth of a mile apart from each other along the rugged trail, which is surrounded by oak, red maple, American beech, and other trees. The heart attack victim's wife called Suffolk County's Enhanced 911 system on her cell phone and reported the trail marker number, posted on a tree that her husband sat slumped under.

Garside and first responders from the Cold Spring Harbor Fire Department sprang into action. Besides being the officer who patrols the area, Garside is trained as an advanced emergency medical technician (AEMT). He consulted the trail marker map, which is available to him on both the Town of Huntington's ArcGIS for Explorer app and on a data terminal in his patrol car.

On the map, Garside could see the details important to coordinating a quick response plan: the latitude and longitude for trail marker 108, the best access point to get to that site, and suggestions as to the types of vehicles and apparatuses to use to bring the patient out.

In 2015, Garside had approached the New York State Office of Parks Recreation and Historic Preservation (NYS OPRHP) with the idea of installing the trail markers in Cold Spring Harbor State Park. NYS OPRHP assigned a GIS team to map the trail and gather each sign's coordinates.

The Cold Spring Harbor Fire Department then sent a team in to walk the trail and create its own response determinates. These included descriptions of the best places to access the trail to get to each marker location (e.g., the south or north end of the trail or a specific residence "near the barn"), the types of equipment suited to the terrain at that site, and the best extrication point. That information was then added to the trail marker map.

In the case of the heart attack victim, the best access point to reach him was through private property on the 200 block of Harbor Road/New York State Highway 25A. When Garside arrived at the house carrying his medical equipment—a Physio-Control LifePak 12 portable cardiac monitor—the property owner was helpful.

"He was pointing me in the right direction *[toward the trail]*," Garside said.

Garside reached the heart attack victim's side in five minutes. The typical response time without the accurate trail marker information might have been about 15 minutes.

The Cold Spring Harbor Fire Department used a Mule litter wheel to bring out the heart attack victim—the recommended equipment listed on the Town of Huntington's Explorer for ArcGIS app.

But prior to that, Garside obtained an EKG reading from the man and sent the readout to a nearby hospital emergency room. The staff there studied it and called in a cardiac care team, so the physicians and nurses could be in place and ready when the patient arrived at the hospital.

↑ The trail marker data was added as a feature layer to the Huntington Fire Preplan app, which helps firefighters plan emergency responses.

↑ Officer James Garside of the Suffolk County Police Department spearheaded the drive to install the trail markers in Cold Spring Harbor State Park. (Photo by JaneeLaw © Long Islander News. Used with permission.)

← The yellow dots show the location of each trail marker.

→ The Explorer for ArcGIS app displays the trail running through Cold Spring Harbor State Park.

The trail signs, the information available via Explorer for ArcGIS, the rescue equipment, and the mobile medical technology—along with the first responders, of course—all helped provide a happy ending to the story.

"It's a blend of old technology, with signs, mixed together with new technology. It worked well," Garside said. "It did save that man's life."

NYS OPRHP's map of the trail that displays markers 101 through 115, along with each sign's coordinates, was posted at a kiosk in Cold Spring Harbor State Park. Visitors can add the trail marker coordinates to their smartphones by scanning a QR Code on the map.

The spatial data from that project, together with the information from the Cold Spring Harbor Fire Department, was shared with the Town of Huntington. The town's GIS manager, Dave Genaway, said he was alerted to the data by Huntington chief fire marshal Terry McNally.

Genaway said the trail marker data was added as a feature layer to the Huntington Fire Preplan app hosted in its ArcGIS Online organization. The Huntington Fire Preplan contains information about local buildings—including roof materials, known hazards, and floor plans—that help firefighters plan their response to fires or other emergencies. That planning and trail marker information also is available to local firefighters and first responders via Explorer for ArcGIS.

When users click on one of the trail markers on the map using Explorer for ArcGIS (or ArcGIS Online), the latitude and longitude for that marker appears.

"It also shows which access point they can use to get to that trail marker in *[the most]* efficient way," Genaway said.

Garside hopes that the trail marker system could be duplicated in other parts of the state in the future. But for now, the police officer is pleased that Cold Spring Harbor State Park will be a little safer for hikers and runners. He said that he came up with the idea for the trail marker system after a man who was walking on the trail with his wife one day in 2015 had a close call.

"It was National Trail's Day, the first weekend in June," Garside recalled. "That *[incident]* was the straw that broke the camel's back."

The man fainted on the trail due to a heart condition. His wife called 911 but had no idea exactly where on the trail they were located.

"When you are on the trail, to the right or left you see woods," Garside said, adding that the steep hills and trees make it hard to stay well oriented.

Garside said it took about 10 or 15 minutes to find the ill man on the trail, which is basically a footpath and not accessible by ambulance. Other hikers on the trail tried their best to help but were unable to give first responders a good estimate of how far down the trail the man and his wife were located, according to Garside.

And what about his inspiration for how the trail markers would work? Garside modeled them after the signs on the interstate highways in New York that include exit numbers.

"I just thought, 'There's got to be a better way *[that]* would take the guesswork out of it,'" Garside said. "These trail markers provide that."

TAKING A MORE GRANULAR LOOK AT TOURISM

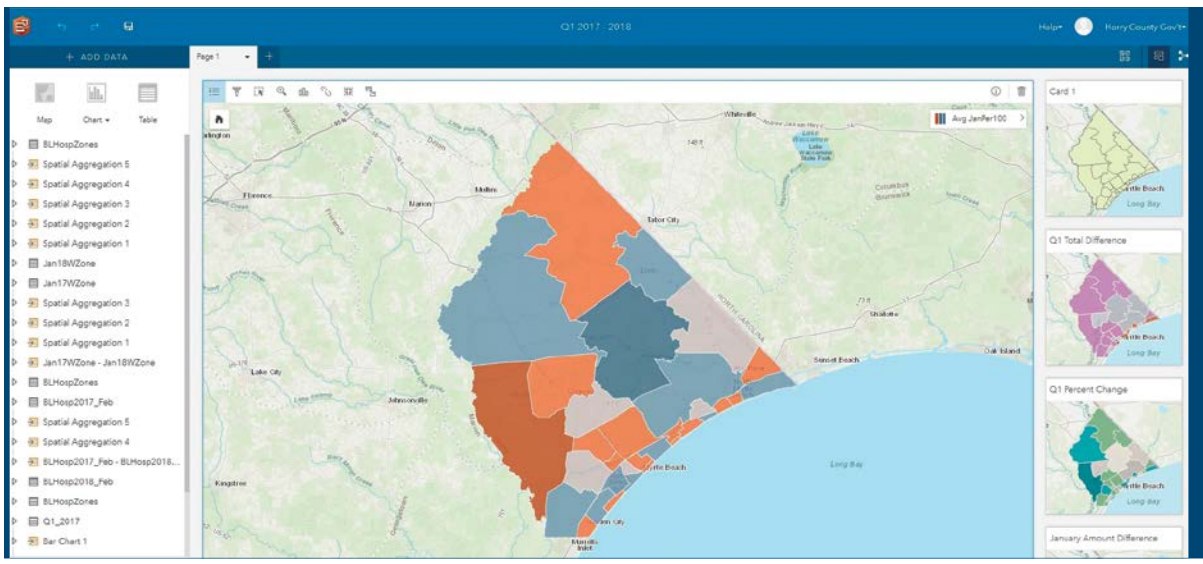
Coastal County Uses Insights for ArcGIS to Analyze Trends and Make Predictions

Horry County, South Carolina, is home to more than 300,000 full-time residents, and its beach towns host several million visitors each year. In 2016 alone, the county's most famous seaside sanctuary, Myrtle Beach, saw a whopping 18.6 million visitors, according to tourism research company D.K. Shifflet & Associates.

Not surprisingly, the area's economy is heavily dependent on tourism. That is in part why all businesses operating within county limits must collect a 1.5-percent hospitality tax on food, beverages, accommodations, and entertainment. That tax money is then used to fund tourism initiatives, such as beach patrol and cleanup, and Chamber of Commerce activities.

While gross revenue from tourism was generally trending upward, Horry County wanted to get a more granular look at the overall health of this economic sector so it could allocate the hospitality budget more fittingly and better support tourism. County staff needed a way to analyze business revenue data alongside weather, crime, development, and other factors that could contribute to increasing or declining tourism. They wanted to be able to understand patterns and make predictions about whether a tourist-based business would succeed or fail.

To do this, the county needed to be able to examine the data based on specific locations so it could scrutinize various submarkets more closely. Horry County's IT team decided that Insights for ArcGIS would work best for doing this kind of analysis.



← Now, Horry County's administration, finance, and business license departments can understand fluctuations in revenue as an aggregate, as well as at the submarket level.

Analyzing Data in Aggregate and at the Submarket Level

Once Insights for ArcGIS was implemented, Horry County's administration, finance, and business license departments were able to use this web-based workbench to explore both spatial and nonspatial data in an array of maps and charts. Now, they can understand fluctuations in revenue as an aggregate, as well as at the submarket level. They can also identify trends and predict outcomes for local businesses and government agencies, all with an eye toward serving both tourists and citizens.

For example, if a golf course reports low profits for the year, is that indicative of a larger trend for all golf courses in the area, or is it an isolated issue? With Insights for ArcGIS, Horry County staff can do a rigorous investigation of this question with just a few clicks.

If other golf courses also report low profits for the year, staff at the county can analyze that data alongside information about the weather and natural disasters to try to pinpoint the root cause. If other golf courses report higher profits, the county can cross-reference that with building permit records, for instance, to see if the low-earning golf course was under construction at any point during the year.

"The minute you open *[Insights for ArcGIS]* and look at the charts…you know exactly what's happening in specific submarkets and why areas have declined *[while]* others are hitting the high notes," said Tim Oliver, Horry County's chief information officer. "In the past, this analysis would have taken days."

Exploring Ways to Boost Tourism Revenue

Prior to implementing Insights for ArcGIS, Horry County staff had to comb through reports on thousands of businesses to do comparison analyses.

"The only thing available previously might have been a ZIP code sort in Excel, which would not even begin to provide the level of detail and analysis that is being done in Insights," said Oliver.

Now, users can divide the whole county into submarkets to show the tourism-based economies situated around well-known venues, such as Myrtle Beach's Broadway at the Beach entertainment complex; various businesses along the stretch of coastline called The Strand; and local universities and colleges, like Coastal Carolina University. They can then quickly understand if one of these submarkets is up or down based on the previous year and identify which businesses or circumstances are causing the change. Did one submarket see a drastic increase in revenue because a new entertainment venue went in that wasn't there six months ago? Did another have a substandard year because more restaurants opened up in an adjacent neighborhood?

Users can also bring in data on crime rates and weather to dive deeper into what's causing each trend. Additionally, they can use demographic data from Esri to delve into psychographic and socioeconomic information for each submarket.

Depending on the results, Horry County can then explore concrete actions to take to ensure that submarket revenues either stay steady or improve.

"If Insights determines that criminal activity in a submarket negatively affects revenues, will an increase in policing be able to provide a safer experience, or will it also change the demographics of the visitors to that area?" posited Oliver. "Those are things we now have the ability to analyze over time."

Scaling Analysis to the Required Geographic Level

With Insights for ArcGIS, Horry County can perform speedy, accurate, and repeatable analyses on how well local businesses are doing—and all this scales to the geographic level required. Once one type of analysis is performed, the app stores the model so other users can easily rerun it with fresh or different data.

Horry County can also share this information with the Chamber of Commerce, an economic development consortium, and state-level agencies so they, too, can see where additional support is needed to help keep local businesses solvent.

"The local economy is driven and supported by tourism," said Oliver. "It's not just the hospitality tax that benefits the county. Sales tax, jobs, and subsequent housing and development are all impacted by tourism."

While the hospitality tax was the impetus for getting Horry County to analyze this data on submarket levels, Insights for ArcGIS is fast becoming the trusted source for gaining a better understanding of the overall health of Horry's tourism economy. That's because it's simple to use and breaks down complex issues into manageable nuggets.

Massachusetts Keeps Drinking Water Safe

Using Survey123 for ArcGIS and Microsoft Flow, Water Management Staff Save Time and Money Conducting Boat Inspections

The Quabbin Reservoir is one of only five major unfiltered drinking water supplies in the United States. It is part of the system that supplies water for more than 2.5 million residents in the Greater Boston area.

While boat-based fishing is permitted in certain areas of the reservoir, the potential for those boats to introduce aquatic invasive species into the water supply is a real risk. That is why the Division of Water Supply Protection (DWSP), inside the Massachusetts Department of Conservation and Recreation's Office of Watershed Management, takes pains to protect the integrity of the Quabbin Reservoir and ensure that the only boats allowed onto it are contaminant-free.

It does this via a boat seal program, whereby boaters wishing to use the reservoir must have their boats inspected, decontaminated, and sealed to their trailers by an unbreakable piece of wire with a special, numbered tag that DWSP tracks in a database. Only boats that pass the inspection are given a seal signifying that they are contaminant-free, which allows them to launch on the reservoir. And when these boats return to land, they are given new boat seals that tag them to their trailers. Boats without intact seals are prohibited from launching.

The boat inspection and decontamination program has historically relied on a combination of manual and paper-based workflows for scheduling inspections, maintaining seal data, and monitoring inspection activities. With about 200 boat inspections to perform each year, sustaining the various workflows throughout the entire process became inefficient.

"There was a huge input of staff time—over 700 hours annually—on translating paper-based information into other systems," said Erica Tefft, DWSP's watershed GIS coordinator. "It was, frankly, an expensive waste of people's time that they could have used to do other things."

The program's management team—DWSP director John Scannell, DWSP's Quabbin and Ware River assistant regional director Lisa Gustavsen, and DWSP's Quabbin and Ware River regional director Dr. Daniel Clark—sought a modern, digital solution for managing the boat seal program. They wanted to streamline the data, as well as all the manual processes DWSP's environmental quality section was using to administer the master boater database.

After attending the 2018 Esri User Conference and regional user group meetings, Tefft learned about Survey123 for ArcGIS, a formcentric solution for creating surveys, collecting answers, and analyzing results. Survey123 was perfectly suited to capturing the tabular type of data required for boat inspections. In addition, the Survey123 Connector for Microsoft Flow would allow surveys to be configured so that when submitted, a trigger would initiate an automated action, such as sending specific data to the Google Calendar and Google Sheets DWSP uses.

For the boat seal program, Tefft designed two Survey123 surveys that together replaced the original manual processes.

The first survey Tefft built was the Quabbin Boat Seal Appointment and Decontamination Survey. Staff at the Quabbin Reservoir Visitors Center use it on desktop computers to set boat inspection and decontamination appointments, while Quabbin Watershed rangers use it on iPads to record critical details, such as regulatory requirements for each boat and motor, during the on-site appointments.

Next, Tefft built the Quabbin Boat Seal Program—In/Out Survey. Boat Launch Area (BLA) staff use this survey to check in boaters who have an inspection seal and sign them out with a new seal when they leave the water.

The two surveys capture all the data DWSP needs to ensure that the Quabbin Reservoir remains contaminant-free, including each boat owner's name and contact information, the boat registration number, the date of the decontamination, and the date and time of every launch.

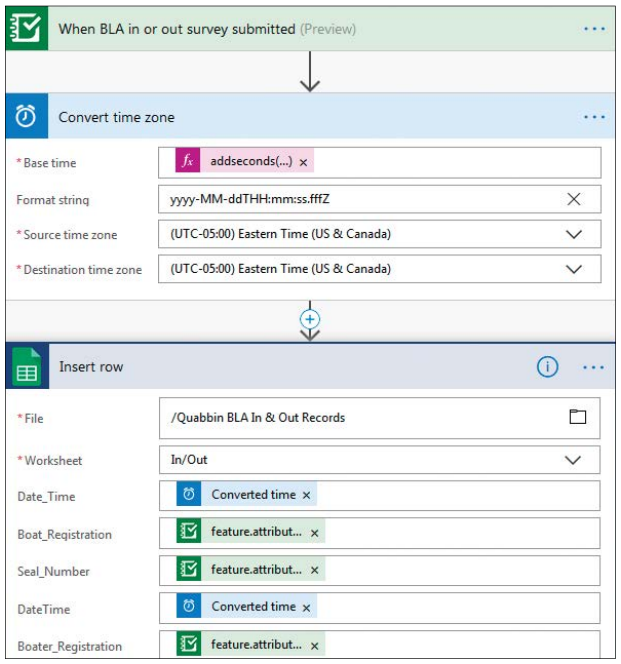
To get the survey-captured data to automatically flow into other systems, Tefft used the Survey123 Connector for Microsoft Flow. From the Quabbin Boat Seal Appointment and Decontamination Survey, the Convert Time Zones action is triggered to automatically detect the appointment date and time, adjust to the correct time zone, and create an end time to reflect a 20-minute duration. The Create an Event Flow is automatically triggered as well, which makes a Google Calendar event. Now, staff use the Google Calendar to see all the appointments for scheduled decontamination days, which eliminates the need to print out each day's itinerary.

When BLA staff submit a Quabbin Boat Seal Program—In/Out Survey, it automatically triggers the Tag_InOut_Flow in Microsoft Flow. This sends the data to a master Google Sheet that BLA employees, staff in the environmental quality section, and Quabbin Watershed rangers use to monitor boat activity on the reservoir for any given day. Having this data available in real time allows watershed rangers to know who is on or off the water at all times, satisfying a long-standing need.

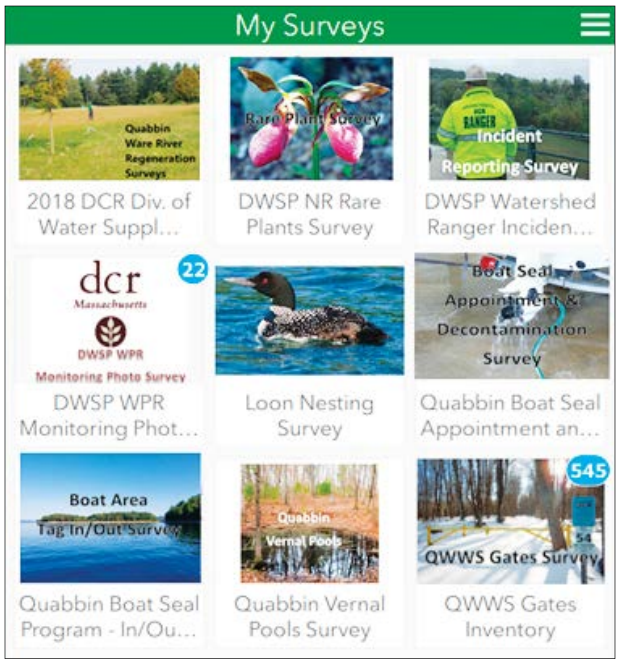
Through Flow actions, the Download Survey123 Data Python script, and an R script, all the data from both surveys is automatically pulled into the master boater database, a repository that contains records for more than 2,300 boats. Having this information automatically entered into the database ensures better data quality and near real-time information. Additionally, the new workflows for digitally collecting the data with surveys and automating the flow of data throughout DWSP's systems reduce the annual number of labor hours by 72 percent.

Using Survey123 and the Survey123 Connector for Microsoft Flow to digitally transform the manual workflows has enabled DWSP to realize a 137 percent initial-year return on investment in labor costs for the boat inspection program. All stakeholders now benefit from having accurate, complete, and up-to-date boat and boater data readily available at any time.

"Overall, using these surveys with the Survey123 Connector for Microsoft Flow is helping improve the quality of the boat/boater database to ensure the Quabbin Reservoir's water quality is being maintained at the highest possible level," concluded Tefft.



↑ When Boat Launch Area (BLA) staff submit a Quabbin Boat Seal Program—In/Out Survey, it automatically triggers the Tag_InOut_Flow in Microsoft Flow, which sends the data to a master spreadsheet.



↑ Many of the Division of Water Supply Protection's (DWSP) projects use Survey123 to capture data.

↓ Having all the boat inspection data available in real time allows watershed rangers to know which boats are on and off the water at all times.

Milwaukee's Industrial Past Is *Rediscovered* and *Redeveloped* Using GIS

By Angela Hronek and Sebastian Renfield, Mead & Hunt, Inc.

Once called "the machine shop of the world," Milwaukee, Wisconsin, is still home to thousands of industrial properties, including breweries, factories, warehouses, mills, tanneries, and foundries. Many of these buildings and neighborhoods are potential candidates for listing in the National Register of Historic Places, which qualifies them to receive Historic Tax Credits that encourage redevelopment. But the Wisconsin State Historic Preservation Office (SHPO) needed to know where all of Milwaukee's prospects were.

SHPO hired the cultural resources team at Mead & Hunt, Inc., to conduct an exhaustive survey of the city's historic industrial buildings. Both parties knew they would need a GIS-integrated approach. So Mead & Hunt's team, which included architectural historians and GIS specialists, used ArcGIS to efficiently review and record large numbers of historic resources in the field and then seamlessly transfer that data to SHPO.

The West St. Paul Avenue Industrial Historic District was one of two potential historic districts identified by the study.

Pinpointing Historic Industrial Properties

To provide comprehensive survey coverage, the project team needed to identify industrial properties within Milwaukee's city limits that were more than 40 years old. But instead of going straight into the field, Mead & Hunt used GIS data from the City of Milwaukee, along with other existing data sources, to first determine the extent of the survey area and then build field survey maps.

The objective was to determine the locations of known historic industrial buildings, as well as previously unrecorded properties.

"GIS analysis of the existing datasets refined and narrowed both the geographic scope and the temporal extent of the data based on project parameters," said Brauna Hartzell, a GIS analyst at Mead & Hunt.

To begin the process, Mead & Hunt obtained the Wisconsin Historic Preservation Database as a shapefile from SHPO, which contains points for previously recorded historic industrial properties throughout Milwaukee. The project team then worked with SHPO to come up with appropriate industrial activity categories—such as "tannery," "brewery," and "manufacturing"—and mapped all the properties in the database using ArcGIS Desktop. Mead & Hunt ended up with a total of 546 already-recorded properties that fit into these categories.

Next, Mead & Hunt needed to identify additional industrial buildings that had not yet been documented. Using the City of Milwaukee's GIS-based parcel data, the project team found all the lots in the city that were zoned for industrial use. The plan was to have surveyors review these parcels in the field to determine if there were any other buildings that fit the survey criteria. This produced more than 1,400 industrial parcels that needed to be added to the survey.

Mead & Hunt overlaid those 1,400 parcels with the 546 previously surveyed features to define the combined survey area. This would enable the project team to pinpoint individual industrial properties and concentrations of industrial buildings that had the potential to be included in the National Register of Historic Places.

Once Mead & Hunt identified all the properties that needed to be surveyed, the company's GIS specialists used Collector for ArcGIS to produce tablet-based maps that included every single property. A point layer containing the previously recorded industrial resources served as the foundation for data collection; surveyors would use it to revisit those properties and confirm that they still existed. A second layer based on the 1,400-feature industrial parcel data would then allow surveyors to track their progress by coding each parcel as "visited," "vacant," or of "nonhistoric age."

Along the way, if surveyors encountered any additional industrial buildings on those parcels, they would be able to use Collector to add new features to the point layer. And the whole survey would be conducted offline so surveyors could compare and check the data before uploading it to ArcGIS Online at the end of each day.

"The *[Collector for ArcGIS]* app provided the necessary functionality to conduct *[this]* survey over an extensive area in an offline environment with multiple teams of surveyors," said Hartzell.

Once the survey was complete, all the final data would then be downloaded to ArcGIS Desktop for use in project deliverables.

Gathering Field Data Digitally

Mead & Hunt sent four people in teams out into the field with Collector. It took them just 10 days to visit all 1,946 properties that had been flagged for the survey.

To discern whether an individual industrial building was a likely candidate for the National Register of Historic Places, the field teams scouted properties that looked exceptionally historic or had interesting architectural features. They also searched for places that appeared to be associated with important Milwaukee manufacturers—including former automobile (and current water heater) manufacturer A. O. Smith; clothing and textile producer Eagle Knitting Mills; and the Allen-Bradley Company, which got its start producing electrical controls. The buildings ranged widely in their industrial use, from manufacturing beer, boots, and steam engines to producing candy, caskets, and straw hats.

Many potentially significant properties were less obvious, however. Using ArcGIS Desktop, the project team displayed the survey data on a map and symbolized the buildings based on when they were built, the types of industries they were used for, and other attributes. This helped the team see concentrations of historic buildings and identify trends that revealed the context of industrial development throughout Milwaukee. Being able to visualize all this on a map allowed Mead & Hunt to begin identifying potential historic districts.

Using Collector for this data-gathering project not only streamlined fieldwork operations, enabling surveyors to track their progress and easily navigate from one industrial parcel to the next, but it also offered several other advantages over traditional pen-and-paper survey methods. For example, developing the survey form in Collector allowed Mead & Hunt to preserve the schema that the Wisconsin Historic Preservation Database uses. This, in turn, enabled SHPO to easily reintegrate the survey records into its own database, eliminating the need to manually enter descriptive data from individual paper forms. Similarly, SHPO was able to obtain property locations without having to digitize each point. With what ended up being more than 900 records in the completed survey, this saved substantial amounts of time and effort.

"These new GIS-based survey methods allowed the project team to significantly increase our efficiency and reduce the amount of time needed to prepare for *[the]* field survey and manage survey data," said Emily Pettis, a project manager at Mead & Hunt. "The client was very impressed with our up-to-date progress maps and digital deliverables, including GIS data."

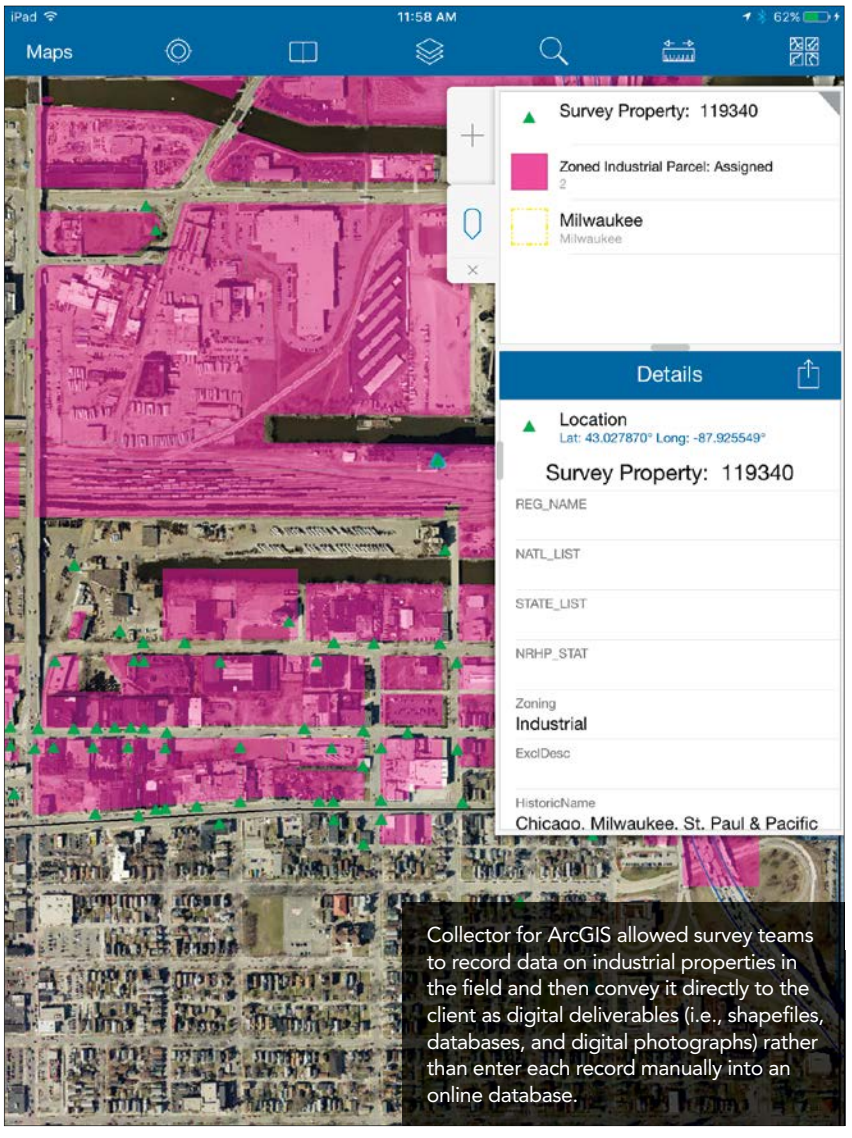
By the end of the survey, the project team had a spreadsheet that could be seamlessly incorporated into the Wisconsin Historic Preservation Database. It also had a point layer containing all the surveyed properties, which SHPO now uses in the interactive map feature embedded in its online database.

Starting Down the Path of Redevelopment

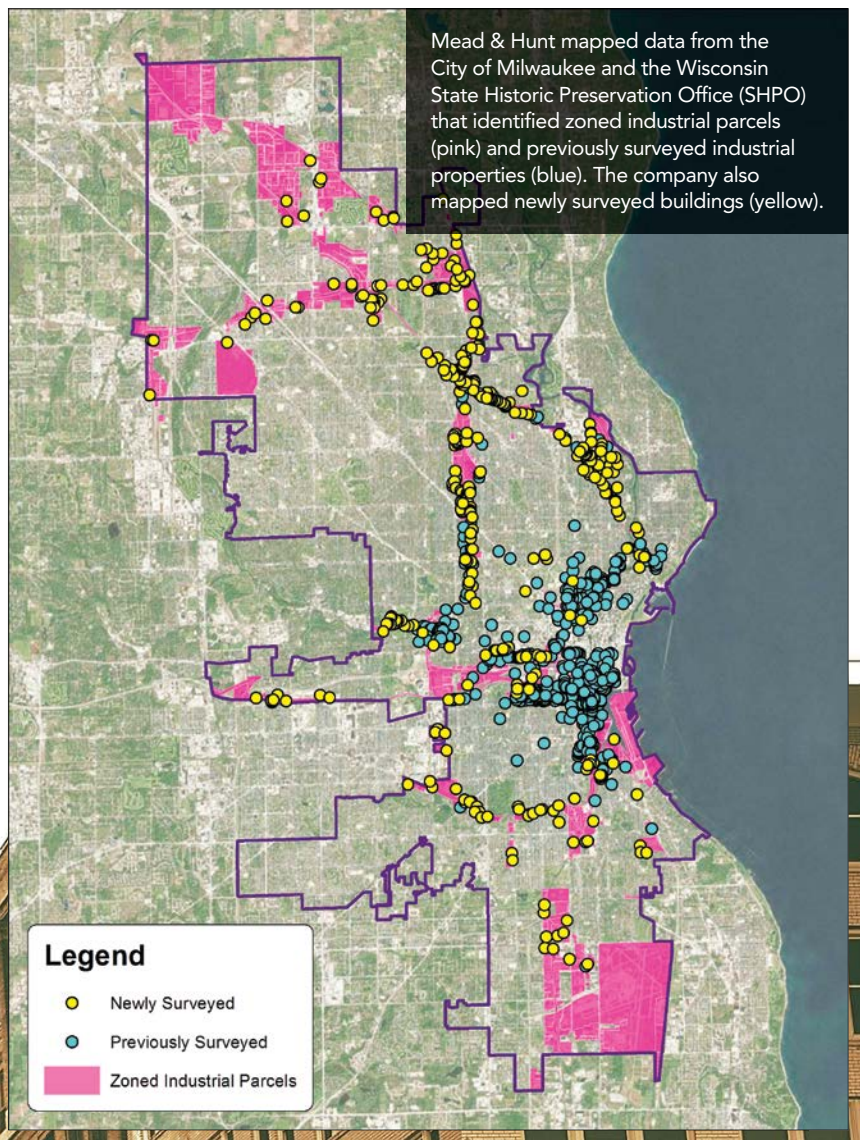
The results of the survey provide a comprehensive overview of Milwaukee's industrial heritage. Multiple local developers and nonprofit organizations are already using them to assist in identifying industrial properties that are suitable for redevelopment.

Through the survey, Mead & Hunt distinguished 39 historic buildings and two historic districts—the Layton Park Industrial Historic District and the West St. Paul Avenue Industrial Historic District—as prospective candidates for listing in the National Register of Historic Places. These properties could undergo significant rehabilitation with help from Historic Tax Credits, which would make it easier for local developers to turn the buildings into apartments, offices, and other commercial entities. In fact, since the Historic Tax Credit program's inception in 1982, it has reinvested $526 million in Milwaukee's historic properties—hopefully with more to come.

Large-scale survey projects, like the one Mead & Hunt conducted for SHPO, greatly simplify the process of evaluating properties for historic preservation. Employing ArcGIS technology makes the fieldwork more efficient and streamlines the digital deliverables. This not only helps open doors to redevelopment opportunities, but it also enables cities to understand more thoroughly the contexts from which they emerged.



Collector for ArcGIS allowed survey teams to record data on industrial properties in the field and then convey it directly to the client as digital deliverables (i.e., shapefiles, databases, and digital photographs) rather than enter each record manually into an online database.



Mead & Hunt mapped data from the City of Milwaukee and the Wisconsin State Historic Preservation Office (SHPO) that identified zoned industrial parcels (pink) and previously surveyed industrial properties (blue). The company also mapped newly surveyed buildings (yellow).

About the Authors

Angela Hronek and Sebastian Renfield are both cultural resource specialists at Mead & Hunt. For more information about how the company is using ArcGIS solutions to conduct cultural resource surveys, email Renfield, who is also the team GIS lead, at sebastian.renfield@meadhunt.com.

Esri Partners Help Increase Geographic Awareness Among and Within Organizations

Esri partners have a profusion of specialties—from fostering collaboration among interagency emergency responders to helping utilities comprehend all aspects of their assets. With ArcGIS Enterprise, Insights for ArcGIS, and more, they are helping organizations around the world keep communities safe and tap into in-depth analysis.

A Fast-Moving Fire, a High-Speed Response

On September 3, 2018, a wildfire broke out at the Bundeswehr Technical Center for Weapons and Ammunition (known as WTD 91 in German), in Meppen, Lower Saxony. With winds at speeds of up to 52 miles per hour, the Moorland Fire spread quickly, threatening several towns. Immediate action was needed.

Emsland District, which encompasses Meppen, has a technical command group that can trigger a rapid deployment of emergency personnel using CommandX from Eurocommand GmbH (eurocommand.com). Not long after the fire started, that's exactly what the district did, alerting the 22 fire departments and several Red Cross units in its jurisdiction about the emergency. While several of them got response efforts under way in conjunction with the Joint Information and Situation Center of Germany's Federal Office of Civil Protection and Disaster Assistance, Eurocommand notified Esri's Disaster Response Program (DRP), which provided additional support.

As part of the DRP, Eurocommand sent three staff members from its headquarters in Hamburg to Meppen. To ensure that everyone had access to all the same data, they brought with them Eurocommand's operational support system, 10 notebook computers, one mobile server, and two large-format displays. It took them just under four hours to get there and less than 30 minuets to set everything up in the command center. By that point, the wildfire had burned eight square kilometers, so tracking it, managing the response, and collaborating on its status—quickly—were critical.

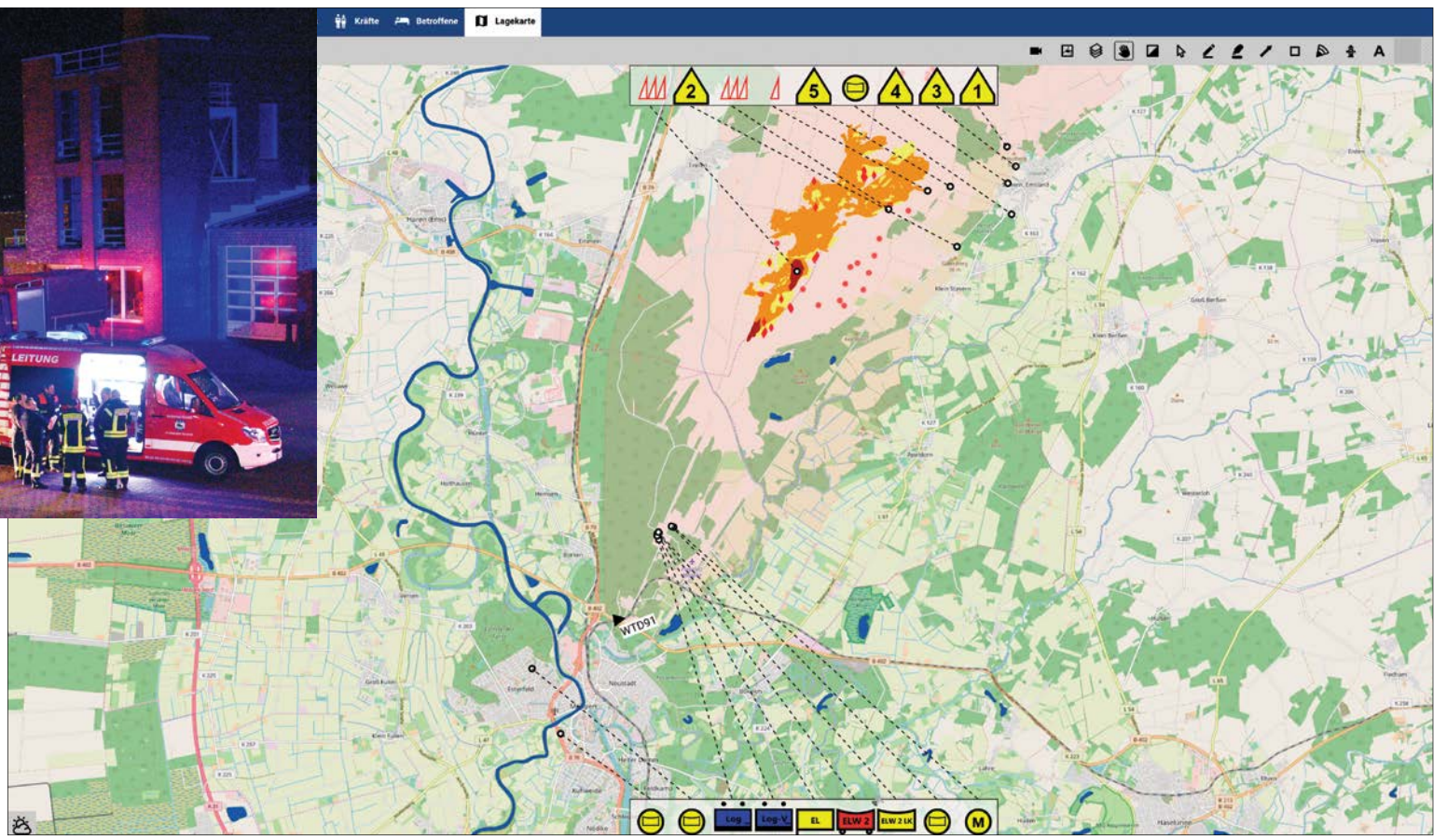
CommandX communicates with ArcGIS Server and Portal for ArcGIS (both components of ArcGIS Enterprise), which enables users to share data rapidly and securely—within their organizations' own infrastructure and behind firewalls. The 64-bit system's bidirectional interface with ArcGIS provides users with live access to basemaps, layers, and data so personnel at all levels and within each partner organization can see the most current situational and planning information on a map. Using CommandX's networked connection, all stakeholders were able to get a realistic picture of the on-site situation without everyone having to be on the ground.

With the emergency response under way, various technical commands from Lower Saxony and the operational headquarters for the fire brigade used the software to keep tabs on ongoing operations. CommandX seamlessly integrated the most up-to-date data—including a task and notification system, a mission diary, a staging organogram, and an interactive tactical map—which made shift changeovers easier.

The wildfire ended up burning for several weeks. But thanks to the coordinated interagency effort facilitated by CommandX, the fire stayed under control. All the threatened towns were saved, and there was no damage outside WTD 91.

Everyone involved in the response effort concluded that with CommandX, it's possible to work thoroughly and transparently and not lose data as it moves between different levels of command and among partner organizations. It also works both centrally and locally without experiencing any outages or interruptions, which is paramount during an emergency that requires networked command support.

↑ After a wildfire broke out at the Bundeswehr Technical Center for Weapons and Ammunition in Meppen, Germany, 52-mile-an-hour winds caused it to spread quickly. Emergency personnel had to ramp up fast.



↑ CommandX's bidirectional interface with ArcGIS provides users with live access to basemaps, layers, and data so they can see the most current situational information on a map.

Visualizing Complex Asset Data, Simply

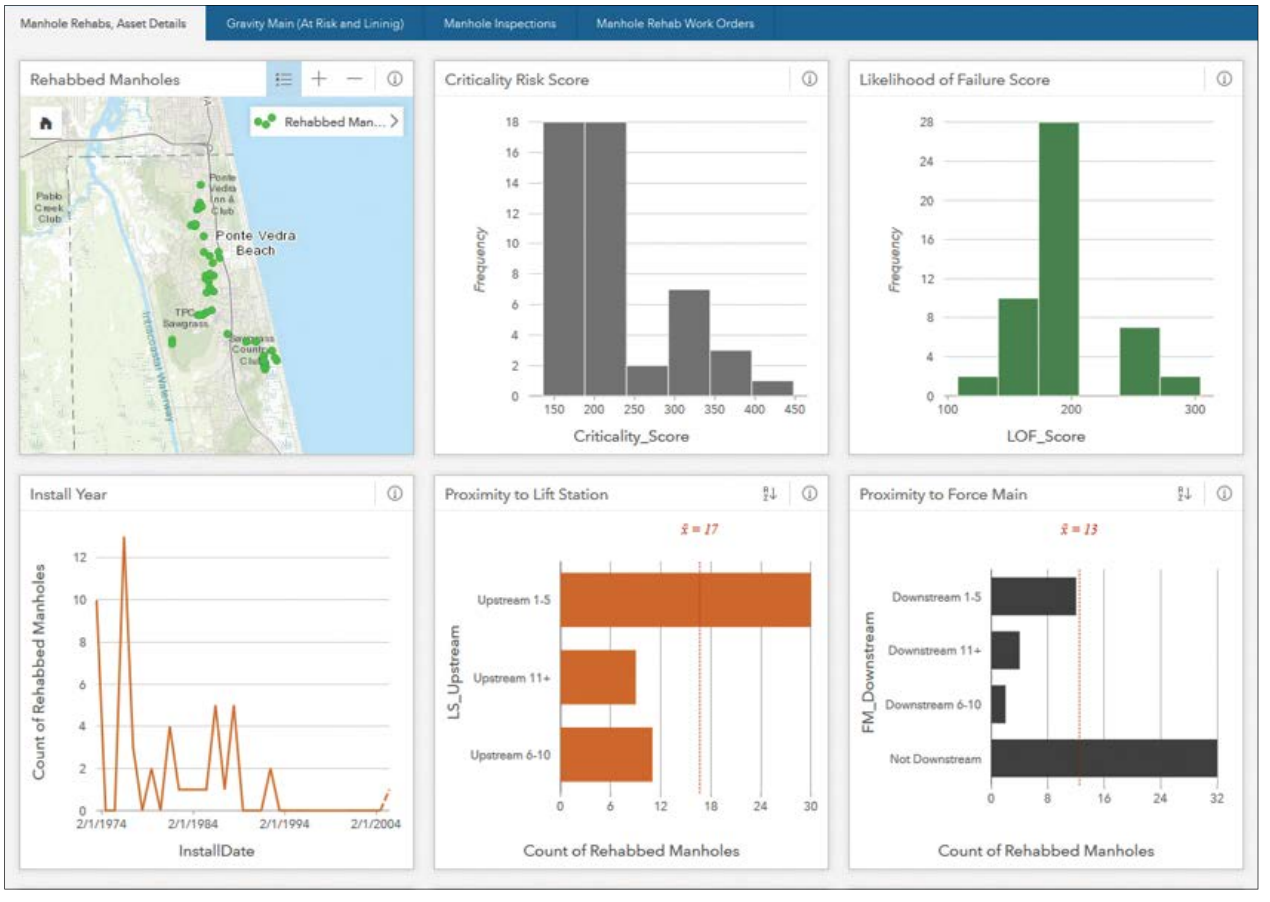
St. Johns County (SJC) Utilities in Florida is no stranger to GIS. The organization has been using ArcGIS technology since 1997 and the Cityworks-Azteca Systems (cityworks.com) asset management platform since 2008. Over the past decade, SJC Utilities has evolved from simply using GIS to track and display historical asset data to employing mobile GIS and real-time data visualizations to manage operations and planning.

To help with this ongoing transition, SJC Utilities worked with Cityworks staff to connect its asset management data to Insights for ArcGIS, Esri's data analytics software that distills complex information into simple visualizations. Using Cityworks and Insights for ArcGIS together would allow SJC Utilities to track its assets and their associated labor, costs, and materials using eye-catching maps, charts, and tables.

Supervisors and staff quickly connected with this dynamic method for informing business decisions. A group from SJC Utilities' engineering, operations, and finance teams, for example, used the solution to analyze their manhole, sewer main, and capital rehabilitation projects. The data discovery and analysis helped them shift rehabilitation funding to the areas of greatest need. The warehouse and purchasing division is also using an Insights for ArcGIS workbook that pulls data from the Cityworks material velocity analysis to review stock quantities, identify material purchase demands, and set minimum stock-on-hand levels.

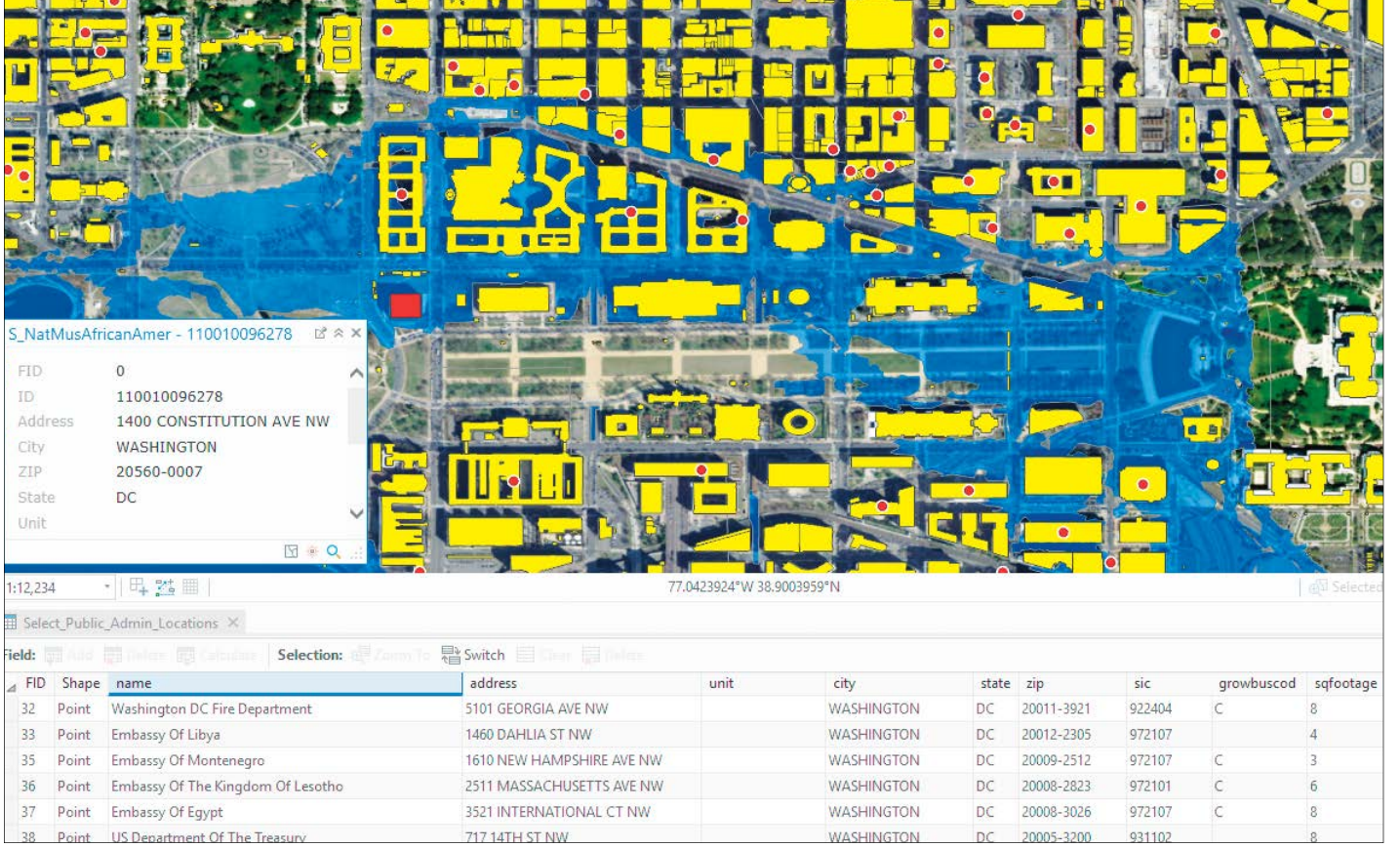
"With Insights for ArcGIS, we can transform our Cityworks data into shareable knowledge and live visuals, promoting awareness and understanding of our projects among all staff," said James Galley, a senior financial analyst at SJC Utilities.

By using Cityworks and Insights for ArcGIS, SJC Utilities reduced the time it takes to build analyses by approximately 60 percent. Instead of having to use flat reports, the organization now has access to live mobile analytical tools. The sophisticated levels of analysis and flexible data navigation support better data-driven decisions both in the short term and with long-term planning.



↑ Using Insights for ArcGIS along with Cityworks enables St. Johns County (SJC) Utilities to use inspection reports, cost analyses, and risk characteristics to determine which manholes should receive funding for rehabilitation.

Esri partners represent a rich ecosystem of organizations around the world that work together to amplify The Science of Where by extending the ArcGIS platform and implementing it in distinct ways to solve specific problems. Their products and services range from configured apps, add-ons, widgets, and custom-built solutions to complete ArcGIS system implementations, content, and hardware. Search for and discover partners, solutions, and services that meet your needs at **esri.com/partners**.



FID	Shape	name	address	unit	city	state	zip	sic	growbuscod	sqfootage
32	Point	Washington DC Fire Department	5101 GEORGIA AVE NW		WASHINGTON	DC	20011-3921	922404	C	8
33	Point	Embassy Of Libya	1460 DAHLIA ST NW		WASHINGTON	DC	20012-2305	972107		4
35	Point	Embassy Of Montenegro	1610 NEW HAMPSHIRE AVE NW		WASHINGTON	DC	20009-2512	972107	C	3
36	Point	Embassy Of The Kingdom Of Lesotho	2511 MASSACHUSETTS AVE NW		WASHINGTON	DC	20008-2823	972101	C	6
37	Point	Embassy Of Egypt	3521 INTERNATIONAL CT NW		WASHINGTON	DC	20008-3026	972107	C	8
38	Point	US Department Of The Treasury	717 14TH ST NW		WASHINGTON	DC	20005-3200	931102		8

↑ BuildingFootprintUSA's attribute data includes information such as business growth rate models (growbuscod) and building square footage (sqfootage).

Attribute-Rich Building Footprints Make Flood Prediction More Accurate

By Priscilla Anand, LERETA, and Karl Urich, BuildingFootprintUSA

Floods cost homeowners, business owners, communities, and farmers billions of dollars in infrastructure and property damages. The impacts from these natural disasters are vast, causing loss of life, destruction of property, devastation to agriculture, loss of livestock, and severe health issues from waterborne diseases.

LERETA, based in Covina, California, has a 30-year track record of successfully determining flood zones and servicing more than 14 million loans for flood recovery. Driving LERETA's business is the need to be accurate, cost-effective, compliant with government regulations, timely in its responses, and extraordinarily customer service oriented.

Figuring out whether an area is at risk for flooding is a strenuous process, though. Sometimes flood studies are divided into parts and represented in several drawings, so it's challenging to view them in conjunction with other datasets.

To mitigate this issue, the Federal Emergency Management Agency (FEMA) converted its flood data and flood insurance rate maps from paper to digital. Now, these flood studies are more accessible to a wider audience, and members of the flood industry can find the information they need quickly. What's more, people can use GIS to seamlessly analyze and explore flood data in the context of other relevant information.

While LERETA was already using GIS to visualize flood extents and create flood risk and damage estimation maps—which help with producing municipal and emergency action plans, flood insurance rates, and ecological studies—not all the data was as accurate as it could have been. Oftentimes, even though LERETA used top-notch geocoding technology to get the location of an address, the company couldn't find out the exact position or shape of particular buildings at a specific address. This had the potential to make its assessments less precise.

Fortunately, LERETA found an affordable spatial layer of building footprints from Esri startup partner BuildingFootprintUSA (buildingfootprintusa.com). Based in Albany, New York, BuildingFootprintUSA creates nationwide, addressed, and attributed building footprint content that can be used in industries such as insurance, telecommunications, and utilities. With rich attributes, the company's building footprint provides a higher level of accuracy than existing state-of-the-art parcel and address point data. The building footprints from BuildingFootprintUSA are enriched with business listing data, real property data, household demographics, building height and ground elevation information, and more.

Having incorporated this building footprint spatial layer into its stack of ArcGIS technology, LERETA can now identify whether or not a specific building polygon—rather than an approximate area—is in a flood zone by evaluating the spatial intersection of the buildings in conjunction with FEMA's flood zone layer. This has increased the accuracy of LERETA's flood zone determinations, which, in turn, has decreased the company's exposure to liability. In fact, since implementing the building footprints, LERETA has seen a 25 percent reduction in disputes as to whether or not specific buildings are located in flood zones.

With a comprehensive set of geoprocessing tools from Esri; an abundance of data layers, including county and parcel boundaries, FEMA flood layers, and coastal resource system layers; and a few custom-built web apps, LERETA has also increased the number of orders it can automatically process from 90 to 92 percent. That 2 percent increase in automation may seem small, but it has reduced the costs associated with having the company's manual search team scour maps and data to see whether or not flooded properties are indeed located in flood zones.

Best of all, LERETA's customers, which consist of lenders and insurance companies, are pleased with its more accurate services. Working with BuildingFootprintUSA is helping LERETA stand out from the competition.

Esri recently partnered with BuildingFootprintUSA to include its building footprint data in ArcGIS Online basemaps at no additional cost. The building footprint data will also be available for advanced geocoding needs through ArcGIS World Geocoding Service, StreetMap Premium for ArcGIS North America, and ArcGIS World Geocoder.

About the Authors

Priscilla Anand is the GIS technical manager for LERETA. She has more than 15 years of experience with GIS and ArcGIS technology. Karl Urich is the president of BuildingFootprintUSA and has spent 25 years creating data products and solutions for companies across a range of industries.

For more information, contact Anand at panand@LERETA.com or Urich at karl@buildingfootprintusa.com.

The Relevance of Cartography

A Cartographer's Perspective

A column by Menno-Jan Kraak
President of the International Cartographic Association

Defining a Cartographer

What is a cartographer?

The answer to this question might seem obvious. So why spend a whole column on the topic? Because perhaps it's not so clear.

Let's first see what dictionaries tell us. The Oxford Dictionary of English app defines a cartographer as "a person who draws or produces maps." Merriam-Webster's online dictionary says a cartographer is "one that makes maps." And the Cambridge Dictionary, also available online, states that a cartographer is "someone who makes or draws maps."

Noticeably, these definitions all focus on making and drawing. This is probably due to the outmoded process of producing paper maps. That chain of production required a whole set of people who each had their own skills. Next to the cartographer, for instance, was also a photographer and a printing press operator.

Interestingly, web-based Dictionary.com writes that a cartographer is "a person engaged in cartography, or the production of maps." This broadens the scope of the word, certainly, but it's still a little vague. What does "engaged in" mean, exactly?

This reminds me of discussions among cartographers that were happening during the 1980s around the question of who was the real cartographer—the person in the drawing room actually drawing the map or the academic who mostly discussed the map conceptually? As a young student at the time, the answer was pretty clear to me: both were members of the Dutch cartographic society and both engaged in the same activities and discussions during meetings, so both would qualify as "real cartographers" because both were skilled in cartography.

When the computer became fully integrated in producing maps in the 1990s, however, the number of people involved who had different crafts (e.g., the photographer and the printing press operator) decreased. By this time, the cartographer was doing all the work. So a cartographer became someone with the knowledge and skills to design and make maps for a particular audience.

The integration of the computer in virtually all work processes also had a few additional effects on cartography. Soon, people who possessed no cartographic skills whatsoever were able to make maps. Oftentimes, they were researchers from geography-based disciplines who used GIS to visualize their data on maps. To me, these people were not cartographers but rather mapmakers, considering they lacked professional cartographic training.

In recent decades, history repeated itself with a slight twist. The rise of the Internet and mobile devices has resulted in a tremendous increase in the creation and use of maps. Most of those maps are of the where-is-it and how-do-I-get-there type. But with social media and our growing habits of sharing information, there has also been a surge of people making mashup maps with online mapping tools.

It could be argued that the professional cartographic community shouldn't be against the presence of more maps in the world. But at the same time, not all maps are necessarily good. This is mainly because, first, the mapmakers' skills are not up to par, and, second, they often use the software defaults, which don't always produce the most accurate results.

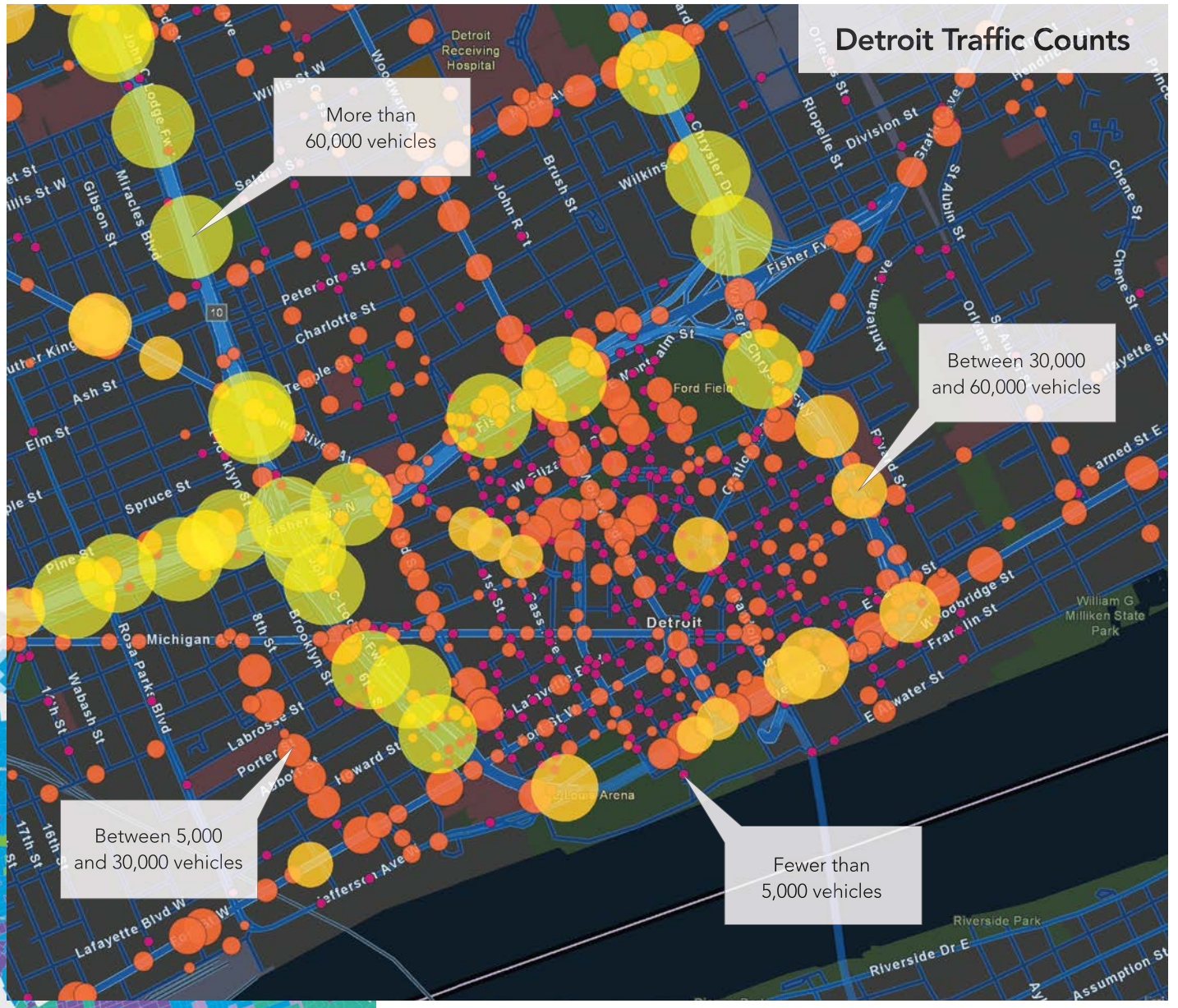
So how can cartographers train mapmakers to do better cartography? Sending them all back to school is not very likely. That said, online, open-source educational modules seem to be a viable option. It would also be useful if the available software better described its default settings and even offered suggestions on which map types or symbology to use during the mapmaking process.

Additionally, cartographers need to pay attention to the map users—those who make use of a map with an objective in mind. We need to ask ourselves questions such as, Do they really understand what they're seeing? Do they realize how this particular type of map works? Do they get why the mapmaker made certain design choices? One solution could be to add annotations or reading instructions to maps to further describe the data.

Given how drastically the process of mapmaking has changed over the past few decades, how do we define a cartographer now? I would say that a cartographer is someone who unquestionably possesses the knowledge and skills to design and make maps, but who is also engaged with map users to ensure that his or her maps are put to proper use.

About the Author

Menno-Jan Kraak is professor of geovisual analytics and cartography at the University of Twente in the Netherlands, where he has been teaching since 1996. He has a degree in cartography from the Faculty of Geographical Sciences at Utrecht University and received his PhD in cartography from Delft University of Technology. Kraak has written extensively on cartography and GIS. His book *Cartography: Visualization of Spatial Data*, written with Ferjan Ormeling, has been translated into five languages. He also wrote *Mapping Time: Illustrated by Minard's Map of Napoleon's Russian Campaign of 1812*, published by Esri Press in 2014. Kraak is a member of the editorial boards of several cartography journals, including the *International Journal of Cartography*. He currently serves as president of the International Cartographic Association.



STEPPING INTO LEADERSHIP ROLES WITH HELP FROM URISA

By Mark Yandrick, City of Centerville, Ohio

↑ The Ohio chapter of Urban and Regional Information Systems Association (URISA) is pictured in September 2018. From left to right: former treasurer Larisa Kruger, treasurer John "Woody" Woodward, secretary Brittany Converse, former president Matt Shade, president Haley Zehentbauer, vice president Ryan Bowe, and former president Mark Yandrick.

Learning and growing fuel my curiosity and always stimulate my next accomplishment. Thankfully, throughout my career, I have never stopped doing either one.

When I first started out as a GIS technician, I was very task oriented, trying to learn the tools and tricks of ArcGIS Desktop. Now, I'm discovering that to move GIS into an enterprise environment and employ the technology's capabilities to their full potential, I need to be a leader and have vision.

Getting involved with the Urban and Regional Information Systems Association (URISA) and other user groups has helped me learn these lessons, develop leadership skills, and forge my own vision for how to use the technology effectively. That's why I recommend that GIS professionals at all levels of their careers look into the growth opportunities fostered by URISA and other, similar organizations.

Get Involved with Local Groups

I have been with the City of Centerville, Ohio, for more than 10 years. Part of what has made my work consistently engaging and fulfilling is that I have had the opportunity to be a member and leader of local user and professional groups. Not only has that allowed me to learn from and network with my peers, but it has also enabled me to help others cultivate their passions and sustain a supportive circle of fellow GIS professionals.

When I began at the city, getting involved in the Southwest Ohio GIS User Group (SWOGIS) in Dayton, Ohio, was invaluable. That's where I learned new technology in ArcGIS Server and how to use Microsoft Silverlight. I also discovered a wealth of best practices and got involved in leading events and working with others to decide on the direction the user group would take.

In 2011, I was connected with the Ohio chapter of URISA. My first responsibility was to implement a statewide user group meeting at the annual Ohio GIS Conference. This would be an opportunity for the dozen or so grassroots user groups around the state to share what each organization was doing to learn, grow, and network in the ever-changing geospatial field.

My second responsibility with Ohio URISA was to create a mentorship program for the chapter. In 2012, I led an initiative to have Ohio URISA adopt a mentoring program called MATCH, which pairs undergraduates, graduate students, and young professionals with mentors who then assist with their career development.

Organizing both the meeting and the mentoring initiative helped me understand how Ohio URISA worked and allowed me to get to know many of its members, leaders, and movements. Through this, I realized my knack for leading and fostering collaboration both within my organization and among members of the larger GIS industry.

Take On a Leadership Role

In 2015, I was nominated to the board of Ohio URISA for a three-year term, with one of those years spent as president of the organization. Although I was timid at first, I did want to give back to the chapter that had done so much for me. I supported what Ohio URISA was doing and felt like this would be an opportunity to build up its membership, improve relations with the national-level URISA organization, and enhance relationships among Ohio GIS Conference partners. The chapter was also moving forward with the OneURISA initiative, which seeks to ensure that members benefit from their own chapters as well as the umbrella organization, and I was eager to assist with that.

During my time as president, we were able to

- Expand membership by 16 percent, to more than 400 members, in one year.
- Increase the number of workshops Ohio URISA conducted and add a new annual event: the Ohio URISA GIS Education Series that takes place in Columbus every spring.
- Partner with the Ohio GIS Conference committee to secure keynote speakers for the event.
- Start a First Time Conference Meetup group at the Ohio GIS Conference.
- Increase the number of updates we send out about URISA events and announcements.

Achieving these objectives was not particularly easy, considering there was other chapter business to attend to as well. But one of the keys to our success was having dedicated board members and committee chairs at Ohio URISA.

While I was chapter president, I made sure that they felt like leaders and took ownership of their tasks and initiatives. This was invaluable to me so I could focus on being the voice of Ohio URISA and guide it in moving forward. It was also significant to the board members, since they were able to get more involved in the chapter and realize professional growth opportunities. Additionally, the organization benefited by having more leaders engaged in the chapter's events.

Although my time on the board has concluded, I appreciate seeing that many of these initiatives—including the MATCH program—are flourishing. The chapter's new leaders are infusing them with great ideas and developing initiatives of their own. And that's helping Ohio URISA continue to thrive.

Attend the URISA GIS Leadership Academy

For anyone thinking about stepping into a leadership role, consider attending a URISA GIS Leadership Academy (GLA).

I worked with URISA to bring a GLA to Columbus in 2018 and witnessed firsthand how using management principles can grow the capacity of a GIS implementation. For the five-day event, we hosted 53 attendees from 16 US states and two Canadian provinces. It was a fast-paced week, with various group activities hosted by GLA faculty members, and countless networking opportunities.

The sessions covered an assortment of principles from the Project Management Institute with a geospatial twist. There was much discussion about what it takes to be a manager versus a leader and how management focuses on fighting fires while leadership emphasizes lighting a fire. It seemed obvious upon hearing it, but leadership can go well beyond just leading a team. Everyone can employ those concepts to champion certain projects—and even GIS itself—to the entire organization.

What was perhaps most eye-opening during Ohio URISA's GLA was everyone's passion for GIS and geospatial technologies. Hearing others' stories—like how someone's love for fishing and mapping got them into GIS—was completely relatable and made me realize all over again why I love this industry and the work I do. It's important for GIS professionals to connect with enthusiasm like that so it can fuel their own desire for growth, both at and outside of work.

Develop a Vision for GIS

My leadership experiences with Ohio URISA, as well as the opportunity I had to organize and attend the GLA, have been very important to me at the City of Centerville. As the planning department continues to expand the reach of its GIS and the technology becomes the central component of Centerville's enterprise resource planning implementation, I can say that my involvement with Ohio URISA and what I learned at the GLA have helped me develop a vision for how to make all this work.

So whether you're a young professional just getting your feet wet with GIS or a 25-year veteran of the field, there are many ways to grow your career and expertise by getting more involved in the industry. Don't be afraid of new opportunities. Go join a local user group or attend a GLA. Your experience might be just what that new project or organization needs. And some of the colleagues you meet along the way may assist you later in your career.

No matter what your goals are, these opportunities can help you climb that proverbial ladder and get what you want out of this industry.

Managing GIS

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

URISA
Fostering Excellence in GIS
www.URISA.org

About the Author

A graduate of Shippensburg University in Pennsylvania, Mark Yandrick, GISP, has been a GIS analyst and planner with the City of Centerville since 2008. He was the Ohio URISA president from 2016–2017 and has been a representative of the Ohio Municipal League—a nonprofit that supports municipal governments' interests throughout the state—on the Ohio Geographically Referenced Information Program (OGRIP) policy council since 2015. His work with the City of Centerville received an Ohio GIS Best Practices Award from the OGRIP in 2014.

Learning to Extend Enterprise GIS

How Harford County, Maryland, Transformed Its Field-Based Workflows

Harford County, Maryland, has a storied history and an intriguing future. Stretched across 437 square miles of land northeast of Baltimore, the county was founded right before the American Revolution and now has a forward-thinking government that uses technology—particularly GIS—to better connect with its 250,000 residents.

As an Esri Enterprise Agreement customer, Harford County is aiming to deploy GIS across its entire organization, incorporating it into more workflows and using it to be more efficient and transparent. Because there is usually a learning curve when implementing GIS at various levels of an organization, two GIS coordinators at Harford County took advantage of Esri Training courses to gain the knowledge and skills they needed to help the county navigate its digital transformation. Most recently, this helped Harford infuse its fire hydrant inspection and maintenance workflows with GIS. The results have been impressive.

A Constant Game of Catch-Up

Harford County has approximately 4,200 fire hydrants, and they all need routine maintenance each year to ensure that they are in proper working order and ready to use.

"We can't have a firefighter hooking up to a malfunctioning hydrant when there's a fire," said Chad Gibson, GIS coordinator for the water and sewer division of the county's department of public works.

During the inspections, which occur between April and October, maintenance workers typically determine that about a quarter of the hydrants require flushing. This scours the pipes to remove any built-up material that could impede water flow, so crews perform that on the spot. They also take chlorine readings for each hydrant to ensure that chlorine levels are appropriate and that the disinfectant isn't being discharged into the environment.

The entire inspection process required crews to spend about 20 minutes at each hydrant. That means it would take approximately 1,400 hours, or 35 full workweeks, to inspect all the hydrants in Harford County—which is longer than the seven-month time frame the county allots for the work.

What's more, Harford's hydrant maintenance workflow has historically been paper based, which is resource intensive and even more time-consuming. According to Gibson, fieldworkers doing the inspections would attend a meeting each morning to pick up paper maps that assigned them to grid-based zones around the county. Out in the field, these workers would use a printed spreadsheet to write down each hydrant's asset ID number, the amount of time the hydrant valve was open, and the chlorine reading. When the work was complete, crews would use a marker to highlight that hydrant's dot on the printed map before moving on to the next hydrant location.

At the end of the day, maintenance workers would turn in their highlighted paper maps and spreadsheets to administrative staff who were tasked with entering the data into the county's work order system. Unsurprisingly, this data entry was painstaking and slow. The three administrative staff members who performed it often had to work overtime to get it all done.

"The whole process could take up to a year," said Gibson. "And only about 2,700 hydrants would be inspected and updated in the *[GIS]* system. Every year we were playing catch-up."

But now, that paper-based process is history.

Bringing a Real-Time Workflow to Fieldwork

Harford County had actually had a digital asset management and work order system from Esri partner Cityworks-Azteca Systems in place for several years. In 2018, the county decided to integrate Cityworks into field operations. Maintenance workers were given iPads with the Cityworks app on them. So Gibson and his colleague Steven Headley, the county's GIS coordinator, decided that they wanted to incorporate ArcGIS mobile solutions into this system as well.

Specifically, Gibson and Headley had heard about ArcGIS apps for the field. They were curious and wondered what might be possible given the county's new digital approach to field-based asset management. To find out, they signed up for an Esri instructor-led training class.

While attending the Field Data Collection and Management Using ArcGIS class (p.ctx.ly/r/8pi6) in June, Gibson and Headley discovered that a lot was possible. Gibson was particularly excited about potential uses for Operations Dashboard for ArcGIS.

Soon after the class, he applied what he learned to create a dashboard that integrates with the Cityworks app. By then, maintenance crews were using Cityworks on their iPads to conduct their hydrant inspection work.

With Operations Dashboard, Gibson "fired up a dashboard in about 20 minutes," he said. Since deploying it, the results have been "huge."

Now, as fieldworkers inspect and flush (if needed) hydrants, they update the asset data directly on their iPads, using Cityworks, instead of on paper. After the data for each inspected hydrant is entered, the dashboard gets updated in real time.

From there, everyone in the office and out in the field can use the dashboard to see the real-time status of all the work being performed in each zone of the county. An indicator shows, by color, exactly how many hydrants have been inspected. Purple means the work has been completed, while red shows all the inspections that are outstanding.

"This is a huge time-saver and changes everything for *[maintenance workers]*," said Gibson. "The dashboard is super motivating because they can see progress."

And while it used to be difficult for supervisors to monitor the status of in-progress fieldwork, now they can see, at any given time, exactly where crews are working and how many hydrants have been inspected.

What's more, if workers out in the field identify a problem while inspecting a hydrant, they can create and submit a work order immediately via the Cityworks app instead of waiting to notify someone when they return to the office. This ensures that hydrant maintenance issues are addressed quickly, which is another key benefit of the county's modernized field workflow.

An Unprecedented Pace

By implementing the new workflow during the 2018 maintenance cycle, Harford County was able to inspect its hydrants at an unprecedented pace. All 4,232 of them were inspected a month and a half ahead of schedule.

Maintenance workers no longer need to attend a morning meeting to pick up paper maps, and they don't have to stop by the office after they complete their inspections to drop off their spreadsheets. Making updates on the iPad is quick and easy, and fieldworkers have more time to actually perform the hydrant work. So they can get more done in less time.

Additionally, administrative staff no longer need to manually transfer paper-based hydrant data into the county's asset management system. The GIS database now automatically stores up-to-date, accurate hydrant data based on the most recent field inspections.

Gibson estimates that for 2018, the automated field data collection workflow saved the county at least $35,000 in labor costs alone.

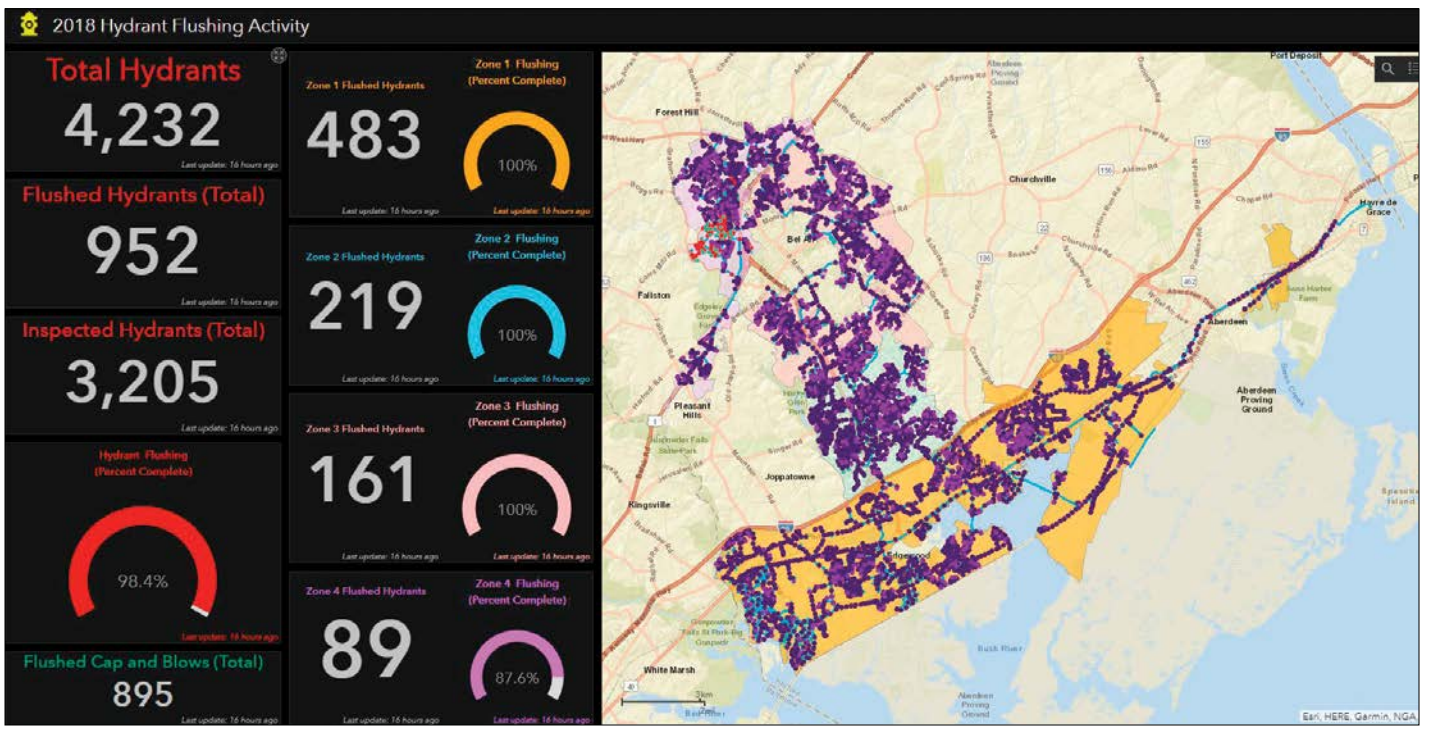
And "we're getting all the work done," he added.

Continuing the Digital Transformation

While making GIS a central component of field workflows was huge for Harford County, that's not where its digital transformation stops. Next, the county plans to implement Esri's Local Government Information Model and is working with Esri Professional Services to prepare its data.

Headley, who had a eureka moment during the Putting ArcGIS to Use Across Your Organization training class (p.ctx.ly/r/8pi7), now wants to equip the county's non-GIS staff with ArcGIS capabilities. He thinks there are plenty of projects that could benefit from GIS-powered insights.

Having deployed both an ArcGIS Online organizational site and an ArcGIS Enterprise portal, the county has the means to enable widespread use of GIS maps and apps among its staff—and realize additional positive results that benefit its residents and local businesses.



← The 2018 Hydrant Flushing Activity dashboard, created with Operations Dashboard for ArcGIS, provides crews and supervisors with a real-time view of how many hydrants have been flushed (purple) and how many are left to inspect (red).

The Value of Esri Technical Certifications, Supported at the Organizational Level

In recent years, the market for certified employees has expanded as hiring professionals realize the value that certification can bring to an organization.

"Trust goes a long way, and certification is a form of validation that everyone can rely on in the marketplace," said Evert Verveer, the training business manager at Esri Netherlands, which now encourages employees, on an organizational level, to get certifications.

Esri Netherlands saw that its clients were beginning to set standards around certification, indicating that advice from certified individuals was highly regarded.

"Increasingly, customers are starting to see the value of certification, and, in turn, we are seen as a partner with expertise and highly valued advice," said Verveer.

Esri Netherlands now requires all its instructors to hold an Esri Technical Certification to inspire confidence in users who take training courses with them. Currently, the distributor has more than 50 certified employees on staff.

Esri Technical Certification is an industry benchmark by which people's skills and experience in using ArcGIS software can be validated. Having a technical certification allows individuals to showcase their expertise and differentiate themselves in the IT industry. It also enables employers to verify proven skill sets.

Making Esri Technical Certification part of an employee development plan, like Esri Netherlands has done, has far-reaching benefits for an organization. Not only does it foster a stronger and more confident workforce, but it also expands expertise beyond just a few people in an office or from one company.

"Our staff are seen as experts in their area of certification, and being certified encourages others to seek certification," said Verveer.

Part of establishing certification as a central component of employee success involves making space for them to prepare for an exam. Since that process varies from person to person, Esri offers a wide range of resources to support individuals as they define their experience levels and identify any knowledge gaps.

"Preparation is the most important matter, and we emphasize taking time to prepare for an exam properly," said Verveer. "Esri has a lot of resources available, such as specific training courses, e-Learning, sample exam web courses, and online resources. We also encourage our staff to discuss their preparation with someone who has already achieved an Esri Technical Certification so they can hear a success story before attempting it for themselves."

For Esri Netherlands, technical certification is an ongoing and strategic activity to make other organizations aware of the benefits of certification. This not only makes it easier for those customers to seek out specific types of experts on the Esri Netherlands staff, but it oftentimes also encourages them to look at certifying their own GIS staff as a means of keeping up with current industry standards and best practices.

Verveer understands that having well qualified and certified staff members means that clients will trust Esri Netherlands' advice and rely on its employees' skills, knowledge, and experience so they can focus on other organizational decisions.

For Verveer and his team, implementing an organization-wide strategy to get employees to undertake Esri Technical Certifications has elevated the work that Esri Netherlands does and transformed its staff into highly sought-out GIS advisers and partners. Any team can do the same.

For more information about Esri Technical Certification, email **certification@esri.com**.

Esri recently released a study guide for the Esri ArcGIS Desktop Associate exam and will continue to produce content to help individuals prepare for exams in a meaningful way. Find more preparation resources at **esri.com/training/certification-find-exam**.

New **Training** and **Certification** Offerings

Training

New Instructor-Led Courses

Esri's instructor-led courses are developed in-house by subject matter experts who have a deep understanding of ArcGIS best practices and recommended workflows. All instructors have Esri Technical Certifications and CompTIA CTT++ certification.

If you're looking for a way to automate and simplify GIS workflows, do more specialized training in geospatial intelligence, or figure out how to manage data infrastructure for a utility, check out the following courses. They will help you learn how to apply ArcGIS tools and capabilities to improve productivity and get better results in less time.

- **Introduction to ArcGIS Workflow Manager**
  ArcGIS Workflow Manager is an easy-to-use, scalable enterprise workflow management system that automates and simplifies GIS and non-GIS work. This course teaches learners how to deploy standardized, centralized, and repeatable workflows across their organizations to drive efficiency in business processes and data production.
- **Introduction to Geospatial Concepts for Intelligence**
  Using real-world scenarios, attendees learn foundational geospatial concepts and get hands-on practice using ArcGIS Pro to prepare, visualize, analyze, and disseminate data that supports mission planning and intelligence operations.
- **Creating and Managing Utility Networks with ArcGIS**
  Get prepared to deploy the ArcGIS Utility Network Management extension to ArcGIS Enterprise. Participants get familiar with the new utility network model as they learn best practices for creating a utility network, configuring network rules, editing network features, performing network traces, and more.

Training for Specific Industries

Esri offers specialized e-Learning and instructor-led courses that teach ArcGIS tools and best practices for workflows that are specific to several different industries. Course exercises incorporate industry examples, realistic scenarios, and appropriate data. Current industries supported include defense and intelligence, public safety, and health and human services. View the courses at p.ctx.ly/r/8pi9.

Certification

ArcGIS Desktop is Esri's most popular technical certification domain, and updated ArcGIS Desktop certification exams are currently in development with an expected release date of early March. Exams are available at the Entry, Associate, and Professional levels. The updated exams will validate expertise with ArcGIS Pro, as well as other desktop components of the ArcGIS platform. Find out more about these exams at p.ctx.ly/r/8pia.

GIS analyst Adrien Hafner began her career in science, where she initially used GIS to support her daily work. Her enthusiasm for the technology grew so much that it inspired her to head in a new direction and become a GIS analyst. She validated her technical expertise by earning the ArcGIS Desktop Associate certification.

"Achieving the first certification was a great confidence boost, and it was beneficial in showing me that I could achieve success in my new career," Hafner said.

A few years later, Hafner switched jobs and her responsibilities expanded into the enterprise GIS realm. Once again, she turned to the Esri Technical Certification process. After just one year with her new company, she was able to earn both the Enterprise Geodata Management Associate and Enterprise Administration Associate certifications.

"I am now well prepared for advancement in my new role," she said.

Read Hafner's full story at go.esri.com/success-gallery.

To explore the latest Esri Technical Certification exams, visit 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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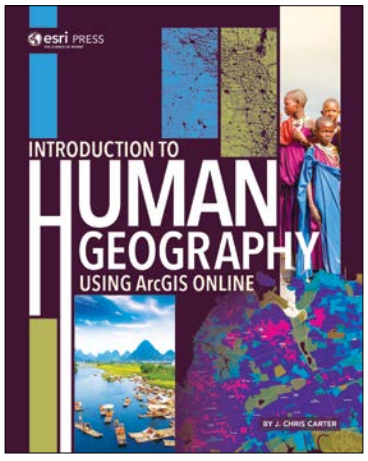
Esri Press

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

Introduction to Human Geography Using ArcGIS Online

By J. Chris Carter

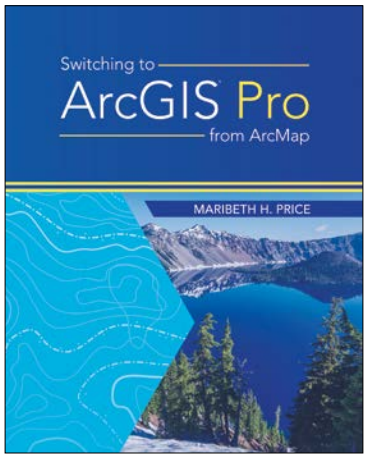
Why are birth rates higher in one country than another? Are there patterns and correlations that help explain this? With *Introduction to Human Geography Using ArcGIS Online*, readers learn how to employ sophisticated software to actively explore, analyze, and answer questions like these, plus many more. Author J. Chris Carter combines a comprehensive examination of human geography with engaging activities that readers do using ArcGIS Online so they can dig into not only the numbers but also their spatial relationships. Bridging classroom lectures with live, current, and interactive data—and letting instructors tailor in-class examples and homework assignments to local geography—this book helps students grasp geographic concepts more swiftly. March 2019, 542 pp. E-book ISBN: 9781589485198 and paperback ISBN: 9781589485181.



Switching to ArcGIS Pro from ArcMap

By Maribeth H. Price

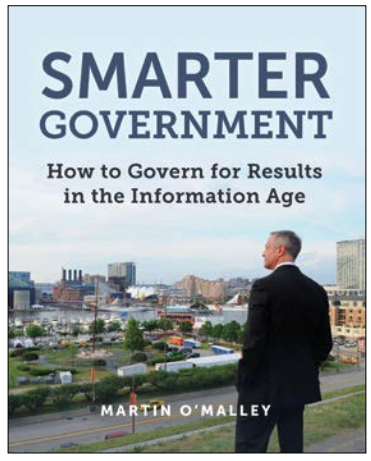
The arrival of ArcGIS Pro has presented a challenge to ArcMap users: the new software is sufficiently different in architecture and layout from ArcMap, so changing from the old to the new is not necessarily a simple process. To use ArcGIS Pro, ArcMap users have to unlearn, or at least heavily modify, some of their workflows. *Switching to ArcGIS Pro from ArcMap* aims to get users who are familiar with GIS and ArcMap to transition quickly to ArcGIS Pro. Rather than teaching the new software from scratch, this book focuses on how ArcGIS Pro is different from ArcMap. Covering the most common and important workflows required for most GIS work, author Maribeth H. Price leverages users' prior experience to help them adjust to ArcGIS Pro. February 2019, 150 pp. E-book ISBN: 9781589485457 and paperback ISBN: 9781589485440.



Smarter Government: How to Govern for Results in the Information Age

By Martin O'Malley

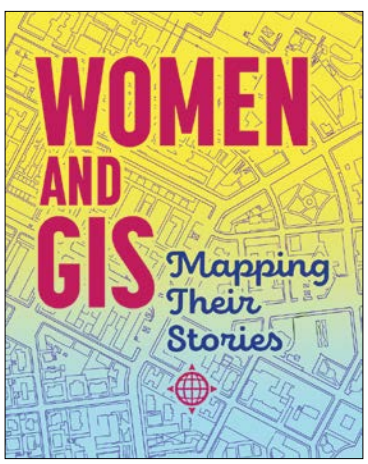
The time has come for the rise of the tech-savvy executive: an individual who understands the need to elevate the use of technology within and throughout an organization, all to the same level, all at the same time. As mayor of Baltimore and then governor of Maryland, Martin O'Malley did that—and more. *Smarter Government: How to Govern for Results in the Information Age* addresses this new way of governing. It looks at how using GIS technology can provide real solutions to real problems while guiding readers through how to develop a data-focused management strategy that will profoundly change any organization. March 2019, 420 pp. E-book ISBN: 9781589485259 and paperback ISBN: 9781589485242.



Women and GIS: Mapping Their Stories

By the Women of Esri Press

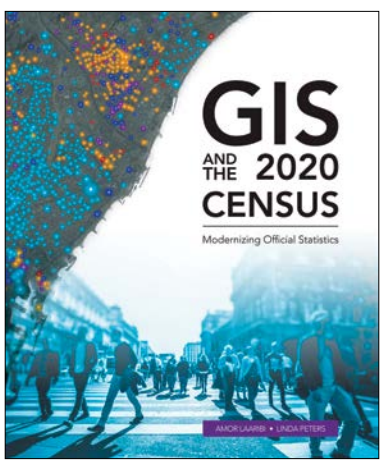
Women have made extraordinary contributions to GIS and our world. All 18 of the remarkable women profiled in *Women and GIS: Mapping Their Stories* applied themselves and the power of maps, analysis, and GIS to overcome obstacles and take their professions—and passions—by storm. Through her intensive geography-based research on birds, for example, ecologist Natalia Ocampo-Peñuela discovered that many more birds are endangered than previously thought. She then parlayed that into a charge to refine areas and species that are deemed threatened. And 23-year-old environmental conservationist Madison Vorva's interests in activism have led her from successfully fighting against practices that put wild animals on the brink of extinction to showing kids—especially girls—how fun and important science and technology are. With additional profiles on oceanographers, archaeologists, entrepreneurs, and more, *Women and GIS* is sure to motivate readers who are developing their own life stories and inspire them to reach their potential in new ways. March 2019, 220 pp. E-book ISBN: 9781589485297 and paperback ISBN: 9781589485280.



GIS and the 2020 Census: Modernizing Official Statistics

By Amor Laaribi and Linda Peters

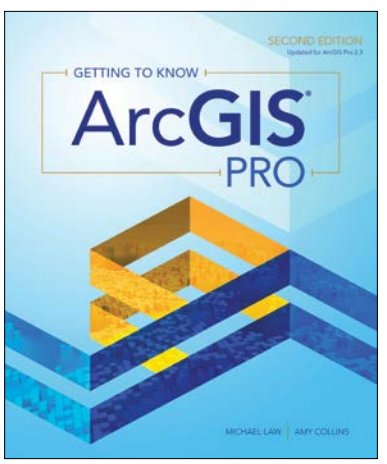
GIS and the 2020 Census: Modernizing Official Statistics outlines the latest methodologies and technological tools that can be used in all stages of the 2020 Census. With this handbook, readers can ascertain how to plan their work with GIS; learn to use new technologies, including cloud computing and location as a service (LaaS); and get familiar with emerging data sources. *GIS and the 2020 Census* focuses on using geospatial tools during enumeration—including for field data collection and operations management—as well as to analyze, integrate, and disseminate census data quickly. It guides readers through employing geospatial technology to look at and capture information at the finest level of geography, and it illustrates the basic foundations of building a statistical-geospatial information infrastructure for censuses. Complete with case studies that exemplify these concepts in practice, this book enables readers to see how using geospatial solutions for all aspects of a census can lead to evidence-based decision-making and sustainable development. March 2019, 576 pp. E-book ISBN: 9781589485051 and paperback ISBN: 9781589485044.



Getting to Know ArcGIS Pro, Second Edition

By Michael Law and Amy Collins

Another valuable addition to Esri's best-selling Getting to Know series, *Getting to Know ArcGIS Pro*, Second Edition, helps new and existing GIS users get started with ArcGIS Pro. Updated for ArcGIS Pro 2.3, the book teaches readers the basic functions and capabilities of ArcGIS Pro using practical, project-based workflows. Authors Michael Law and Amy Collins, who have a combined 30 years of experience using GIS, guide readers through how to solve problems by creating, querying, analyzing, visualizing, and presenting geospatial data in both 2D and 3D environments in ArcGIS Pro. By the end of the book, readers will have a deep understanding of this essential and powerful component of the ArcGIS platform. January 2019, 480 pp. E-book ISBN: 9781589485389 and paperback ISBN: 9781589485372.



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"At Redlands, I had the unique opportunity to learn the underlying science of GIS and the latest technology trends from people who are developing GIS software on a daily basis."

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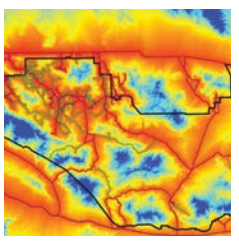

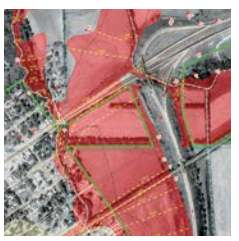

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