ArcNews

Esri | Winter 2017 | Vol. 39, No. 1

Briefly Noted

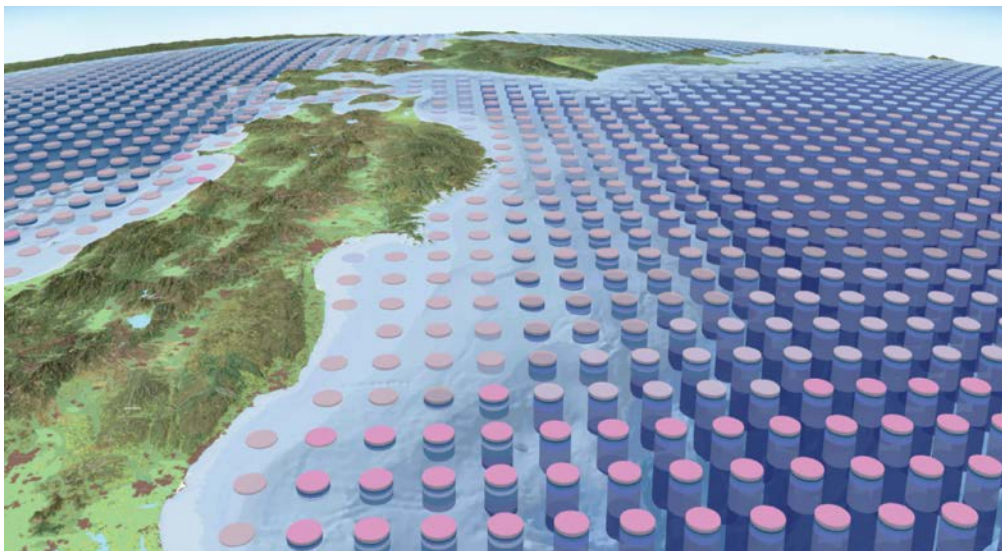
GIS More Widely Accessible in Microsoft Azure
ArcGIS is newly integrated with Microsoft's Power BI and the Microsoft Azure cloud platform. Power BI users can now leverage integrated data and geospatial analytics from ArcGIS—including interactive basemaps and US demographics—in their dashboards, reports, and data visualizations. Additionally, users can now enjoy all the capabilities of ArcGIS Pro in Microsoft Azure with the newly available NV-Series virtual machine.

Esri Joins AWS Marketplace
Esri users can now instantly deploy select ArcGIS licenses from Amazon Web Services (AWS) Marketplace. With flexible, pay-per-use deployment models and service options, launching GIS in the cloud is simple. By using Esri software on AWS, developers can share assets and build new apps that take advantage of the powerful, ready-to-use location and mapping services available in the ArcGIS platform.

New Traffic-Sharing Option for Governments
Municipalities already using ArcGIS can now quickly and easily exchange data through the Waze Connected Citizens Program, a free, two-way data exchange program from the crowdsourced traffic and navigation app. This makes it easier and more economical for governments to leverage real-time transportation reports and merge them into existing enterprise systems, such as emergency dispatch and street maintenance systems.

Esri, USGS Release First Truly 3D Map of World's Oceans

By Dawn Wright, Kevin A. Butler, Sean Breyer, and Keith VanGraafeiland, Esri, and Roger Sayre, United States Geological Survey



↑ The Ecological Marine Units (EMUs), composed of a point mesh framework of approximately 52 million global ocean measurements that were collected over a 50-year period, are big data.

Humans' survival on earth depends on the ocean. It is an important source of food for many species. It impacts climate and weather patterns. And around 90 percent of global trade moves by sea.

Yet that great expanse of dark, deep water is still a mystery. Only 5–10 percent of the ocean has been explored in detail. So we still lack accessible data to protect and manage the marine ecosystems that we rely so heavily on.

In a world of accelerating change, especially when it comes to the climate, this means we are exposing ourselves to unnecessary risk. That is why Esri and the United States Geological Survey (USGS) led an innovative public-private partnership to create the Ecological Marine Units (EMUs), a 3D representation of the world's oceans.

Accessible at esri.com/ecological-marine-units, the EMU map differs from existing maps of marine ecoregions or biogeographic realms because it is globally comprehensive, driven by quantitative data, and truly 3D. With its extensive yet detailed information about all dimensions of the ocean—including the surface and what's beneath it—the global EMU map champions the wise use of ocean resources and the preservation of environmental resilience.

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Esri Launches Insights for ArcGIS

Bold New Solution for Intuitive and Interactive Mapping and Spatial Analysis

Insights for ArcGIS, debuting with ArcGIS 10.5, is an innovative web-based app that allows users to interactively discover and explore both spatial and nonspatial data. For the first time within a single ArcGIS app, users can incorporate data into their analyses from enterprise databases such as Microsoft SQL Server and SAP HANA; geodatabases; Microsoft Excel spreadsheets; and any data that can be brought into ArcGIS as a feature layer, including demographic data.

Exploring data visually in Insights is simple. The app uses a smart, graphical user interface that analyzes data as it gets added and recommends appropriate data exploration tools and visualizations. Users manage Insights projects in workbooks that include data connections, iterative analysis, visualizations, workflows, and the information produced by the app's analysis. Workbooks contain pages for collecting related content. On a page, data is visualized on cards as maps, charts, and tables.

Cards are the primary way for users to interact with Insights, and it is within the cards that analysis happens dynamically. The connected nature of the card interface provides on-the-fly synchronization between data views. Users can create, update, and compare maps, charts, and tables; draw buffers; aggregate numeric data across any geography; apply spatial tools; and slice and summarize data by any field—all using cards.

Insights also works alongside and takes advantage of other leading ArcGIS products. For example, users can do quick data discovery in Insights and then continue this spatial analysis in ArcGIS Pro. Or users can

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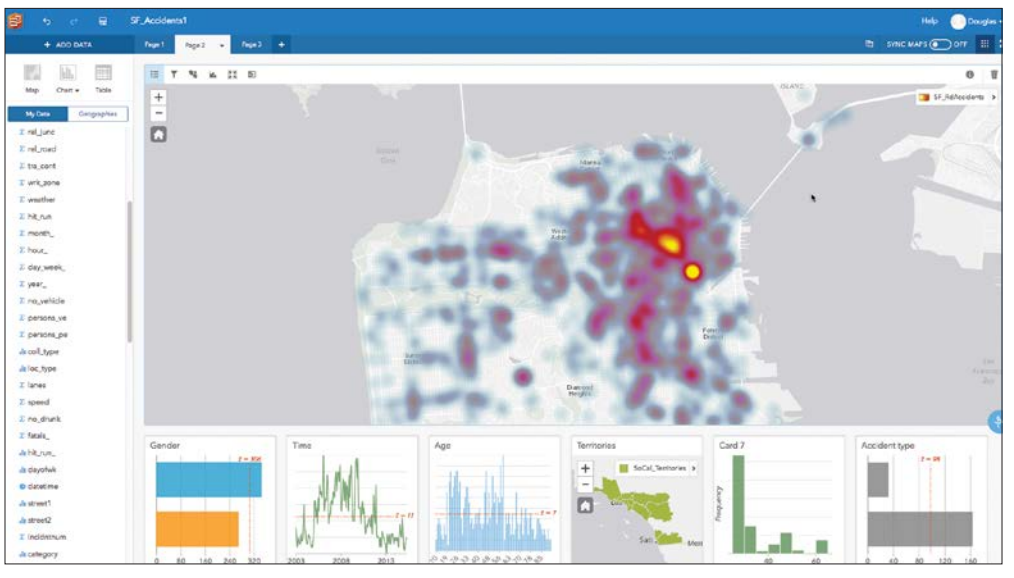

↑ Insights for ArcGIS, a premium app in ArcGIS Enterprise, allows users to drag and drop data into workbooks so they can easily visualize and interact with it.

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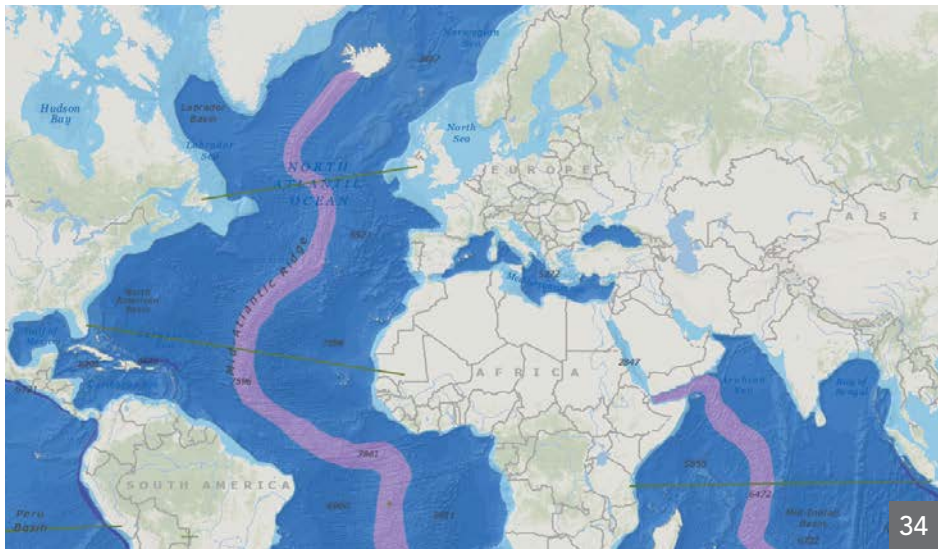

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Esri pledged to continue participating in ConnectED—an initiative launched in 2013 to make American schools more technologically savvy—through 2019, giving more teachers and schools access to ArcGIS software donations and support for years to come.

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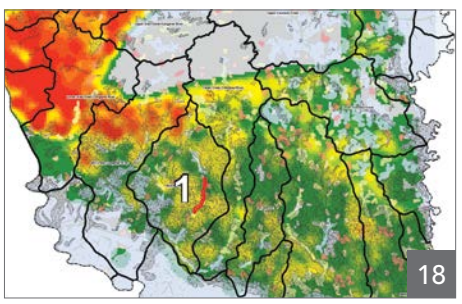

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The Science of Where: Our Promise

I am excited to share with you Esri's renewed emphasis on our brand, its meaning, and its promise. We have captured our long history, our values, and our mission in a new tagline, "The Science of Where," which we feel represents Esri's essence.

From Esri's earliest days, its values have been rooted in purpose and service and a mission to inspire positive change. For nearly half a century, we have relentlessly pushed the boundaries of geographic science and opened the world to the possibilities of powerful geospatial technologies.

With the advent of the digital transformation, we stand on the edge of a new technological frontier. The release of Esri's ArcGIS 10.5 is The Science of Where in action. With ArcGIS 10.5, we provide the next generation of GIS that will simplify and amplify the work of our users everywhere. Together with our user community, we are pioneering a common visual language that combines mapping and advanced analytics to connect real-time data to the organizations and people who need it most—you, our users.

The Science of Where is the perfect representation of our past, our present, and our future because The Science of Where is, quite simply, what we do. It's what our users do, too, every day. Our users around the world practice The Science of Where by mapping the ocean floor; by making organizations smarter; by implementing retail location strategies; and by building strong, resilient economies. They understand and embrace the knowledge and commitment it takes to make these kinds of projects work, which is something you will see again and again as you read the stories featured in this issue of *ArcNews*.

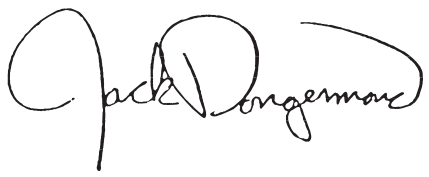
The Science of Where is the science of digital transformation; the science of exploration and navigation; the science of commerce and ecology. It's the science of insight and innovation. It inspires us and drives us to offer the most high-powered, high-performance mapping and analytics capabilities in the world.

The Science of Where is the context layer for all our content and visualization capabilities. It streamlines the spatial analysis of geographic and enterprise data through intuitive maps, charts, and graphs.

The Science of Where is our brand. Our brand is our promise. It reflects our commitment to geoscience and to innovating the great technologies that harness it so that our customers can continue to create the maps that run the world.

Please join me in embracing The Science of Where as an articulation of our joint mission to make the world a better place.

Warm regards,



GIS Gains Altitude in Archaeology

Drone2Map for ArcGIS Helps Re-create Historic Native American Site

By Andreas Forrer, Newburgh Theological Seminary and College of the Bible

3D renderings of archaeological sites can give archaeologists and historians a better understanding of how ancient people lived.

From AD 900 to 1200, a Native American population inhabited about 20 acres in Aztalan, Wisconsin, which lies 40 miles east of the current state capital of Madison. According to archaeologists who have studied the site, the village was well-planned with agriculture that included beans, corn, and squash and village life that involved organized ceremonies.

Most of the village was encompassed by a wooden barrier, and there was a sizable plaza in the middle, demarcated by two platform mounds and a natural knoll. It is believed that at least some of the inhabitants of Aztalan were part of a bigger, more complex society—the Mississippians—that can be traced back to Illinois, near what is now St. Louis, Missouri. Not much else is known about the 500 or so people who inhabited Aztalan and their lifestyle, though the site, which is now located in Aztalan State Park, is one of Wisconsin's most important archaeological locations.

To dig into deeper layers of this Native American community's existence, archaeologists need new ways to document the excavation site. In the past, the mounds—which may have served some religious purposes—were reconstructed, and archaeological digs take place on occasion to unearth clues as to how and why the site was constructed. But to build a comprehensive map of the place and get a better idea of how the population might have lived, it was imperative to get aerial views of Aztalan.

For years, archaeologists have used regular photography and hand drawings to document full archaeological sites. To get a bird's-eye view, they have typically relied on cherry picker cranes and specially erected scaffolding. But with high-precision drones equipped with high-resolution cameras, getting overhead views of archaeological sites has become much easier. One aerial photograph rarely covers an entire site, however, so drone-supplied aerial photos need to be stitched together.

Drone2Map for ArcGIS offered a great solution to this challenge. Working directly with ArcGIS, the app can quickly process a series of aerial photographs into orthomosaics and 3D textured meshes, which can then be used to create a realistic reconstruction of portions of the site as they looked originally. This was my goal for Aztalan.

Capturing Aerial Images of the Site

For the project, I used a DJI Phantom 3 Advanced drone, a reliable unmanned aerial vehicle (UAV) that supports EXIF data natively. Having this metadata—which includes the location, altitude, and camera settings for each photo—is key to correctly positioning the images.

With the remote control connected to an iPad, I flew the drone in a grid pattern over the main mound at Aztalan and took nearly 40 aerial photographs from an altitude of 100 feet (30 meters) above the mound. Aiming the drone straight down to produce nadir images worked best, since it captured visual data for all sides of the moderately slanted mound while excluding data from the background.

After the flight, I uploaded the photos to ArcGIS Online, where Drone2Map read the EXIF data and started the process of building the orthomosaic and 3D mesh. Using key points in the images, such as poles or corners of steps on the stairs, Drone2Map automatically deciphered how the photographs overlapped and linked them together. In about 15 minutes, Drone2Map generated an imagery basemap (from the orthomosaic) and assembled a high-quality 3D diagram of the main mound.

↓ Drone2Map for ArcGIS produced a 2D orthomosaic of the mound at Aztalan, which functions as an imagery basemap of the site.

Re-creating Aztalan in 3D

With these outputs from Drone2Map, I then imported the OBJ file for the 3D mesh into Daz Studio, a software from Daz3D that allows users to create static scenes of people and their surroundings. Using visual clues based on findings from other historians and archaeologists—such as drawings from *Aztalan: Mysteries of an Ancient Indian Town*, by Robert Birmingham and Lynne Goldstein, and artifacts from local museum exhibits about the site—I generated a 3D rendering of what Aztalan might have looked like 800 years ago.

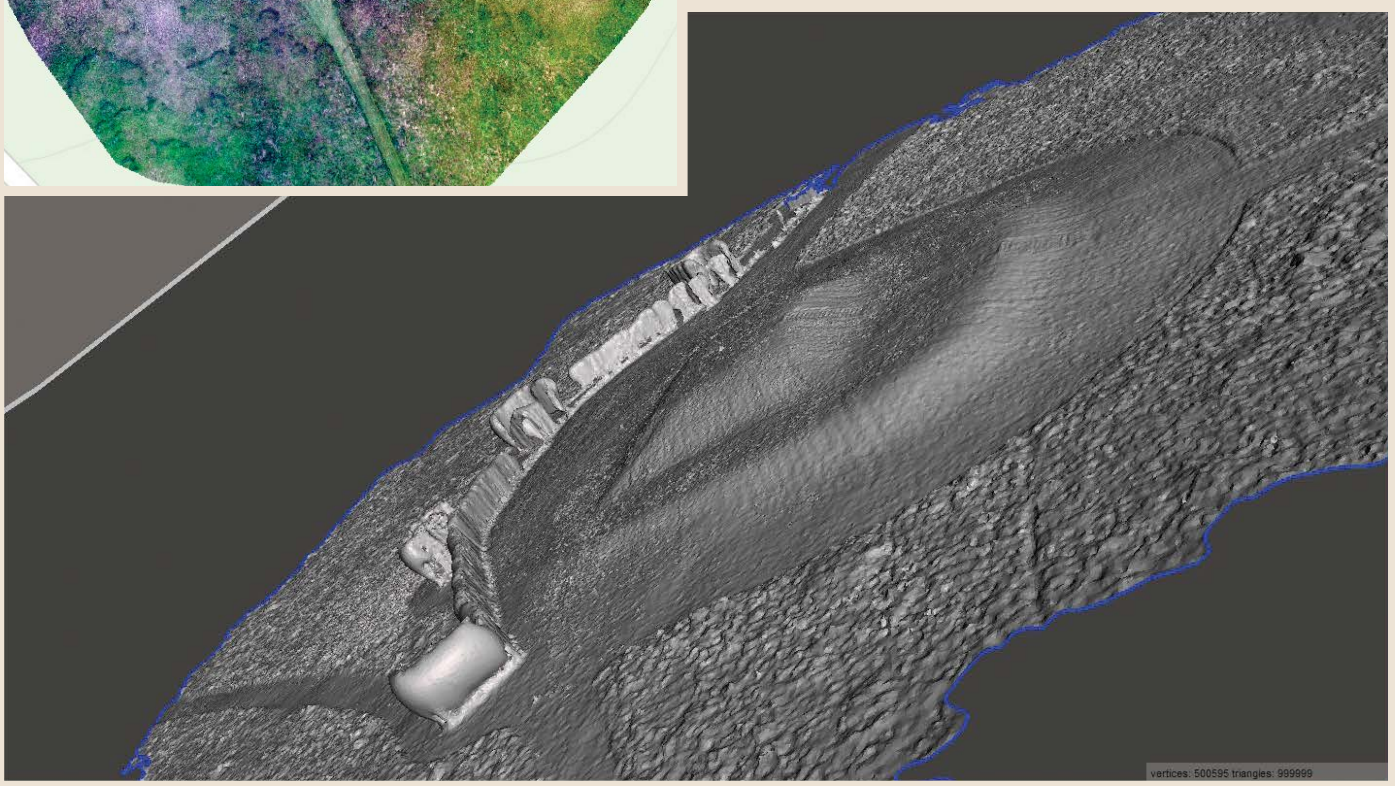
For archaeologists, getting a complete 3D view of a site can serve several purposes, including representing an area as it exists today or virtually re-creating an archaeological site to envisage what it might have looked like in the past. For instance, in places where archaeologists find the foundation of a building, they can use drone-generated aerial images and 3D modeling software, such as Esri CityEngine, to reconstruct the columns and walls of a building so they can conceptualize what it used to look like and how the building factored in to the rest of the environment. Or in Aztalan's case, just having the mound represented in 3D allows archaeologists and historians to see what it might have been used for and how the wooden barrier could have factored into everyday life.

"We can better understand the lives of these ancient people by viewing them in their actual environment, as re-created through 3D renderings," said Karen Kitover, a docent at the Loyola University Museum of Art in Chicago.

And using drones—along with Drone2Map—makes producing these 3D renderings much easier. As IT specialist and computer engineer Roland Kunz (who helped me configure the drone) pointed out, "The virtual reconstruction of Aztalan shows us…what can be achieved with drones *[in archaeology]* going forward."

About the Author

Andreas Forrer, PhD, studied Aztalan as part of his thesis project for the Newburgh Theological Seminary and College of the Bible in Indiana, where he recently received a second PhD in archaeology. For more information about this project, email Forrer at forreran@rocketmail.com.



↑ Drone2Map also created a 3D mesh of the mound at Aztalan, which made it possible to generate a 3D rendering of what Aztalan might have looked like.

Greater Analysis and Collaboration with ArcGIS 10.5

ArcGIS 10.5 provides new capabilities that enhance analytics and problem-solving and make it easier to connect to and integrate many types of enterprise data with ArcGIS. The most significant change with the 10.5 release of ArcGIS is ArcGIS Enterprise.

ArcGIS Enterprise is the new name of the ArcGIS for Server product family that includes ArcGIS GIS Server, Portal for ArcGIS, ArcGIS Data Store, and ArcGIS Web Adaptor. ArcGIS Enterprise offers new features that take Esri server software to a whole new level.

Getting Started

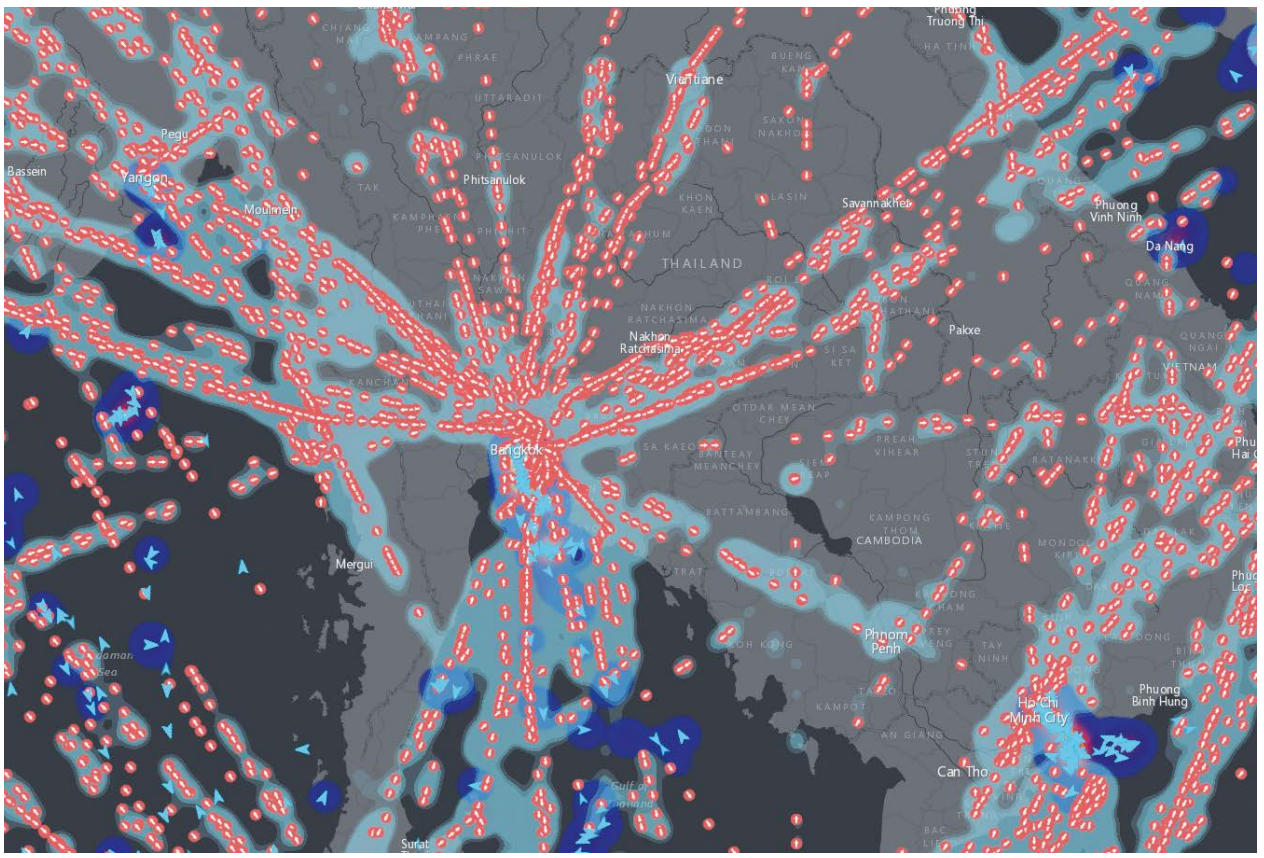
To get started with ArcGIS Enterprise, users create a base ArcGIS Enterprise deployment. A base deployment is the configuration of the four software components—ArcGIS GIS Server, Portal for ArcGIS, ArcGIS Data Store, and ArcGIS Web Adaptor—into a functional Web GIS that lives on an organization's own infrastructure. The base deployment can be configured with all components on a single machine or with components distributed across multiple machines in a multitier configuration. ArcGIS Enterprise can always be deployed with high availability as well.

Server Roles

From the single ArcGIS Server software component, users can license the specific server capabilities their organizations need through server roles. At ArcGIS 10.5, there are five server roles: ArcGIS GIS Server, ArcGIS Image Server, ArcGIS GeoEvent Server, ArcGIS GeoAnalytics Server, and Esri Business Analyst Server. These five server roles provide an off-the-shelf solution that feels completely custom. Each server role added to the base ArcGIS Enterprise deployment can be scaled independently. ArcGIS Enterprise can be deployed on any infrastructure that meets the minimum system requirements so it can be architected to align with any organization's technology road map.

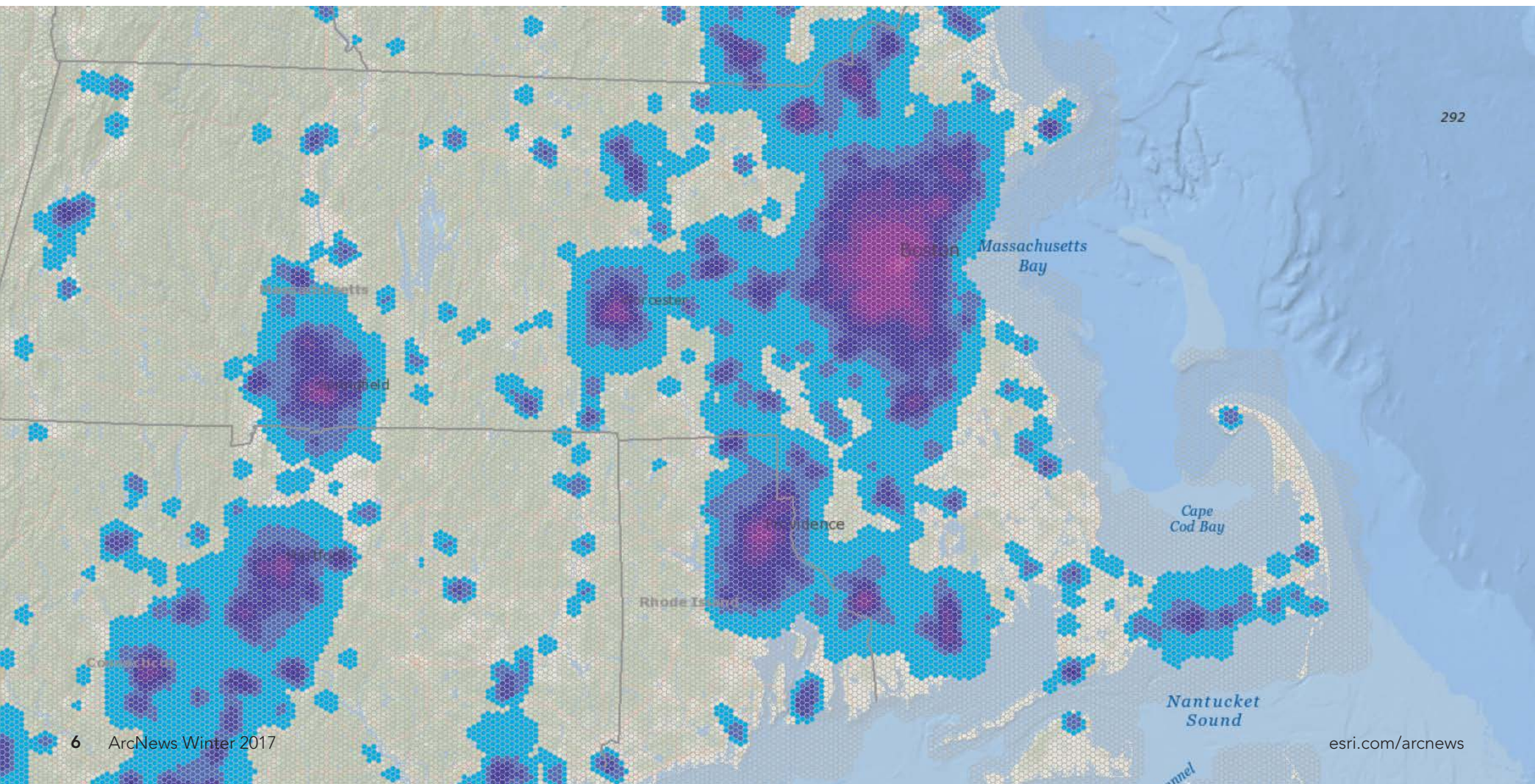
The **GIS Server** role captures everything ArcGIS for Server was in prior software releases. It provides the same service types and allows the same analytical capabilities. GIS Server is offered in Basic, Standard, and Advanced editions and at the Workgroup level. Users will still be able to extend and customize the functionality of the GIS Server through Esri-built extensions or through custom written server object extensions and interceptors. It powers Web GIS behind a firewall, but it can also be used in dedicated server sites to support specific functions for an organization such as mapping and visualization and maintaining workload separation for optimal system performance.

At ArcGIS 10.5, ArcGIS Image Extension for Server has been replaced by the **Image Server** role. It provides everything the extension offered but also introduces Raster Analytics. By harnessing the power of distributed and parallelized computing, Raster Analytics can produce pervasive, full-resolution raster/imagery outputs in a fraction of the time previously required. Users can run simple raster analysis tools or chain together analytical



↑ With GeoEvent Server, users can monitor and analyze—in real time—many types of streaming data, such as flights over Bangkok, Thailand.

↓ The new ArcGIS GeoAnalytics Server makes it much faster to do batch spatiotemporal analytics on massive datasets, using distributed computing to aggregate points, join features, find hot spots, and more.



functions to create raster models to answer even the most complex questions. Whether the data resides in a data center or in the cloud, Image Server has many options for connecting to existing raster and imagery libraries.

GeoEvent Server, which replaces ArcGIS GeoEvent Extension for Server, serves the same purpose and has the same analytical horsepower as its predecessor. GeoEvent Server is designed to handle high-volume, high-velocity real-time and streaming data. It provides solutions through on-the-fly analysis and dynamic aggregation of large datasets, which makes data visualization easy. When connected to the base ArcGIS Enterprise deployment, GeoEvent Server can archive data to the spatiotemporal data store for further and future data analyses.

GeoAnalytics Server makes its debut at the 10.5 release. It is designed to handle the analysis of massive datasets. GeoAnalytics tools are a subset of Esri geoprocessing tools that use distributed and parallelized computing to run space-time analyses on extremely large datasets. These tools can be executed using the Portal for ArcGIS map viewer, ArcGIS Pro, the ArcGIS REST API, or the new ArcGIS API for Python. GeoAnalytics Server can connect to data from the Hadoop Distributed File System (HDFS), Hive, local file shares, and data from within ArcGIS Enterprise, including using as input the archived spatiotemporal output from GeoEvent Server. Because GeoAnalytics Server uses the base ArcGIS Enterprise deployment to write and store analytical output, it is easy to use and share the resultant layers and data.

Business Analyst Server is an Esri solution package that has been turned into a server role. Unlike the other server roles, Business Analyst Server includes a bundle of specialized tools, data, and apps. Business Analyst Server content is specially curated and proprietary to Esri. It allows users to target specific markets and enrich the data analysis process. Custom tools and applications make analyzing, generating, and exploring business intelligence data easy. Full integration with the base ArcGIS Enterprise deployment means that all business intelligence data remains safely behind the firewall.

In addition to the server roles, ArcGIS Enterprise differs from its predecessor, ArcGIS for Server, by delivering Esri-curated Living Atlas of the World content behind the firewall. Using the base ArcGIS Enterprise deployment, an administrator can configure Portal for ArcGIS to include Living Atlas content, which contains imagery, demographics and lifestyle data, historical maps, and basemaps. An administrator can decide which Living Atlas resources to make available to align with the organization's business priorities.

Extending Collaborative Capabilities

ArcGIS 10.5 is designed for full integration with Web GIS, which provides a centralized location for an organization to share data, analyses, and information. Esri offers two paths to Web GIS: ArcGIS Enterprise and ArcGIS Online. The choice will depend on whether an organization wants to manage the infrastructure behind its Web GIS.

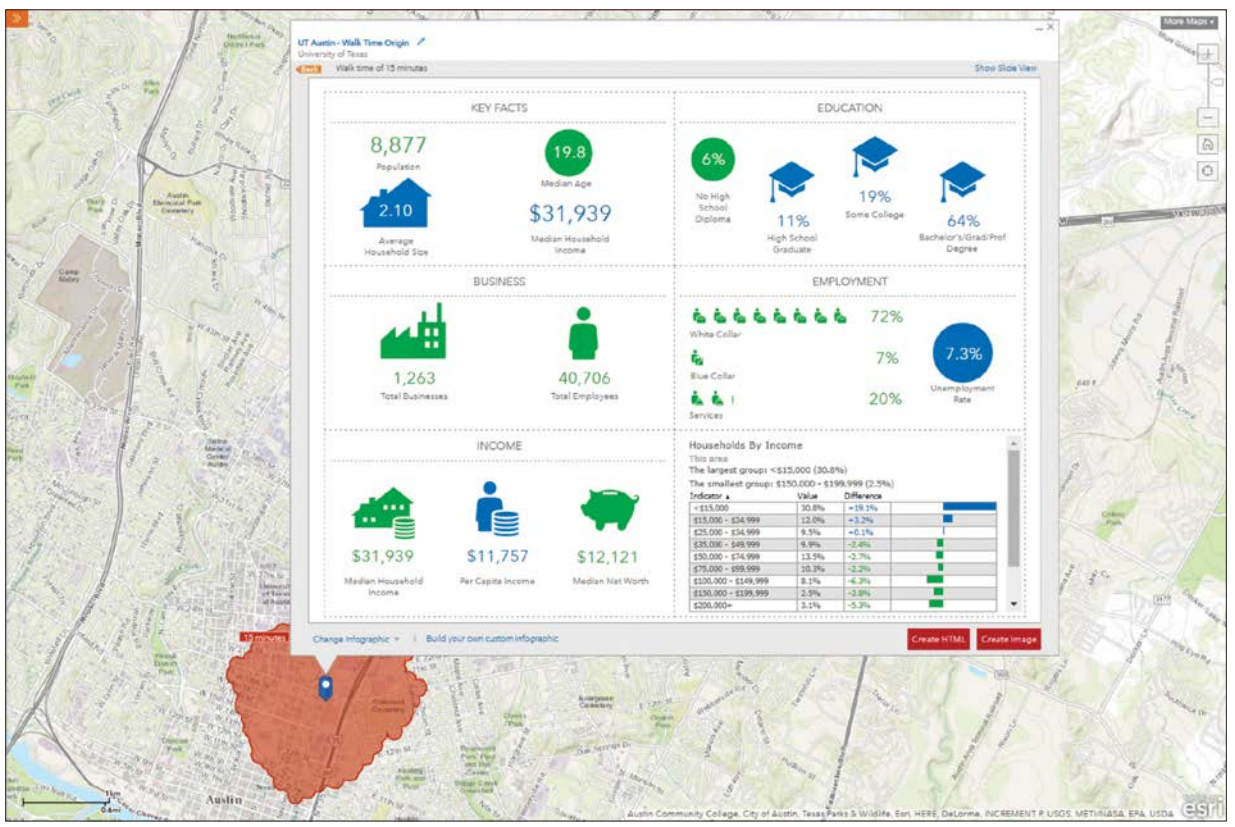
If everything should be kept behind an organization's firewall and software installations and deployments handled in-house, then ArcGIS Enterprise is the choice. If it makes more sense for the organization to have Esri manage the scaling, updating, and overhead of its Web GIS, then ArcGIS Online is the choice.

With the release of ArcGIS 10.5, the collaborative capacity of Web GIS has been expanded. New with ArcGIS 10.5 is the concept of distributed Web GIS, in which content is shared between multiple, independent Web GIS implementations. The first wave of Distributed Web GIS—Portal-to-Portal Collaboration—is unveiled at ArcGIS 10.5. Portal-to-Portal Collaboration uses the Portal for ArcGIS component to share content between two or more ArcGIS Enterprise deployments.

In addition to greater collaborative capabilities in Web GIS, the apps offered by ArcGIS 10.5 give better connectivity between the office and the field so an organization can gain new information from its data.

Tools for Developers Too

ArcGIS is code free by design. Everything from running analyses to creating web apps can be accomplished in the ArcGIS platform without writing a single line of code. However, ArcGIS 10.5 has many GIS tools for developers, programmers, and data scientists. It introduces Python API, which provides new options for scripting and automating analysis and administrative tasks within the ArcGIS platform. It is especially useful when applied to ArcGIS Online or ArcGIS Enterprise. Python API integrates well with Jupyter Notebooks and the SciPy stack and includes modules that allow the display and modification of maps directly from Jupyter Notebooks.



↑ Esri Business Analyst Server brings Esri demographic data, such as population density and household spending, inside an organization's own infrastructure.

Esri Launches Insights for ArcGIS

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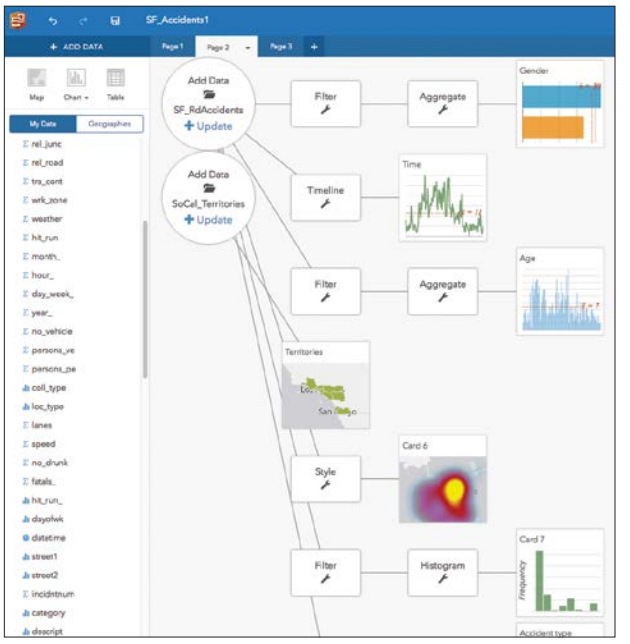
employ feature layers from ArcGIS GeoAnalytics Server or ArcGIS GeoEvent Server in ArcGIS Enterprise 10.5 to analyze massive amounts of historic data or a snapshot of real-time data in Insights.



↑ Cards, which provide on-the-fly synchronization between data views, are the primary way users interact with Insights.

Putting Insights to Work

With Insights, Esri users from all industries can put the most powerful spatial analytics to work for their organizations. Retailers can use Insights to analyze sales performance based on the proximity of a store to certain demographics. Insurers can use it to conduct portfolio and claims analyses to understand the spatial patterns of certain insurance claims—for floods or earthquakes, for example—over time. Law enforcement agencies can work in Insights to identify crime patterns and manage operational resources.

The app is also valuable for emergencies. When a hurricane hits, for example, emergency responders can use Insights to help during the aftermath. To clear downed trees and open up critical roads, the local department of transportation could use a dataset about the condition of the city's trees from the parks and recreation department, along with the transportation division's own data on the area's roads, and visualize the large datasets together in Insights to quickly identify the most vulnerable trees around the most critical roadways. The city could then send crews out to clear those areas first.

The city could also use Insights to get better prepared for future storms and emergencies. By importing the parks and recreation department's tree conditions dataset early, the city could proactively identify problem trees so it can focus its resources there before a big storm hits. This would reduce the time, effort, and risk it takes citizens and the city's workforce to manage and recover from a natural disaster.

Improved Sharing with Decision-Makers

Insights makes it simple to communicate findings with key stakeholders. The app's integration with ArcGIS Enterprise lets users share Insights workbooks throughout an organization. Similarly, analysis results can be embedded in web pages, making them publicly accessible from any device.

What's more, users can clearly communicate how they arrived at their conclusions. Insights automatically tracks and diagrams workflow steps, such as what data was brought into Insights and when, which filters were applied, and what analyses were generated. This makes it easy to repeat and verify analytical workflows across an organization.

To learn more about Insights, visit go.esri.com/insights.

Detroit Tackles Overhead Graffiti Using GIS

Department of Transportation Cleans Tagging Off 76 Highway Signs in 35 Days

By Matt Robinson and Joe Bartus, Michigan Department of Transportation

A few years ago, Detroit faced a challenge familiar to many metro areas: a rise in unwanted graffiti on public infrastructure. The Michigan Department of Transportation (MDOT) also noticed that new graffiti was appearing in more precarious spots. Instead of marking up typical roadside assets—such as abutment walls, concrete and steel bridge beams, and gas stations—taggers were spray painting signs that hung 15 feet in the air, usually above moving traffic.

At the peak of the problem, more than 90 overhead signs were tagged along the metro Detroit freeways, creating distracting and unsafe driving conditions. Citizen complaints increased, as did political pressure to get rid of the graffiti. MDOT maintenance crews needed to find a way to efficiently clean the signs—especially the ones affixed to bridges and trusses over roadways with high volumes of traffic.

While MDOT's metro Detroit office was trying to figure out how to remove this graffiti, the department's central GIS team was testing ArcGIS Online and Collector for ArcGIS. Since the metro Detroit office needed to locate all the tagged signs and carefully plan cleaning operations so as not to completely disturb traffic, the central GIS team decided this would be an ideal pilot project for trying out the two ArcGIS programs.

The overarching goal was to get the tagged signs cleaned. But the ArcGIS Online Graffiti Pilot project had three additional objectives:

1. Streamline cleaning efforts across the five offices and maintenance garages that were involved in graffiti removal.
2. Develop a reporting tool that showed the operation's progress to MDOT management and outside agencies, such as the City of Detroit, police departments, and the media.
3. Gain experience using innovative technology like ArcGIS Online and Collector.

It took the central GIS team six months to build the foundation for the project—developing data schemas, writing training guides for how to use Collector, and configuring the app.

In the summer of 2014, MDOT maintenance staff began gathering data using Collector on their iOS phones and tablets. Every place they saw a tagged sign, they would record the location, note the sign's basic attributes—for example, its route direction (eastbound, northbound, etc.), which side of the sign the graffiti was on, its status in the project (tagged, clean, retagged), and the date of the most recent activity on the sign—and take a photo.

This first inventory of Detroit's freeway signs helped create the initial dataset. Following that, MDOT staff collected information about other tagged signs on a more ad hoc basis, photographing and logging new graffiti locations while they were riding in a car or updating the database when citizens called in with fresh complaints.

The mobile data collection was invaluable. Having a photo accompany the location data for the signs allowed the team to plan each cleaning. Knowing the extent of the graffiti and the lanes over which it occurred helped MDOT figure out how much of the road to close during the cleaning and for how long, as well as the amount of cleaning supplies that would be needed.

The team also incorporated MDOT's live lane closure service (from its 511 site, michigan.gov/drive) into the app. This enabled cleaning crews to track down planned lane closures so they could complete their graffiti cleaning at the same time that other roadwork was being done.

Using ArcGIS Online and Collector allowed the maintenance team to be much more organized, especially since the work was being done by offices and garages that don't normally communicate with each other. The technology helped everyone get on the same page by using common data formats and got people to speak the same language.

"Having the graffiti information and photos in the online map was critical for us to be able to efficiently and accurately report *[the]* status of the cleaning work to our stakeholders throughout the cleaning process," said Tony Kratofil, the metro region administrator for MDOT.

This project also made the graffiti issue universal to the region rather than a problem each branch had to deal with solo. That's in part because upper management at MDOT monitored the cleaning project through Operations Dashboard for ArcGIS. And when local and state law enforcement learned about the project, they partnered with MDOT to share data about the taggings. MDOT gave the agencies information on the locations of the tagged signs and the dates they were recorded, as well as the photos, to aid in the apprehension and prosecution of taggers.

Although cleaning the graffiti off all the signs seemed insurmountable at the outset, it only took MDOT 35 cleaning days to clear up 76 signs.

As the project progressed, fewer and fewer signs were being tagged. So the pilot project unofficially ended in early 2015. The data that was collected, however, is still valuable for MDOT maintenance staff today, and the department still uses Collector.

In fact, shortly after the completion of the tagging project, MDOT used the data to manage and install climbing deterrents on trusses. It also used the same methodology to replace 30 of the signs that were too badly defaced by graffiti to clean up.

Additionally, the pilot project initiated a new way for MDOT to contract out graffiti cleaning. In the past, MDOT identified the location of the graffiti, got a vendor out to clean it, inspected the cleaning, and paid the vendor. But with the new GIS-based system, MDOT started a graffiti cleaning contract for the region in which a vendor monitors and cleans graffiti on its own using the ArcGIS technology MDOT developed during the pilot. MDOT posts new graffiti locations in ArcGIS Online and uses Dashboard for ArcGIS to ensure that the vendor is cleaning tags effectively.

This new contract is a testament to the success of the central GIS team's pilot project with ArcGIS Online and Collector. Using Esri technology, MDOT found an innovative solution to Detroit's rising graffiti problem and overcame it—just like any smart community could do.

About the Authors

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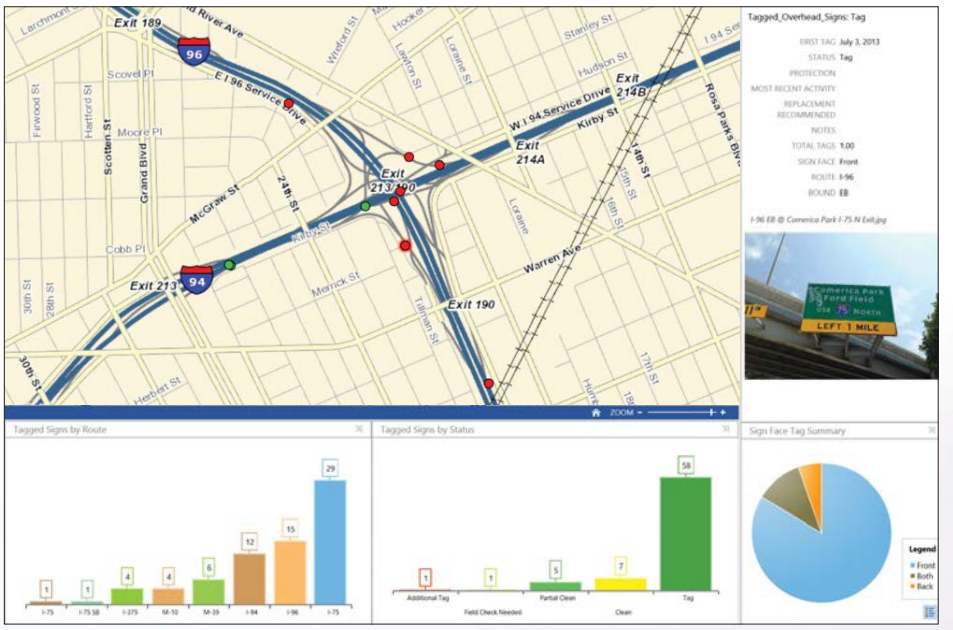


↑ MDOT used Operations Dashboard for ArcGIS to communicate its progress to management, indicating cleaned signs in green and signs that still needed attention in red.

Canadian Utility Goes Real Time with Mobile GIS

Managing Meters Gets Faster with Workforce for ArcGIS

As part of its distinct multiutility model—delivering water, wastewater, natural gas, and electricity services—Utilities Kingston provides safe and reliable gas services to nearly 15,000 customers in Kingston, Ontario, Canada. The company routinely inspects customer appliances and related infrastructure and replaces out-of-date gas meters with upgraded ones.

Recently, Utilities Kingston switched from a paper process to a mobile GIS solution for gas meter inspections and replacements. Using Workforce for ArcGIS, a location-based app from Esri designed to improve coordination and teamwork, the utility was able to complete more than 60 percent of its meter inspections and replacements within four months. The teams also collected key data not previously available—such as unique meter IDs and information on meters that serve multiple addresses—which helped the utility integrate its meter data with other information systems and better determine how meter work would affect gas services in the vicinity.

"We hired eight employees on contract to get 5,300 gas and water meter changes done within six to eight months," explained Jordan Rogers, a systems analyst at the City of Kingston who, at the time, was a GIS technician at Utilities Kingston. "We created all 5,300 assignments in Workforce for ArcGIS and then categorized *[them]* based on the type of work that needed to be done. Within four months, we had already completed 3,100 assignments."

From Paper to Mobile

In the past, Utilities Kingston relied on paper forms to inspect meters and change them out. Fieldworkers would complete inspection sheets and meter order forms on paper and then manually submit them to multiple clerks in several departments, who input the information into the utility's customer information system and several spreadsheets used to track projects and assets. A summary of the data would then be sent to the customer service team to ensure that this department had the most accurate information for customer calls.

"That's a lot of traveling around for a piece of paper to do," Rogers said. "We knew we could set something up using real-time data streams."

To update this process, the metering and communication departments—in conjunction with the service and gas operations division—first created a Microsoft Excel spreadsheet with details for all 5,300 meters that needed to be replaced within the company's distribution area. The GIS group then used Workforce to lay out the spreadsheet data geographically. Seeing everything on a map allowed the natural gas team to quickly identify concentrations of work that needed to be done and focus their efforts on specific geographic areas each day.

"If we replaced meters in alphabetical order, for example, we would have had workers running all over the city," Rogers said. "The gas team used Workforce to help prioritize their schedule. Employees—from management to field staff—were able to see the strong benefit of a system that helps organize complex workflows and make them simple."

The Benefits of Real Time

Here's how the process works now. A scheduler for the Workforce project designates dates and priorities for each meter inspection or replacement work order. The eight employees assigned to the job work in teams of two, traveling to assignments in work vans. Every day, the teams open the Workforce app on the tablet computers they bring with them to see what they have to do and where they have go.

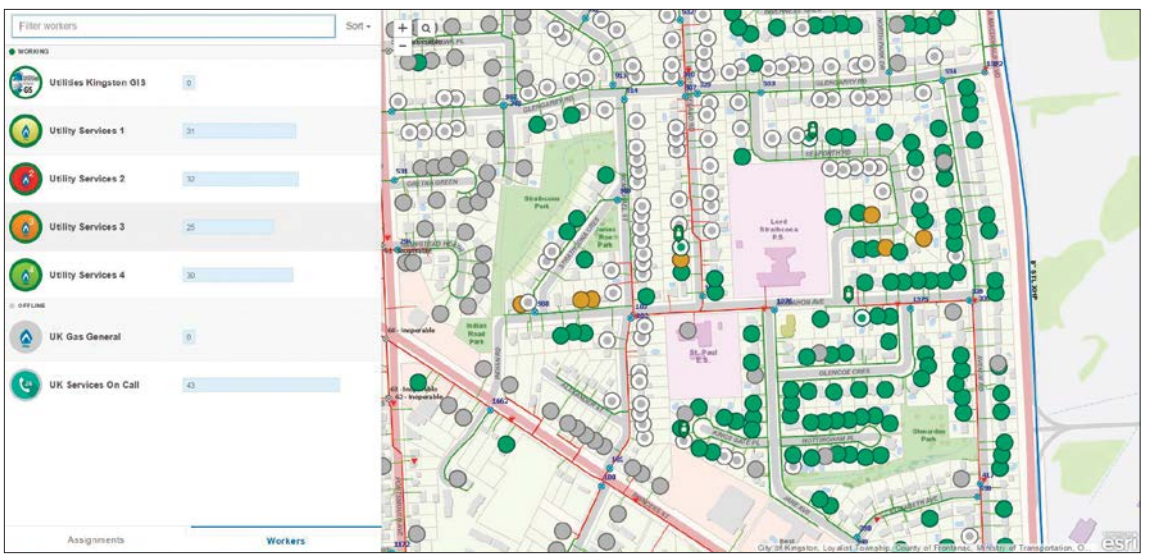
At each assigned stop, the fieldworkers use Workforce to directly access information on each assignment and collect relevant data using Collector for ArcGIS. Within the Workforce app, they can add important notes, such as when the gas was turned off and whether appliances need to be relit. This information is available in real time to office staff, who can now more quickly create status reports, manage customer inquiries, and plan future inspections.

"Workforce is allowing us to collect important information *[that was]* not available in the field and will now be available for use by our service technicians," said Karen Santucci, the company's manager of utilities services and gas operations. "This is the big selling point for our field staff."

↑ Working in teams of two, field crews access Workforce for ArcGIS on their tablets to see what they have to do each day and where they have to go.

Now, more employees have access to information that was previously only available to some, and data is presented in a user-friendly format that makes it easier to perform analysis. Whole processes don't stop just because a piece of paper got stuck on someone's desk, and status reports and analyses are always up-to-date. With real-time data coming in, dispatchers can see where crews are and how much work they have left to do in a given day to determine if jobs need to be reassigned. It also helps the customer service department answer inquiries as quickly and thoroughly as possible.

With more departments using real-time meter data in new ways, organizational transparency at Utilities Kingston only continues to improve.



← With real-time data coming in, dispatchers can see where crews are and how much work they have left to do in a given day to determine if jobs need to be reassigned.

DIY APPS FROM ESRI MAKE APP BUILDING EASY

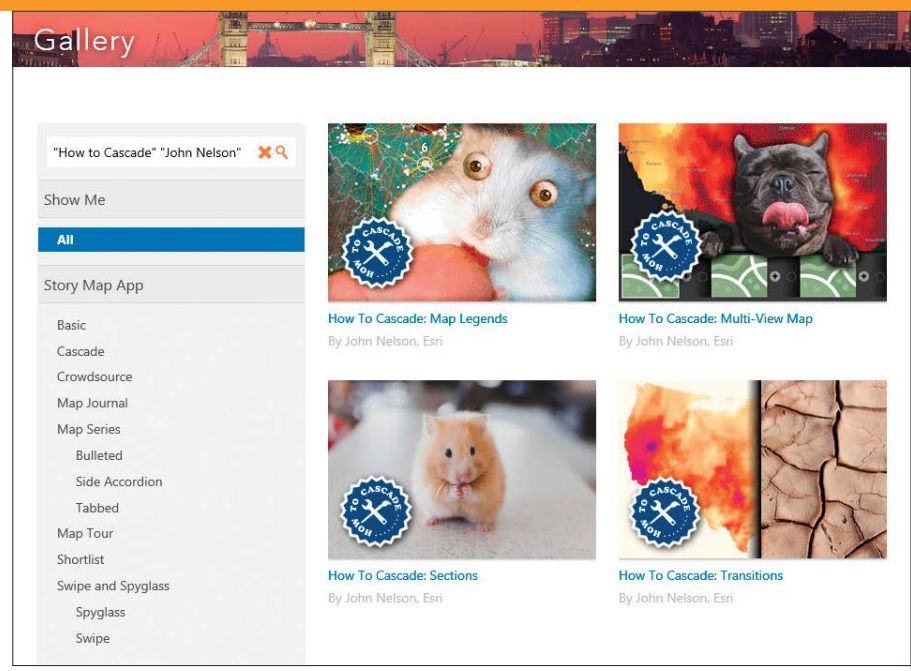
With the Right Tools, Anyone Can Build a GIS App

Many homeowners spend their weekends scouring home improvement stores to get the materials they need to make their homes even more beautiful and comfortable. While some larger renovation and remodeling ventures require assistance from experts, most home improvement projects can be tackled by the homeowner. Many of these do-it-yourself, or DIY, projects are pretty small in scale, and they can pay off big-time. Installing an automatic garage door opener or replacing an old water heater with a new tankless one makes life at home run more smoothly and preserves the investment in a house. And as long as homeowners have the right tools, they can do these things themselves—without having to hire a contractor.

Likewise, Esri has a collection of app builders that enable GIS users of any skill level to create apps that make their organizations and operations run more efficiently. Whether a GIS department is serving its own company and stakeholders or external clients and communities, Esri's easy-to-use app builders—which require no coding—help extend the use of GIS beyond technical staff. Again, the payoff can be big: An emergency services agency could quickly spin up an app for citizens to find the closest shelter during a natural disaster, or a local marketing company could assemble an app that showcases the best places to visit in a city to encourage tourism and economic development.

Whatever the objective, Esri's app builders give people the tools they need to broaden the benefits of GIS and get the most out of this technological investment. What's more, those who want to build an app don't have to scour the Internet to get what they need. Everything is available in the virtual aisles of esri.com/appbuilders.

Aisle 1
Esri Story Maps



↑ The Esri Story Maps website contains tutorials to help users build story maps.

Esri Story Maps apps let users, well, tell stories with maps. Harnessing the power of geography to inform, they combine authoritative maps with narrative text, images, and multimedia content. Whether the goal of the story is to educate decision-makers, share infrastructure plans with the community, communicate with customers, or fire up supporters for a cause, there's an Esri Story Maps app that can do the job.

Users can currently choose from eight story map layout templates, including Story Map Basic, Story Map Cascade, Story Map Crowdsource, Story Map Journal, Story Map Series, Story Map Shortlist, Story Map Swipe and Spyglass, and Story Map Tour. These templates intuitively guide users through the steps needed to design and configure an app. For a more customized experience, users can change the defaults of the story map app builders to experiment with additional options and make each story map unique.

Additionally, the Esri Story Maps website contains a library of tutorials and blog posts with tips and tricks to help users build compelling story maps. Go to storymaps.arcgis.com to learn how to add images to a story, embed story maps in a website, use story maps for presentations, and more.

Aisle 2
Configurable Apps

↑ To choose the right configurable app template, users browse through a list of templates organized by category and pick the one that works best for the job at hand, such as comparing analyses.

Configurable apps from Esri are the fastest and easiest way to go from a map to a shareable app. No coding is required, and users can choose which configurable app to use based on the purpose of the project, the needed functionality, and the desired aesthetics. Whether the intended audience for the app is the general public, citizens of a certain town, customers of a business, stakeholders in a project, or the local homeowners' association, configurable apps make it easy to communicate in a spatial context.

Each configurable app offers distinct layouts, tools, and user interfaces to enhance user engagement. GeoForm, for example, is the most apt tool for collecting data, while the Basic Viewer and Public Information templates are best for getting information to customers quickly. Being clear about who the audience is and how it will use the map helps when selecting a configurable app.

Picking the right configurable app template for the job is easy, just like looking through a well-organized and labeled toolbox. Users simply browse through a list of templates that are organized into categories to find the app that will work best for the time frame and budget at hand. Once the configurable app is created, it can be shared with the public or privately within an organization, giving any GIS user's audience a focused experience for interacting with maps.

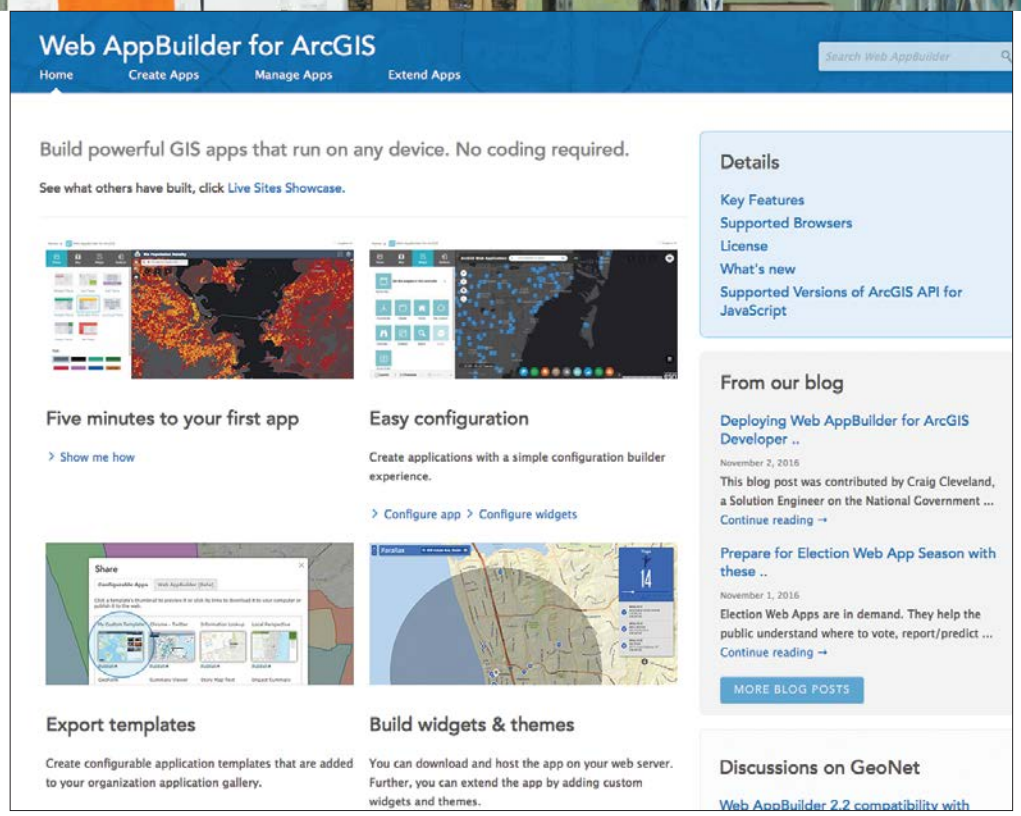
Aisle 3
Web AppBuilder for ArcGIS

When starting a new home improvement project, it is common for DIY-ers to face two fears: first, that the project may be outside the scope of their abilities, forcing them to hire outside help, and second, that the finished product won't turn out as they envisioned it. Deciding to build an online mapping app can elicit similarly daunting thoughts.

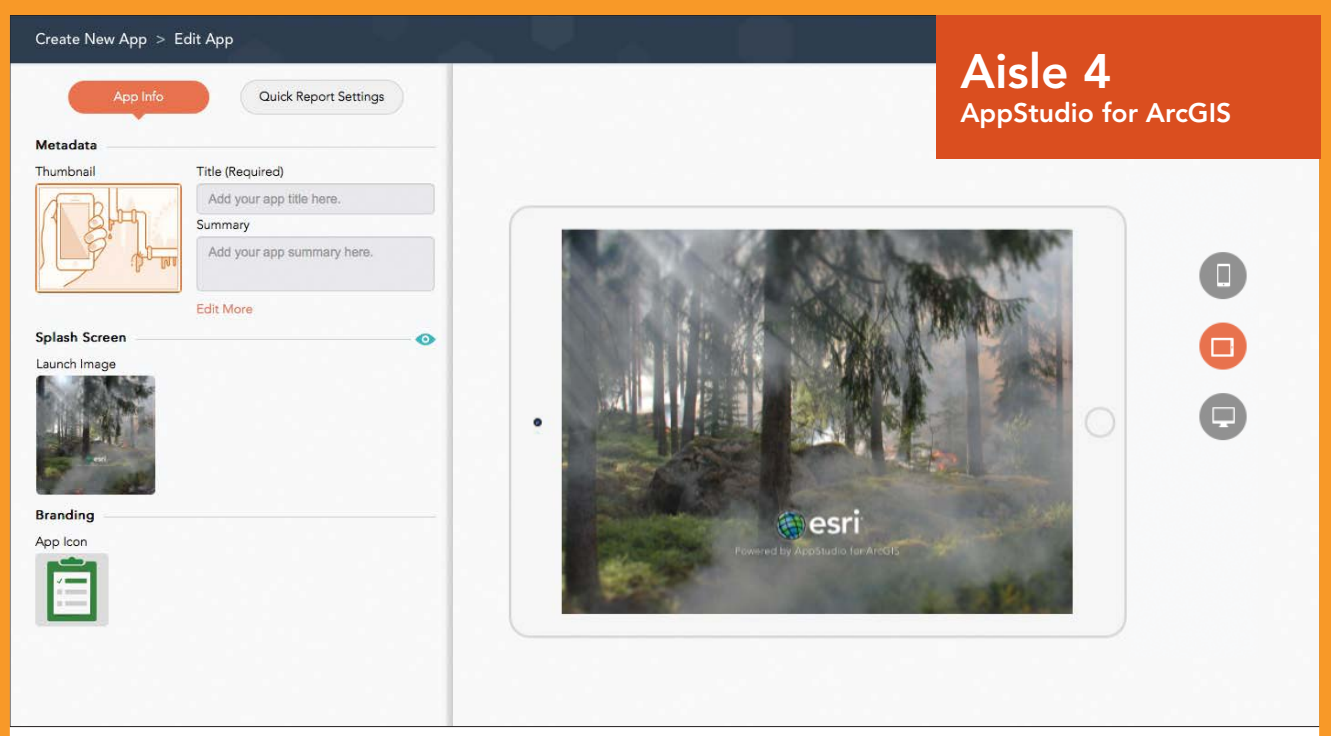
"Expensive," "tedious," and "difficult to learn" are words and phrases used to describe DIY projects and the process of building a web app. But both can be easy when using a guide or template.

Web AppBuilder for ArcGIS provides that foundation. It enables people to build web apps that serve a range of purposes, from aggregating data and reporting findings to informing colleagues and the public. Users with no programming knowledge can use Web AppBuilder for ArcGIS to create beautiful web apps without writing a single line of code. They simply configure the look and feel of the app by picking a theme from a collection of styles and layouts. Then, instead of building functionality from scratch, users can incorporate widgets that are ready to use (again, no coding required) and even perform advanced functions such as querying, measuring, and providing directions. Once a user chooses the attributes and saves and launches the app, it's ready to share with the public or throughout an organization.

Users who do have experience in developing web apps can extend the options on Web AppBuilder for ArcGIS to create custom widgets and themes. And, with a little practice, any Web AppBuilder for ArcGIS user could go from beginner to pro in no time.



↑ Users with no programming experience can use Web AppBuilder for ArcGIS to build engaging web apps without writing a single line of code, while users who are skilled in web development can use the app to create custom widgets and themes.



Aisle 4
AppStudio for ArcGIS

↑ AppStudio for ArcGIS lets users convert web maps into beautiful, consumer-friendly mobile apps that run on iOS, Mac OS X, Android, Windows, and Linux systems.

Building an app that runs natively on various devices might seem like a daunting task that requires hiring a third-party developer. But with AppStudio for ArcGIS, anyone can build a native app without writing a single line of code.

AppStudio lets users convert web maps into beautiful, consumer-friendly mobile apps that can run on any device. Build an app once, and it automatically functions on iOS, Mac OS X, Android, Windows, and Linux systems.

With AppStudio, people who don't consider themselves developers or designers can create their own branded native apps—just like any homeowner can build a self-assemble entertainment center or closet for their home by picking the model out of a catalog; gathering up basic tools, such as a hammer and a screwdriver; and following simple step-by-step instructions.

It is also easy to get these apps into the Apple, Google Play, and Microsoft stores, or users can choose to keep them behind their organizations' firewalls by sharing them securely within their own enterprises.

Checkout
Now Get Started

With all these tools available at esri.com/appbuilders, any GIS user can embark on a GIS app-building project. Looks like it's time to get to work.

Esri, USGS Release First Truly 3D Map of World's Oceans

continued from cover

Big Data for a Huge Project

"While oceans cover about 70 percent of the earth's surface, the impact of climate change on the oceans—apart from sea level rise—has largely been hidden," said Dr. Suzette Kimball, director of USGS.

But as Kimball points out, the EMU project is a significant step forward in the quest to comprehensively map the entire ocean.

"This easily accessible map will serve as a fresh resource for improving our understanding of the ocean's structure—its salinity, temperature, oxygen levels, and nutrients—in millions of places," she said. "This insight will, in turn, help us better understand the rapid changes in ocean ecology that are now happening around the world."

The team of scientists and analysts who worked on the project delineated 37 3D regions in the oceans, which became the EMUs. Each unit is a physically and chemically distinct area of the ocean distinguished by six variables: temperature, salinity, dissolved oxygen, nitrate, phosphate, and silicate.

While GIS has been used time and again to map the 2D surface of the ocean, as well as the 2D seafloor, this is one of the first uses of the technology to visualize, characterize, and analyze the 3D volumetric space between the surface and the bottom of the sea on a global scale. What ultimately made this possible were the incredible recent advances in big data analytics.

The EMUs are composed of a point mesh framework of approximately 52 million global measurements of six key variables (collected over a 50-year period) that represent the physical and chemical properties of the ocean and are most likely to affect how marine plants and animals respond to their environment. Once this mesh was created, the team applied rigorous k-means statistical clustering to group together areas with similar properties. This resulted in the 37 physically and chemically unique volumetric EMUs—each of which stretches from the ocean's surface all the way down to the floor.

With the global EMU map, there is now scientific support for marine spatial planning and management (to accommodate the various uses of the ocean, from commercial fishing and shipping to recreation), designing new marine protected areas, and understanding the effects of climate change and other disturbances on all kinds of ecosystems.

Accessing and Implementing the EMUs

To give users easy access to the EMUs, Esri has built the Ecological Marine Unit Explorer app (livingatlas.arcgis.com/emu), which allows users to explore the EMUs—as well as the original data from the National Oceanic and Atmospheric Administration's (NOAA) World Ocean Atlas—on the web and with mobile devices. Teachers and students can use the Explorer app, free of charge, to view 3D ocean data both in the classroom and in the field, as it is intended to enhance laboratory projects and field exercises.

Working with the EMUs extends far beyond the classroom as well. The EMUs are open data, available in a variety of formats in ArcGIS Online (at esriurl.com/emudata), so anyone can access and share the 3D point mesh and the EMU clusters for the surface of the ocean, the bottom, and the water column in between.

Interest in the EMUs is far-reaching. The project was initially commissioned by the Group on Earth Observations (GEO), an intergovernmental partnership that aims to open up access to earth observation data to help people around the world make better decisions, so the results were always intended to be shared extensively. Additionally, the EMUs were created in collaboration with NatureServe, the Marine Conservation Institute, the University of Auckland in New Zealand, GRID-Arendal in Norway, Duke University, the Woods Hole Oceanographic Institution, New Zealand's National Institute of Water and Atmospheric Research, NOAA, and the National Aeronautics and Space Administration (NASA), so enthusiasm for the global EMU map is widespread. Already, a number of organizations have expressed interest in using the EMUs, including GEO's Blue Planet Initiative, the MPA Action Agenda of the World Wildlife Fund's Global Marine Programme, the Ocean Data Interoperability Platform, the Ocean Biogeographic Information System, the Mission Blue initiative's Hope Spots program, and the South African National Biodiversity Institute.

The Relevance of Cartography

A Cartographer's Perspective

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

The Mapping Challenges of Big Data

Big data is everywhere. At least, that is what we're told. But has anyone ever fact-checked that statement to see if it is true? Is big data really everywhere, or is it just hype?

To begin to answer that question, we need to ask a couple more. First, what is big data? And second, is what we determine to be big data really ubiquitous?

As is often the case, answering these questions is a matter of definition and context. Even then, there can be multiple perspectives.

Big Data Is…

So what is big data? From a mapping viewpoint, I can think of all kinds of very big datasets.

Imagine, for example, a global dataset of 2.5-meter contour lines. You might wonder at first why someone would have such dense contour lines for such a large area. Well, in the Netherlands, we have them on our 1:25,000 topographic maps to help defend land located below sea level. So they matter.

If someone has this global dataset and puts it on your desk, though, you might have some trouble processing it because of its size. But the data is not actually complex because the contour lines never cross each other. It's just a very large amount of data.

Now imagine receiving a collection of five years' worth of georeferenced social media posts taken from Twitter and Facebook. Like the contour lines, there is a lot of data. But it is also more complex because the content is varied, with photos, text, and videos about diverse aspects of users' daily lives. The geography might also be fuzzy because of the subjective nature of user-generated geotagging. (If a woman tags her post as "New York City," for instance, which borough is she in?) This data will clearly be less coherent than the contours, which suddenly look easy.

But the lingering question remains, are both sets of data considered big data?

The Five Vs

To answer that, let's looks at some definitions. Big data can be characterized by five words that start with *V*.

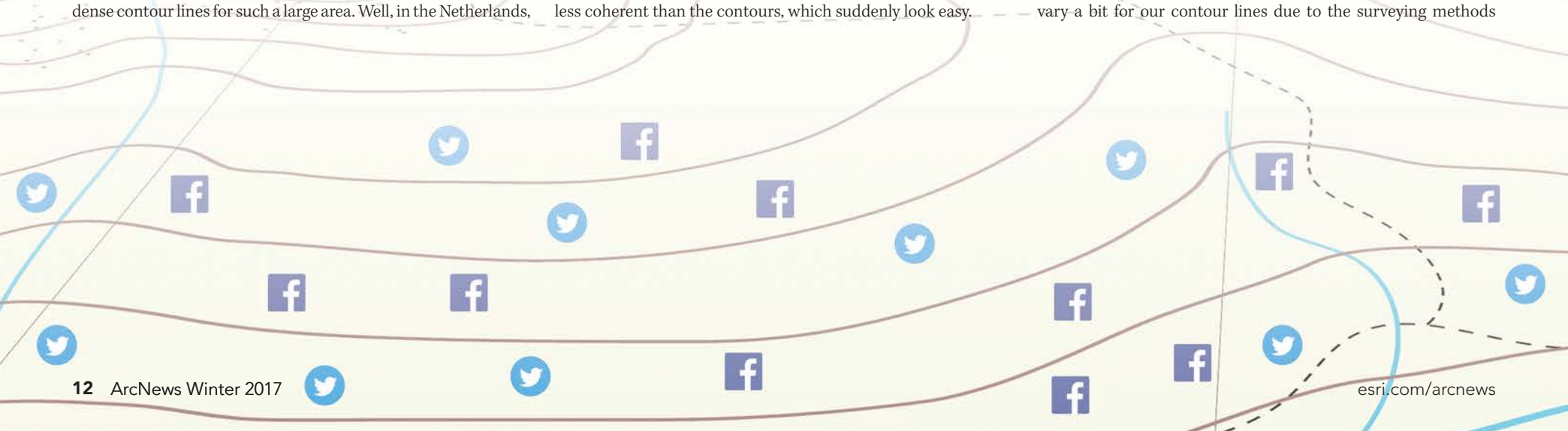
The first is *volume*: a considerable quantity. Both of our datasets are sizable, to be sure—though it is prudent to keep in mind that proportions are defined by context.

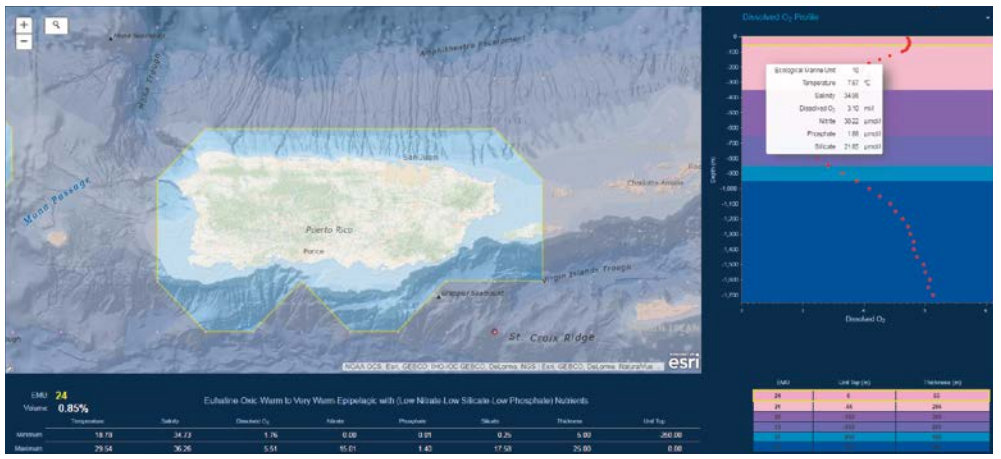
The second word is *variety*: a collection of heterogeneous things. Here, our contour lines do not qualify because they're all the same. Our social media data, however, does.

Third, we have *variability*: in geographic terms, differences in spatial and temporal distribution, scale, and attributes. Our contour dataset has spatial variability—some areas are flat and have virtually no contour lines, while others are mountainous, with contour lines that are very close to one another. The social media data also has spatial and temporal variability in that posts come from different places and appear at different times.

The fourth word is *velocity*: the rate at which the data is updated. For the contour lines, this is likely limited because these attributes don't get updated very often. But it could apply for the location of the contour lines themselves—in a river delta, for example, where land and water alternate positions, thus swiftly changing the contour lines. The social media data, on the other hand, gets updated constantly; therefore, it fits this definition.

Fifth, we have *veracity*: the accuracy of the data. This might vary a bit for our contour lines due to the surveying methods





← The EMUs can be easily viewed in the Ecological Marine Unit Explorer.

This does not mean, however, that the project is finished. Work on the EMUs continues in earnest, with future plans including a global delineation of Ecological Coastal Units (ECUs) at a very fine spatial resolution and the development of global Ecological Freshwater Units (EFUs), now in the very early stages of planning. The team will also be exploring how to conceptually and spatially connect the EMUs, EFUs, and Ecological Land Units (ELUs) at the ECU juncture.

To continue discovering new workflows for teaching and science, everyone is encouraged to apply the methodology used to derive the EMUs to their own areas of interest and using their own high-resolution data. Ultimately, the team hopes that the ecosystem-based management espoused by the EMUs will guide ocean conservation, ocean geodesign, ocean policy, and so much more.

For more information about the Ecological Marine Units map, visit esri.com/ecological-marine-units, email Dawn Wright at dwright@esri.com, or contact the team at the Ecological Marine Units page on GeoNet.

About the Authors

Dawn Wright, PhD, is Esri's chief scientist. Kevin A. Butler, PhD, is a spatial statistics product engineer at Esri. Sean Breyer is the ArcGIS content program manager for Esri. Keith Van Graafeiland is a product engineer and ocean content lead at Esri. And Roger Sayre, PhD, is the senior scientist for ecosystems at the USGS Land Change Science Program.

used, but, in general, contours are within the bounds of good-quality data. Our social media dataset, however, is probably more prone to imprecision because it is crowdsourced information.

So what does all this mean? Although neither dataset adheres to all five V-words, each conforms to enough criteria to be considered big data. What qualifies as big data, then, depends on context, which can be analyzed by looking at the dataset's volume, variety, variability, velocity, and veracity. By analyzing each dataset according to these guideposts, we can figure out whether big data actually is everywhere. Indeed, though, it looks like contemporary forms of data are tending to get larger and larger.

Summarizing Versus Interpreting

Since maps are visual representations of an environment, they are the interface between users and data. Big data, with its increasing prevalence, has a substantial effect on how cartographers work.

In the past, cartographers were expected to create authoritative products—products that, in large part, went unchallenged. Often, cartographers had to fill in gaps in information to present the essence of the message—in an election map, for example, turning certain areas red or blue to show which way they are trending before all the votes are tallied. This required cartographers to employ specific skills, such as interpolation or extrapolation, to interpret missing data or inaccuracies. But when the map was finished, its message was mostly fixed and stable.

Today, however, many cartographers retrieve the essence of their message from big data. They, therefore, are required to summarize more than interpret. Traditional cartographic practices, then—such as generalizing, classifying, and aggregating—no longer suffice. Cartography now requires different skills, along with teamwork.

To deal with big data, the cartographer of today has to be able to do computer programming and communicate with data analysts to get to the core of the message. This message is likely to change over time, however, due to the velocity at which information is updated and the variability of the insights contained within the data. Cartographers now have to create flexible summary maps that can present multiple perspectives. That is challenging for the cartographic community, since it requires coming up with novel designs and even map types. Although summary maps might be simple and schematic, they also require the user to possess the skills to read them.

To help cartographers rise above these new hurdles in map design, the International Cartographic Association (ICA) tasked four of its commissions with putting together a research agenda around how big data affects maps. The Commission on Cognitive Issues in Geographic Information Visualization; the Commission on Visual Analytics; the Commission on Use, User and Usability Issues; and the Commission on Map Design published their findings in the most recent edition of the *International Journal of Cartography*, which can be viewed at tandfonline.com/loi/tica20.

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.

Cartographers to Converge in Washington, DC

By Eric Anderson, Cartography and Geographic Information Society

One week before the 2017 Esri User Conference (Esri UC) gets under way in San Diego, California, the Cartography and Geographic Information Society (CaGIS) will host the 2017 International Cartographic Conference (ICC) in Washington, DC. With the events being held in relative proximity (just a domestic flight apart) and in two consecutive weeks (July 2–7 for the ICC and July 10–14 for the Esri UC), mapping buffs and GIS aficionados from around the world have the opportunity to attend both conferences in one trip.

At the ICC, a biennial event organized on behalf of the International Cartographic Association (ICA), about 2,000 conference participants from more than 80 ICA member countries will take part in workshops; go on specialized tours; and see hundreds of presentations on cartographic techniques, algorithms, products, and theories. In addition to engaging in interactive learning experiences, attendees will be able to see exhibits that include the following:

- The International Cartographic Exhibition, which showcases recent cartographic achievements from member countries and affiliates.
- An extensive International Trade Exhibition, where commercial companies and government and academic institutions display their newest and most advanced products and technologies.
- A display of the winning cartographic creations from young artists who participate in the 2017 Barbara Petchenik Children's World Map Competition, organized by the ICA's Commission on Cartography and Children.

Keynote speeches and technical sessions will cover a variety of topics, including interactive maps, dynamic cartography, spatial analysis, big data, sensor networks, virtual and augmented reality, and 3D mapping. Sessions will also explore historical cartography, web cartography, open-source mapping, and innovations in cartography and GIScience.

Special events on the schedule include an exhibit by internationally renowned artist Mary Edna Fraser, who flies, hikes, and boats—consulting maps, charts, and satellite imagery—to create stunning images of earth on pieces of dyed silk in the ancient art form of batik. The Library of Congress, which has one of the world's largest map collections, will also present an exhibition of historical maps.

Attendees will have the chance to go on tours of the United States Geological Survey and the National Oceanic and Atmospheric Administration. The social program will feature several receptions, a gala dinner, and an orienteering competition.

For more information on the 2017 ICC or to register, visit icc2017.org.

What's New
in ArcGIS Online

Wrapping up a great year of development with ArcGIS Online, the December update to the software included more advanced GIS capabilities, additional improvements to the user experience, and better ways to manage accounts and share work.

Boosting Advanced GIS Capabilities

Esri vector basemaps came out of beta in the December update. The new vector basemaps feature nine styles from a single tile service. The styles—which are derived from commercial, community, and open-source data—include dark and light gray canvas, three street variations, terrain with labels, navigation, topography, and an imagery hybrid. These map styles, which users can customize, are published as tile layers or web maps. They deliver a better display on high-resolution devices and can be updated more frequently.

With point layers in the scene viewer, it is now possible to incorporate both 2D and 3D symbology. For example, if wind speed is a numeric attribute in a dataset, it can be visualized with proportional symbols for color and size based on the wind speed value. The camera animation for point-to-point flights in the scene viewer has also been enhanced to provide a smoother user experience.

ArcGIS Online now has expanded analysis functions as well. The new Join Features tool transfers attributes from one layer or table to another based on spatial and attribute relationships. This is especially useful for operations such as appending common boundary or demographic information to incident data, identifying the facilities closest to a known location, or determining the number of residences that fall within flood zones. The new Find Outliers tool, which identifies features whose values are significantly different from other data points, creates maps that show statistically significant clusters and spatial outliers in the data. This tool can help answer questions such as

- Where are the sharpest divisions between affluence and poverty within a study area?
- Are some stores struggling with low sales, despite being near high-performing stores?
- Where are there anomalous spending patterns?
- Are there counties in the United States with unusually low life expectancy compared to their neighbors?

Additionally, demographic maps for Canada, the United States, and several other countries were updated in the December release. Canada now features 2016 demographic data. Maps for the United States now include the latest US Retail MarketPlace and Shopping Centers data, and daytime population information is available for mapping and analysis. Other countries with more current data include Belgium, China, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Poland, Russia, Spain, Sweden, Switzerland, and the United Kingdom.

A More Inviting User Experience

When styling and labeling feature layers in the map viewer, users can now author; edit; or apply Arcade, a new scripting language. For example, a user could create an expression to generate a yearly sales figure for individual territories by summing the value of monthly sales fields. The yearly sales figures would then be represented as different-sized symbols on the map. Moreover, users can now edit or delete attributes, photos, and files directly in the feature layer attribute table in the map viewer.

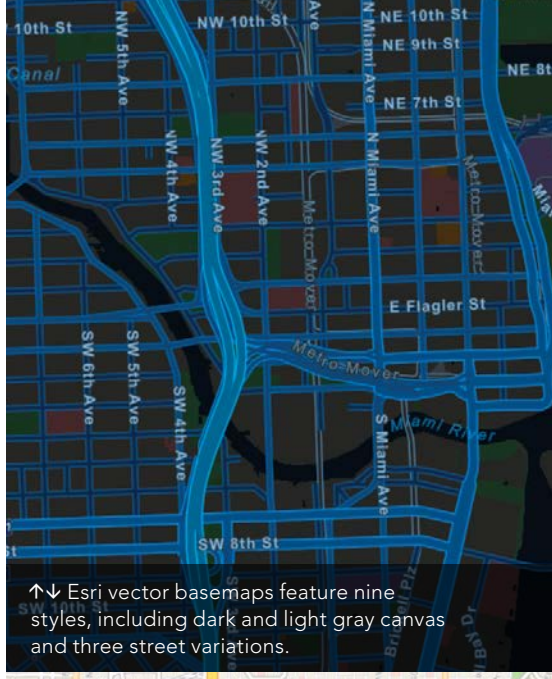
Enhancements were also made to time animation in ArcGIS Online. For layers with live data, a new tool called Show Advanced Options allows users to view the temporal extent of the data when reopening a saved map instead of merely seeing static content. When filtering feature layers by date, users can set a relative extent for the animation as well, making the start time for the animation the last day data was recorded, for example. Users can save the position of the time animation slider, too, so when they reopen the map, the slider defaults to that spot. Additionally, the start of the time slider can be controlled in the configured extent.

ArcGIS Online is now available in 34 translated languages as well, including Bosnian and Indonesian.

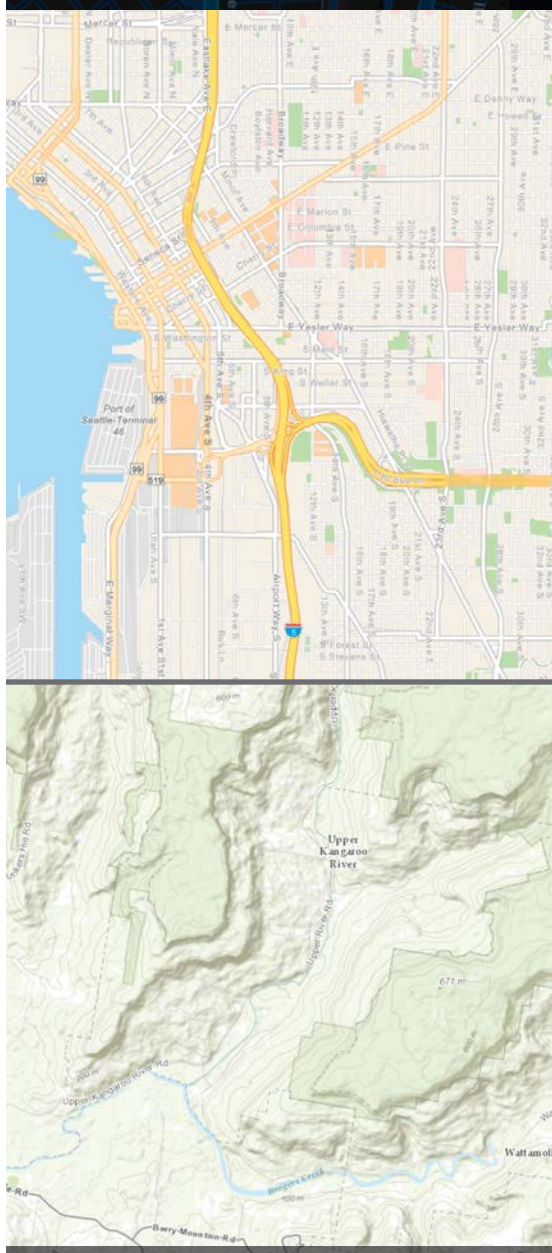
Simpler Administration and Sharing

The updated ArcGIS Online enables users to create new organizational accounts with credentials from social networks, such as Facebook and Google. There is also a new cost-effective way for subscribers to increase the number of people in their organization who can view the GIS work being done in ArcGIS Online. Users can now share mapping work with executives, fieldworkers, analysts, and other select individuals without making the data public.

To learn more about the updates to ArcGIS Online included in the December release, visit the ArcGIS Online What's New page and check out the ArcGIS Online blog at blogs.esri.com/esri/arcgis/category/arcgis-online.



↑↓ Esri vector basemaps feature nine styles, including dark and light gray canvas and three street variations.



↑↓ Esri vector basemaps deliver a better display on high-resolution devices.

Taking Next-Generation GIS Even Further

ArcGIS Pro, Esri's 64-bit desktop app, is bringing 2D and 3D GIS to the next level. The release of ArcGIS Pro 1.4 features new, user-requested functionality; the latest innovations for working with 2D and 3D spatial data and performing advanced analytics; and enhanced support across the ArcGIS platform.

New Features and Functionality

ArcGIS Pro 1.4 comes with more features requested by users. There is a new user experience for georeferencing images and CAD files. The app also now supports the ArcGIS 10.5 geocoding engine, which is faster and provides better results. This release gives users the ability to share their own locators with their own types of addresses, meaning that if a user is working in certain parts of England, he or she can use house names instead of numbers. And it includes dynamic legends that are updated based on the content of the current map extent.

Innovations in Spatial Data, Analytics

In ArcGIS Pro 1.4, users can employ the intuitive Ortho Mapping User Experience to orthorectify imagery and generate mosaics. ArcGIS Pro also contains new SDK configurations so developers can customize its user interface and launch experience. Want to limit the functionality of an app to a very specific set of tasks in ArcGIS Pro? Configure a kiosk mode.

There is so much to build into ArcGIS Pro. Creating 3D animations and incorporating video elements—things that weren't as easy to do or even feasible with ArcMap—are now possible with ArcGIS Pro. Users send in a lot of requests to augment the software as well. With this kind of excitement circulating throughout the GIS community, Esri has prioritized the development of ArcGIS Pro to meet users' needs—and users are always at the ready to take advantage of the app's new capabilities as soon as they're built.

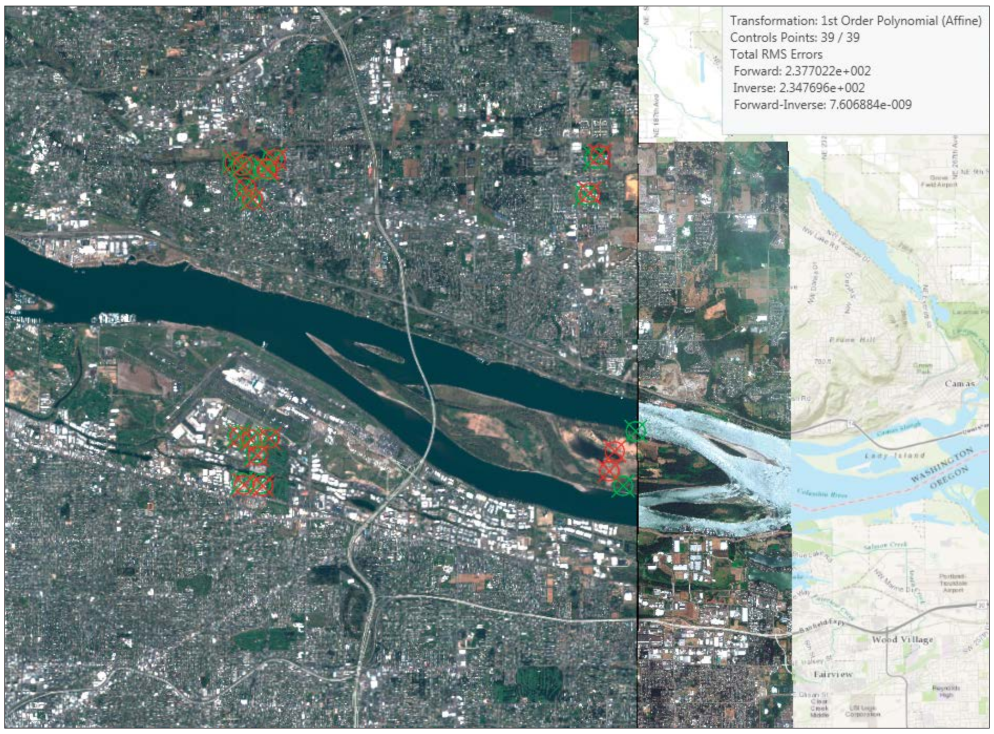
ArcGIS Platform Support

With the latest release of ArcGIS Pro, users will discover greater support for more of their ArcGIS work. At ArcGIS Pro 1.4, users can now do the following across the ArcGIS platform:

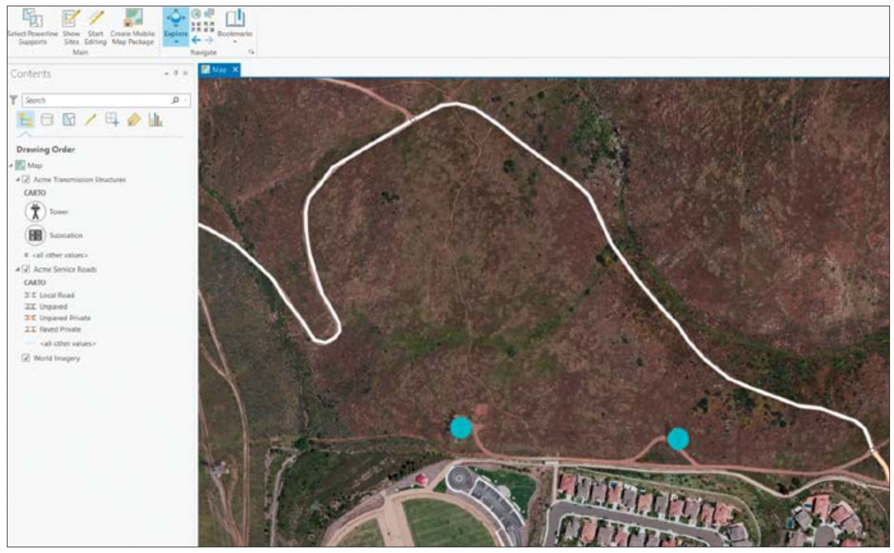
- Create and share point cloud scene layers to quickly display symbolized and filtered LAS point cloud data.
- Employ range-aware maps to build and share multistory maps and scenes of a building.
- Create, share, and consume vector tiles in any projection.
- Access Arcade, a new scripting language (available at ArcGIS 10.5), to generate label and symbol expressions.

ArcGIS Pro was built with the ArcGIS platform and enterprise GIS in mind. Developers at Esri are working hard to make ArcGIS Pro the best tool possible for creating content; authoring analyses; and sharing maps, scenes, and layers.

For more about ArcGIS Pro 1.4, visit esri.com/arcgispro.



← ArcGIS Pro 1.4 includes an interactive interface for positioning and aligning raw imagery to its correct spatial location.



↑ New SDK configurations let developers customize the ArcGIS Pro user interface and launch experience.

Operational Intelligence for the Whole Enterprise

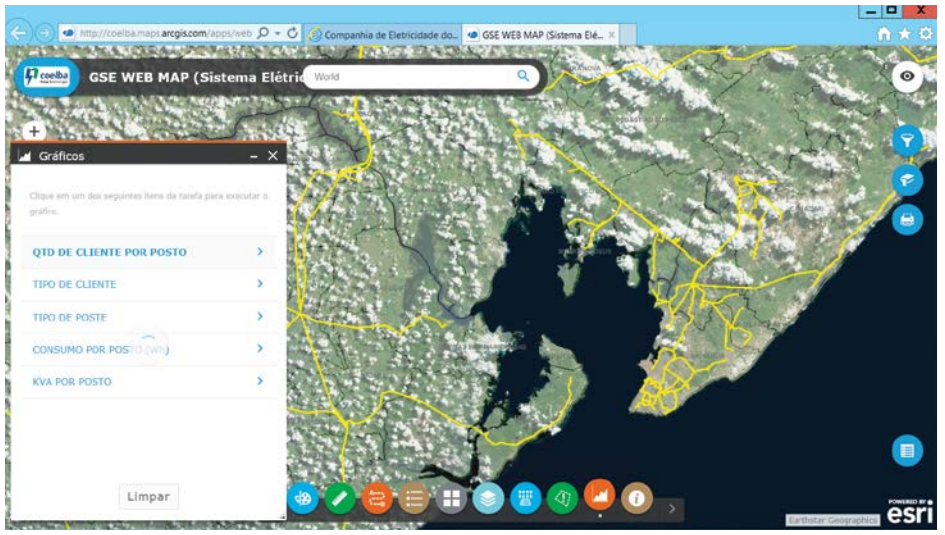
Brazilian Electricity Company Unleashes Geospatial Data with Web App

The Bahia State Electricity Company, known by its Portuguese acronym Coelba, needed a better way to share geospatial data throughout the organization. Too often, Coelba's mapping and cadastre unit had to generate small maps of specific areas and share them as PDFs with other departments so they could do various types of analysis. This was time consuming, and the technical information in the maps was static.

To best serve its more than 5.6 million customers in the northeastern Brazilian state of Bahia, Coelba (which is part of Brazil's Neoenergia Group, one of the largest private investors in the Brazilian electricity sector) created an online app to allow its employees to search and access geographic data related to the region's electrical system. The app, called GSE Web (which stands for Gestão do Sistema Elétrico, or Electrical System Management), enables staff on the sales, planning, design works, and maintenance teams to more easily plan projects and increase operational intelligence.

Opening Up Network Information

At Coelba, several departments need access to information about the electrical network. The sales team uses it to check customer locations, plan meter-reading routes, and assign field crews to customer requests to disconnect and reconnect service. The inspection department uses the data to check electrical circuits and prepare inspections. The design works team uses it to maintain and expand the energy network. And the maintenance department employs geographic information to plan tree pruning and support general operations.



↑ GSE Web helps members of the sales team find customers on a map and sort them visually according to various attributes, such as type of location or type of customer.

To relieve the mapping and cadastre unit (known by its Portuguese acronym OOMC) of having to provide maps of Coelba's distribution network for so many distinct projects, the company worked with Imagem, Esri's official distributor in Brazil, to launch GSE Web last year. The app enables anyone at Coelba to use a desktop or mobile web browser to access general information about the distribution network, as well as cartographic data and basemaps.

"The new app helps relieve the burden on the company's employees who were inundated with requests for data searches, making life easier for users and the support team," said Vandson Bomfim Santos, a project engineer for OOMC at Coelba. "Now users have direct access to this data and can perform searches and small analyses with maps and satellite images without having to involve the mapping team."

Working Together More Than Ever

Imagem and Coelba built the GIS solution in the ArcGIS platform. Coelba's network distribution data is stored, managed, and shared in ArcGIS Server. Members of the OOMC staff can then use Web AppBuilder for ArcGIS to easily create apps for each of the company's different business areas and share them on GSE Web. From there, users throughout Coelba can search the distribution network data and perform certain types of analysis, such as proximity and aggregation, both at their desks and in the field.

"Now we have to work together more than ever, as the demands *[began]* coming in thick and fast from the moment users started using the search tools and learning all of the app's functionalities," said Santos.

He is pleased, though, because "with the app… our employees are free to focus on what matters most: providing the best service to consumers."

Technologies with Great Potential

Coelba is so satisfied with the solution, according to Santos, that the plan is to extend the app to the two other companies that constitute Neoenergia—Celpe, the energy company for the Brazilian state of Pernambuco, and Cosern, which provides energy to the state of Rio Grande do Norte.

"In a market like energy distribution, where geographic factors have a great impact on the understanding of critical processes such as the maintenance, conservation, and expansion of distribution lines, having technologies with great potential is an essential factor," said Santos.

For Coelba, GSE Web is one of those technologies. The app has enabled all the company's business areas—from the mapping and design units to the sales and maintenance teams—to infuse their operations with geographic intelligence and has made countless processes more efficient.

For more information on GSE Web and other solutions from Imagem, visit img.com.br.

Marketing to New Customers with Enterprise GIS

Telecommunications Company Develops Spatially Enabled Customer Engagement Strategy

Horry Telephone Cooperative (HTC), based in South Carolina, is the largest telecommunications cooperative in the United States. HTC has a wide range of offerings, from telephone service and high-speed Internet to digital cable, wireless service, and security systems.

With a diversifying customer base, the cooperative wanted to streamline how it offered and delivered services to members and new customers. With this in mind, HTC made its internal information accessible from one place: the ArcGIS platform.

"Esri gave field engineers the ability to do something that they couldn't do before, or with anything else out there, because they could take the information into the field and say, 'This is where I want to put this, and here are the details behind it.'"

Edward Gause
Director of Information Services Operations
Horry Telephone Cooperative

Paring Down Internal Communication

Previously, HTC managed its operations using tabular spreadsheets and apps built in-house. Information was stored in multiple systems. While employees could ultimately find what they needed, having a system that didn't support interdepartmental collaboration meant it took longer than necessary—sometimes days—to find the right data.

To make internal communication more efficient, HTC took its information about customers, operations, and marketing—which resided in multiple systems—and put it into a geodatabase. This not only enabled employees to pull the critical information they needed directly from the system, but it also gave the data a spatial foundation, allowing staff to visualize this information in ways that weren't possible before.

"You get so much more when you present that data on the map than you do just looking at spreadsheets," said Sid Blackwelder, HTC's chief information officer.

Engaging New Customers Spatially

Before HTC had access to ArcGIS and, specifically, Esri Business Analyst Online (now called Esri Business Analyst Web App), developing marketing strategies for new markets was a time-consuming manual process. Obtaining reliable demographics for each prospective market and campaign required searching through multiple systems, examining outside data sources, and building complex spreadsheets. With Business Analyst Web App, however, marketing staff can visually assess demographics, household information, and other consumer data almost instantly using highly informative, interactive maps that are easy to understand and use.

"Rather than looking at a spreadsheet of just a lot of data, *[ArcGIS]* allows me to really build a case for a particular geographic target and helps us make informed decisions *[about]* where we need to go next," said senior marketing coordinator Jessica Strickland.

By mapping new markets, staff can understand potential customers' preferences, lifestyles, and media sources. The HTC marketing department can also use spatial analysis to identify new markets to target with customized messages and offers.

With this spatially enabled customer engagement strategy, sales teams can check specifics for each home, such as its service history and available rates. Members of the sales team can also see if homeowners are existing customers or prospective patrons and alter their sales messages accordingly.

"We can *[quickly]* tailor each customer message based upon the history that we built through ArcGIS," said Brent Groome, the chief executive of marketing, economics, and strategic initiatives for HTC.

Using ArcGIS, the marketing department at HTC can visually monitor campaign results. They can identify patterns and trends and pinpoint any changes and opportunities. This allows them to understand in real time what is working, where they can improve, and which corrective actions to apply.

Enhancing Field Capabilities

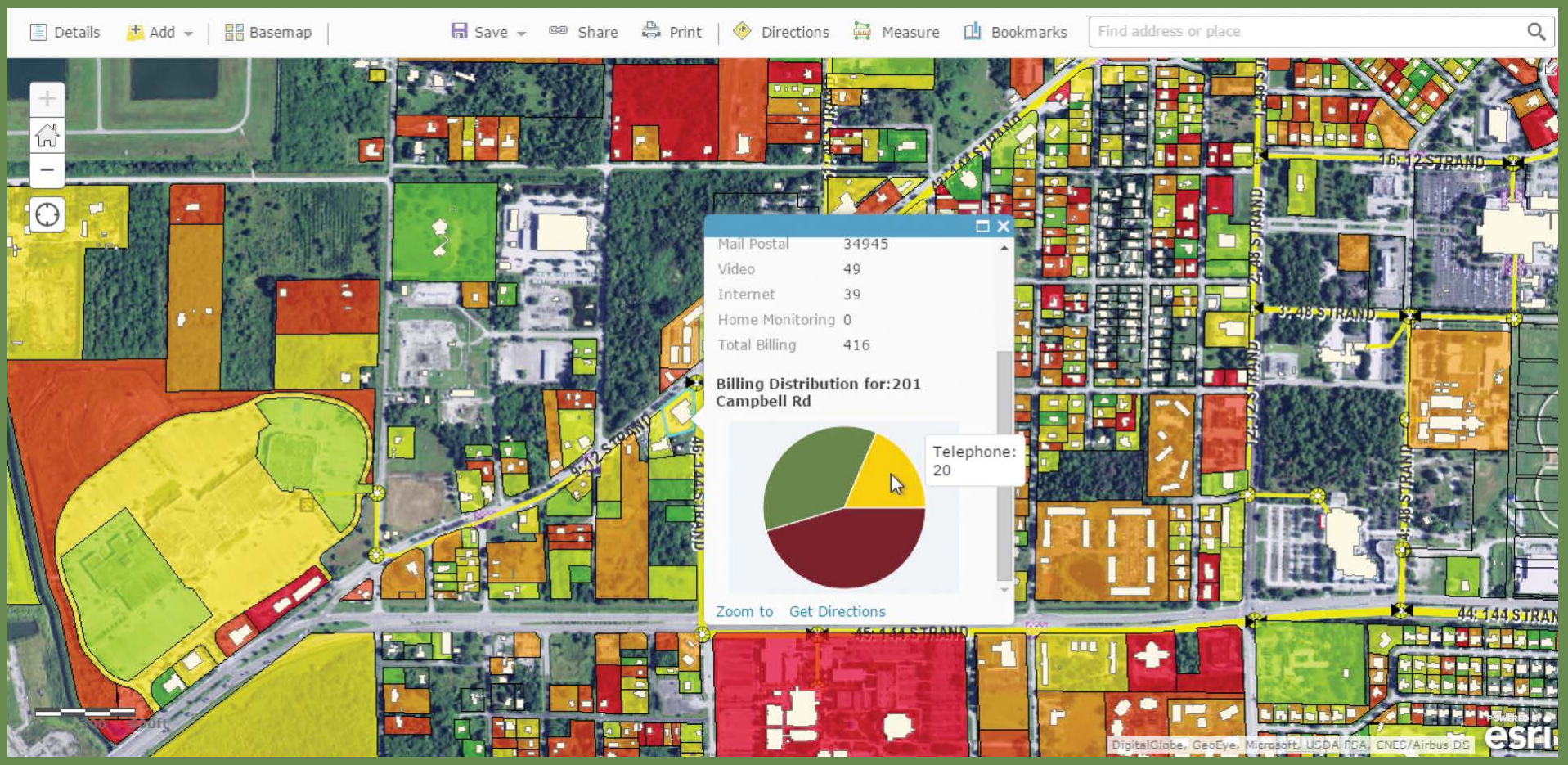
It was critical for HTC employees to be able to instantly share information across the platform both internally and externally from multiple devices.

"It's vitally important to share information *[with other]* parts of the organization so everybody is on the same page and understands the goals and how to attain the most effective results," said Jon Tyler, HTC's chief executive of sales and customer service.

Employees with no previous GIS experience are accessing geospatial information in the ArcGIS platform and discovering new, faster ways of solving old problems.

Engineers can determine where to invest in network expansions by identifying geographic patterns in customer service requests and comparing where customers live versus where they work. While out in the field, they can also propose facility upgrades with easy-to-understand maps that show details such as demographics and service request history.

"Esri gave field engineers the ability to do something that they couldn't do before, or with anything else out there, because they could take the information into the field and say, 'This is where I want to put this, and here are the details behind it,'" said Edward Gause, director of information services operations. "They can pull that information up and manipulate it on the spot."



↑ With ArcGIS, Horry Telephone Cooperative can use demographic and consumer data to perform analytics on existing and prospective customers and map new markets.

Green Infrastructure Plan Fuels Smarter Growth in Richland County

With GIS and a Green Infrastructure Model, Government Finds Scientific Support for Strategic Conservation

To mitigate the effects of climate change and extreme weather events, governments at the state, regional, county, and municipal levels must understand why these events occur and how their impacts can be prevented in the long term.

Following a devastating storm in Richland County, South Carolina, decision-makers there are gaining a better understanding of how people's choices alter natural environments—and how these changes affect everyday life and future generations. The county is now testing a new approach to bolster the region's sustainability. By combining GIS with a green infrastructure methodology, Richland County is gaining a scientific understanding for how to create a more resilient, economically viable, and smarter place to live and do business.

The Long-Term Consequences of Disaster Recovery

In October 2015, a two-day storm caused by Hurricane Joaquin swept across South Carolina, leading to devastating flooding, more than a dozen deaths, and the destruction of critical infrastructure. The state recorded $12 billion in losses with up to 160,000 homes damaged.

Richland County was hit worst. This once-in-1,000-years event dumped two feet of water in some areas of the county, killing nine people and threatening the drinking water. Schools, businesses, and roads remained closed weeks after record rainfall and dam failures occurred.

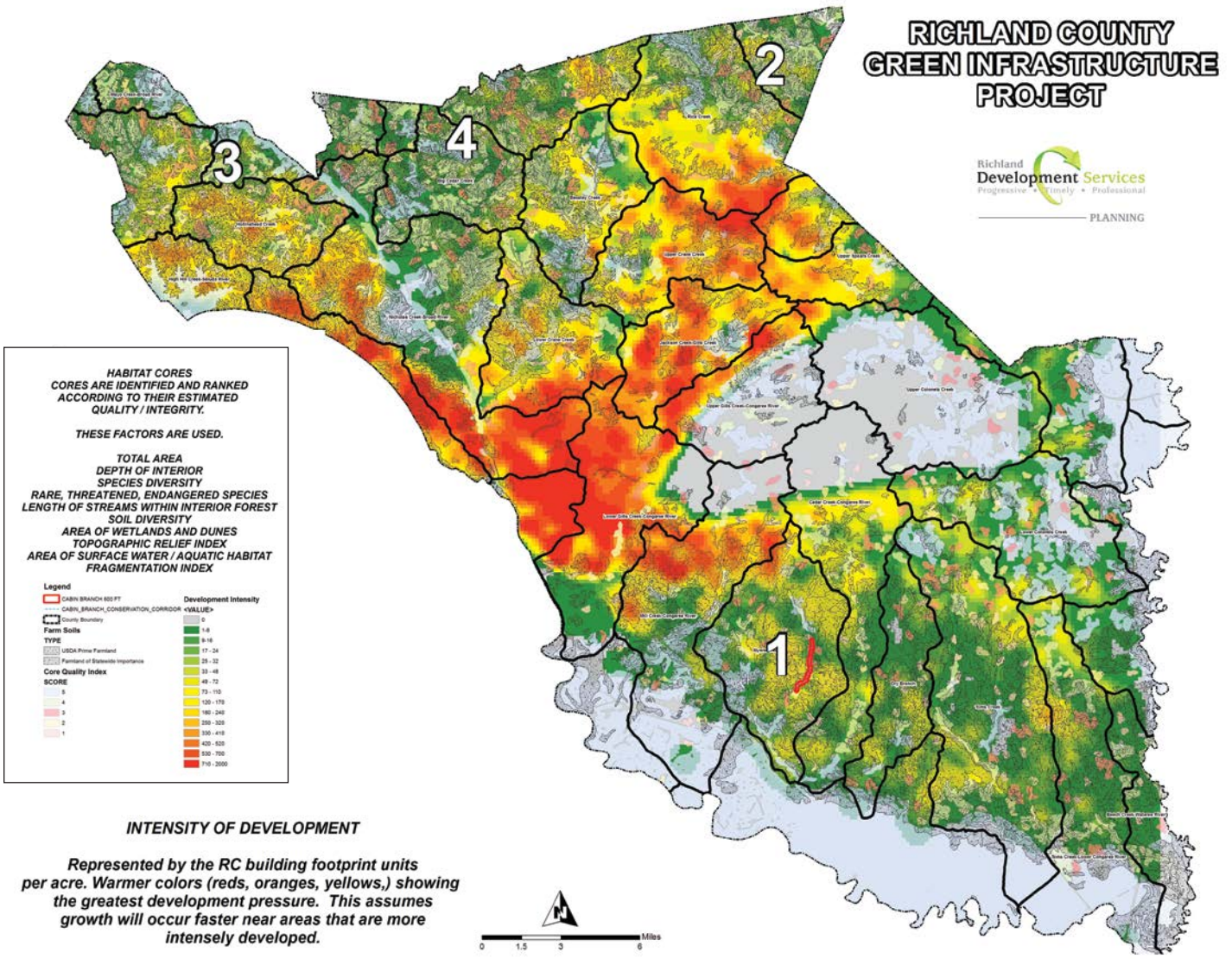
The historic flood urged decision-makers to ask serious questions. Why did flooding occur in this area? What caused the dams to fail? What can we do to prevent this from happening again?

For some, however, the answers had been evident for a long time.

"Flooding is a natural event, but the impacts we experience are caused by humans," said Quinton Epps, director of the Richland County Conservation Department. "We build in the areas that are flood prone. Very often, we change the areas in dramatic ways…that increase flooding impacts. These are things people have known for hundreds of years."

Homes built near bodies of water, for example, are appealing and tend to have higher property values, but they are predisposed to flooding. In Richland County, regulations require developers to build houses that would accommodate a 100-year event, meaning the structures must be built two feet above the base of a potential flood. But although subdivisions meet current regulations, they are still in danger of being damaged by more severe floods like the county saw during its 1,000-year event.

As the person in charge of securing properties and funding for conservation efforts, Epps also acquires easements to help avoid disasters like the 2015 flood. He spearheads projects to connect people with nature as well.



↑ Brenda Carter, the GIS manager for Richland County's planning and development services department, used the green infrastructure tool to identify four priority areas in the county that met the criteria of being an intact core, or habitat, at risk of losing its natural assets.

The job is no easy task. Success relies heavily on factors that are out of his control, such as the availability of land, willingness of property owners to sell or donate easements, and political interests that drive funding and development decisions.

After Hurricane Joaquin, Epps advocated to fund easements in flood zones to ensure that the land is never developed. But Richland County allocated its limited grant dollars from the Federal Emergency Management Agency (FEMA) and the US Department of Housing and Urban Development elsewhere—namely, to rebuilding homes and roads.

"The way people look at disaster recovery tells the story of how we don't look at long-term consequences," Epps said. "Do we have money to fix the problems of the last 50 to 100 years of development? No. But we can try to prevent history from repeating itself."

To Epps, most disaster recovery and development strategies focus on rebuilding and extending existing man-made infrastructure. However, these strategies dismiss a critical component of creating a safe and livable community: green infrastructure.

Using GIS to Identify, Map Critical Resources

Several months after the storm, Epps attended a workshop hosted by Karen Firehock of the Green Infrastructure Center, where she presented her methodology for developing and implementing a green infrastructure plan.

The idea was appealing—use data, science, and GIS to identify and map the critical resources that make each community unique and that also serve a vital purpose, such as rivers, trees, and hazard areas. Then, prioritize the ones that should be preserved and roll out a plan that protects, restores, and connects the landscapes.

With Richland County still reeling from the flood, a green infrastructure model could do more than connect people with nature; it could also help win executive buy-in for conservation projects that safeguard wildlife habitats, protect people and property from future harm, and boost the economy. By using GIS to assess all the county's features that the community deems valuable, Richland could explain the importance of green infrastructure in a more scientific way.

"We could provide a rational basis for conservation efforts not tied to politics or opinions," Epps said.

He was inspired to formulate a green infrastructure plan that would enable the county to plan smarter, but he couldn't do it alone. Based on Firehock's guide, *Evaluating and Conserving Green Infrastructure Across the Landscape*, he knew one person would be the key to developing the model—Brenda Carter, GIS manager for the planning and development services department at Richland County.

A Green Infrastructure Plan for Richland County

When Epps approached Carter to help with the project, she read through the guide and did additional research online. Carter was familiar with

the concept of green infrastructure, given her 32-year career in GIS. And soon, she knew why Richland County needed a green infrastructure plan and why GIS was such a critical component.

"Reading through everything made me realize that this was something really, really important for all counties and for all people—especially after our county had just suffered a great flood," Carter said. "I started seeing the connections as to why the flood could have happened and why we needed to do something about it."

Thus, the planning and conservation departments formed a partnership to bring green infrastructure planning to Richland County. Carter outlined goals and developed the entire green infrastructure blueprint. She began by identifying four goals:

- Improve water quality by providing a buffer to help prevent runoff and erosion and reduce pollutants
- Maintain forested land cover to facilitate recharging groundwater aquifers for drinking water
- Preserve and promote natural resource-based recreation, such as hiking, bird watching, hunting, and fishing
- Conserve community character and heritage by protecting a historic landscape.

With the task force's mission set, Carter executed GIS analyses to determine priority areas in Richland County. She referenced Firehock's guide as a road map for gathering and analyzing data, as well as evaluating and prioritizing critical resources.

Once Carter had the essential data layers in place—including existing county GIS layers such as conservation easements, address points, and zoning—she used tools from Esri to create asset maps and maps of intact habitats, also referred to as cores. Carter employed ArcGIS Spatial Analyst for ArcGIS Desktop to conduct landscape analyses, assess fragmentation and risks, develop a core quality index, and prioritize opportunities.

"The first step to mapping the intact habitat cores is identifying the location and shape of habitat cores," Carter said. "The second step is ranking the cores based on their ecological integrity using the best available data and science."

The process took Carter approximately six months to complete.

"Brenda took the ball and ran with it," Epps said. "The project would have been dropped if she hadn't been interested, taken the reins, and done all the hard work."

With the green infrastructure tool in place, Carter identified four priority areas in the county that comprise unique rural lands and waters. Each of these locations met the criteria of an intact core at risk of losing its natural assets. As part of the green infrastructure plan, Carter and Epps also identified potential projects to protect the cores—such as purchasing easements to preserve certain streams—and made clear the benefits of implementing them.

"I've been doing environmental work for 30 years," Epps said. "I had a picture of what the green infrastructure model would look like and, in the end, it didn't resemble what I had in mind. But that's what *[is]* cool—Brenda used scientific data and tools to set the strategy. It's not just about picking out what we think we should protect; it's scientifically supported."

Scientifically Preserving Natural Resources

The task force presented the green infrastructure plan and maps to the Richland County Conservation Commission, a group of 11 members appointed by the County Council to implement conservation goals. The commission was impressed.

"Science proved what they were thinking all along," Carter said. "Now they have scientific evidence to prove which areas need protection and restoration."

The team plans to present the information to the County Council as well, but progress has already begun on the policy side. Talks are taking place on how to resolve issues with zoning and the county's comprehensive plan. And the county's land administration department is starting to rewrite the land development code, keeping the priority cores top of mind.

"We're not going to write code to keep developers from *[building new homes]*," said Carroll Williamson, land development administrator with Richland County. But the "new codes will guide smarter development that will be better for the land, people's investments, and our county in the future. We used to tell developers that green infrastructure was a 'nice to have' feature. But if we can say scientifically that green infrastructure is critical to our well-being, then it takes on much greater significance."

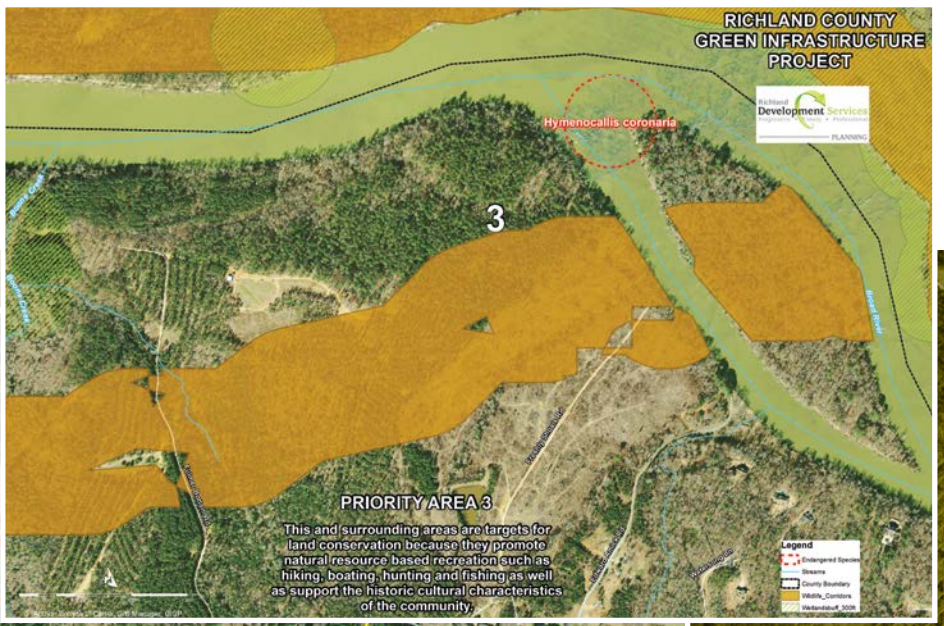
Moving forward, the team will continue the project and identify additional priority cores throughout the county's council areas. They're excited about the possibilities that the green infrastructure plan can bring to the county, including for the local economy. Helping people—especially county executives and developers—understand the benefits of green infrastructure will be critical.

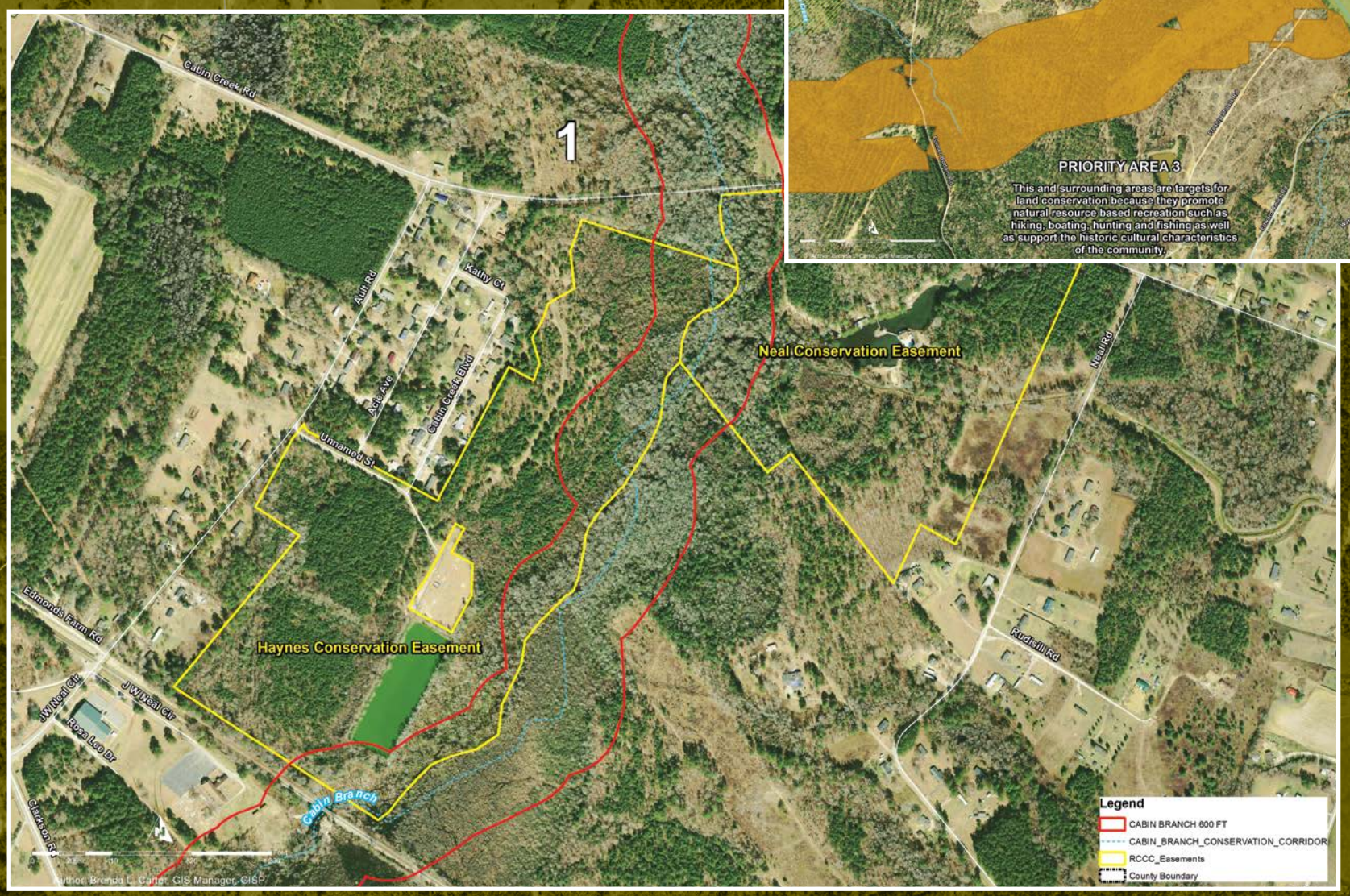
"Green infrastructure is a big idea," Epps said. "We want to conserve not just because we like trees. In the long term, green infrastructure provides a more sustainable and resilient community. So 20 years from now when we have another 1,000-year flood, a lot less people will be impacted."

For Carter, green infrastructure means using her craft to enhance quality of life for all of Richland County, for years to come.

"We don't want to re-create the flood situation that we had before," Carter said. "We don't want to damage the wetlands or cut down all our trees. We want to be able to have good water quality for the entire county. We want to preserve the natural resources that we have in the county so we can protect our quality of life. We want to grow, but we want to have smart growth."

For more information about this green infrastructure implementation, email Brenda Carter, GISP, at carterb@rcgov.us. To learn more about how to start a green infrastructure plan in your community, visit esri.com/greeninfrastructure.





←↑ The priority areas are targets for land conservation for various reasons. One aims to protect groundwater aquifers for drinking water, while another promotes natural resource-based recreation.

Congo Basin Gets Community-Built National Park

Using GIS, the Democratic Republic of the Congo Gained First Highly Protected Wilderness Area Since 1970

After almost a decade of work to secure the land, the Democratic Republic of the Congo (DRC) received its first national park in more than 45 years when then-prime minister Augustin Matata Ponyo officially established *Parc National de la Lomami* in July 2016. The 3,500-square-mile (9,000-square-kilometer) swath of land, known in English as Lomami National Park, is the first national park created in the DRC since 1970 and only the eighth area in the country with this designation, which garners the highest level of protection.

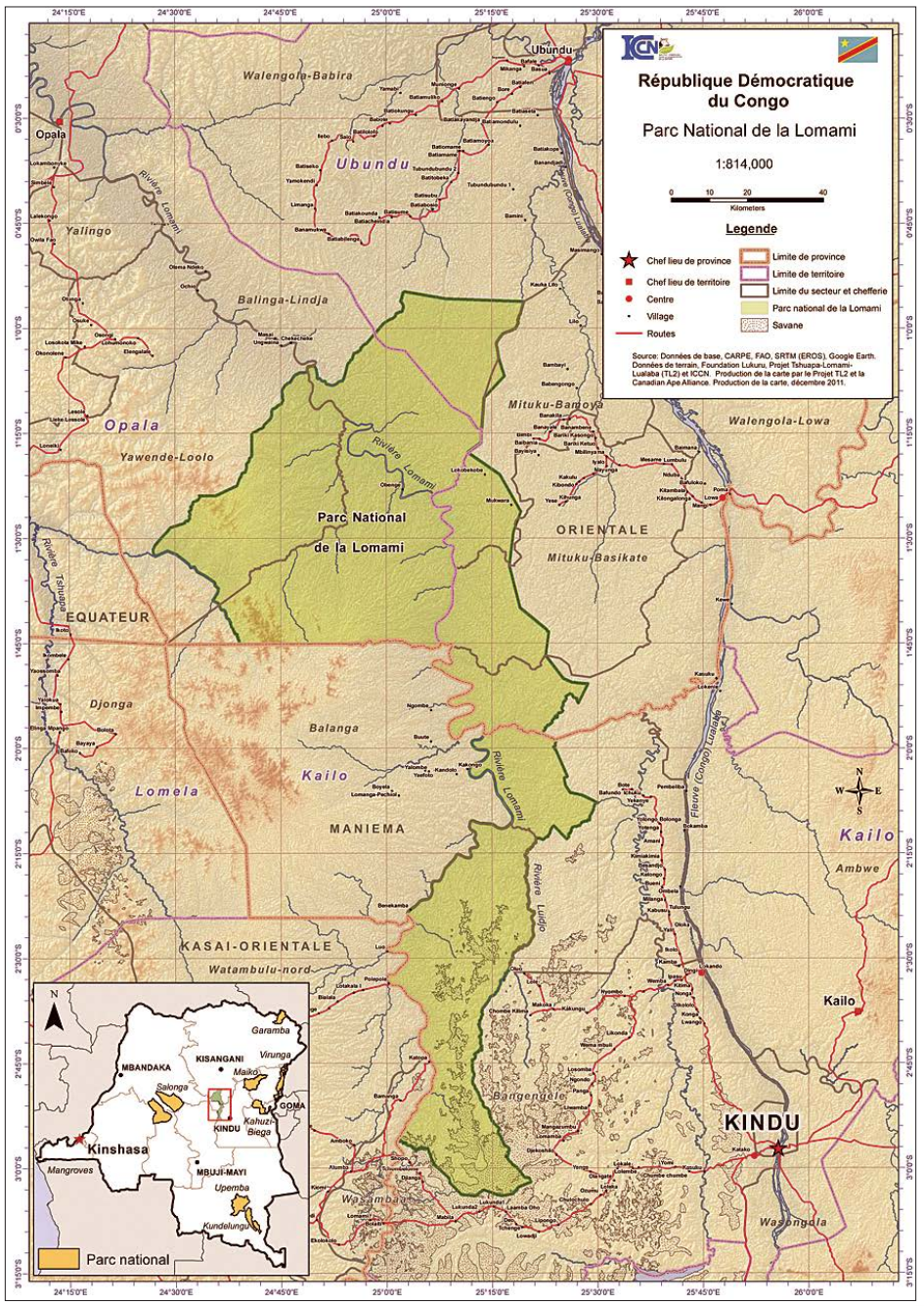
GIS has been the backbone of the project since its inception in 2007, when the Lukuru Foundation began exploring the scarcely observed landscape between the Tshuapa, Lomami, and Lualaba Rivers. Beyond what local hunters understood, little was known about the forest composition or animals within this 15,000-square-mile (40,000-square-kilometer) area.

The initial expedition, called the TL2 project (named for the three rivers), was led by John and Terese Hart, whose experience in diplomacy and field research prompted them to make it a locally based undertaking. With funding from the Arcus Foundation, the Abraham Foundation, and the US Fish and Wildlife Service—along with an Esri conservation grant procured through a partnership with the Canadian Ape Alliance—the Harts composed a dedicated team of Congolese field biologists who used GIS to collect field data. As the project evolved, TL2 also used GIS to work with people from the area to delineate logical park boundaries, monitor wildlife, and establish protections for the park. Thus, Lomami became the first national park in the Congo (and one of few in Africa) to be established with major backing from local communities.

Gaining Support to Protect a Unique Wilderness

Lomami, which is almost as large as Yellowstone National Park in the United States, is one of the last true wildernesses on earth. It lies in an area of the Congo Basin that has some of the highest

↓ Lomami National Park occupies previously unexplored wilderness in central Africa's Congo Basin.



levels of biodiversity in the world. But protecting it wasn't easy.

"The model we pursued from day one was to work from the bottom up, gathering village support immediately through conservation education," said Nick January, a volunteer GIS applications specialist with the Canadian Ape Alliance, a nongovernmental organization based in Toronto, Canada. "This approach builds the strongest foundation possible."

From the first surveys conducted in 2007, the TL2 project recognized the benefits of employing GIS to explore, document, and define the region for conservation. That year, TL2 developed an innovative partnership with January and the Canadian Ape Alliance, which had been receiving an Esri conservation grant since 2005 for gorilla research in the DRC. With the Canadian Ape Alliance leading the implementation of GIS at Lukuru, the Harts and their researchers gained access to a full range of advanced Esri software licenses and extensions.

Mapping the Park and Discovering What's Inside

Because it was so difficult to obtain complete and accurate geospatial data for the area, TL2's first mission was to construct a reliable basemap using ArcGIS. At the start, the organization only had one basic digital map to work from. To get information on boundaries, transportation, population centers, and the like, the project relied on generalized open data from sources such as the United Nations' Food and Agriculture Organization (FAO), the Shuttle Radar Topography Mission (SRTM), and the United States Agency for International Development's (USAID) Central Africa Regional Program for the Environment (CARPE).

From 2007 to 2008, researchers also conducted field expeditions to survey the area. They observed wildlife and used GPS to map animal tracks, which helped them highlight areas that needed to be revisited and surveyed in greater detail in subsequent years. Right away, the team discerned zones with important animal populations and other areas devoid of wildlife.

With good digital data of the area finally coming in, the TL2 team was able to begin a process of constantly refining the existing spatial data and continuously organizing the steady inflow of new field data, which included reconnaissance surveys; maps of trail systems, wildlife observations, and small communities; and documented evidence of hunting. Soon, the organization developed a comprehensive, current, and dynamic mapping system that pulled information from multiple sources in the field and revealed areas with strong wildlife populations and limited human interaction—prime locations to protect. As the national park started to take form, the digital maps generated by TL2's GIS evolved on-screen into a dynamic representation of the proposed park that contained diverse habitats ranging from tropical lowlands and forested hills to swamps and natural savannas.

Throughout the project, TL2 field researchers made a number of important discoveries. In particular, GIS helped them document and map the existence and range of many wildlife species. It is now known, for example, that Lomami is home to several rare or endemic primate species, including the recently discovered lesula monkey and a newly identified population of the extremely rare Dryas monkey. Other important primates found within the park include populations of the bonobo chimpanzee, wolf's monkey, the blue monkey, and the red-tailed monkey. Researchers confirmed the existence of the okapi, the DRC's endemic forest giraffe (whose presence was only suspected before). TL2 documented more than 275 bird species as well, including the vulnerable Congo peafowl. And at least 500 African forest elephants were found living in the park—one of the country's last remaining elephant populations.

Engaging Local Communities with GIS

While all these discoveries were being made, the Lukuru Foundation broadened its activities beyond just research and monitoring to include the whole scope of protecting and maintaining the park too.

During the time that the park was temporarily designated as two provincial parks, Lukuru research teams patrolled certain areas to look out for poaching activity. The organization then helped with guard training for Lomami National Park, first in association with the military and then, starting in 2015, with the Congolese Institute for Nature Conservation (known by its French acronym *ICCN*). The park guards, who were selected almost exclusively from the surrounding communities, are now dispersed in the seven operational surveillance camps that Lukuru established on the park border and within its boundaries.

Maintaining commitments like this with local populations is imperative to the success of Lomami and helps convey the park's immediate value. Having members of local communities work as administrators, researchers, assistants, and porters through Lukuru has certainly added to the enthusiasm and determination of staff on the ground to keep this project going. Without community members' continuous outreach, close connections, and ability to foresee problems and provide local solutions, the plans for this national park would still be far from realization.

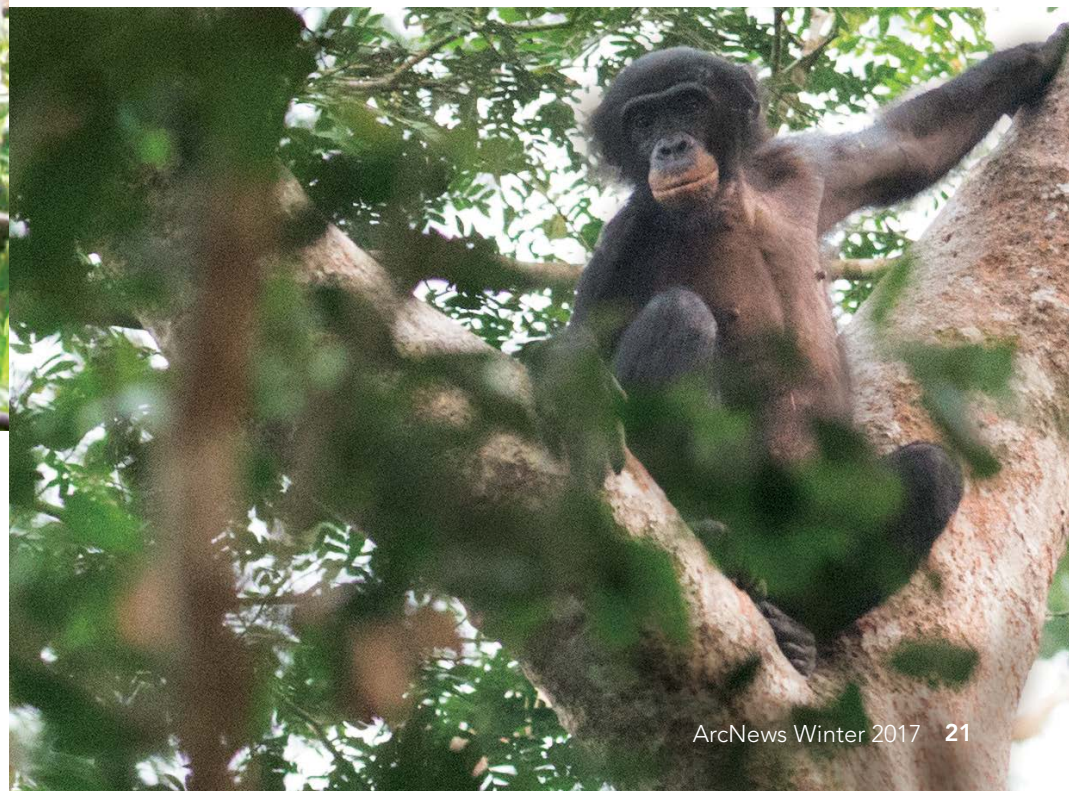
Expanding Technology to Support an Evolving Project

As Lomami National Park continues to develop, so does its GIS. Project partners in both the DRC and Canada are using multiple licenses of ArcGIS Desktop to continue incorporating new field data into the system, refining boundaries and settlement locations, identifying areas of interest, and mapping animal tracks and evidence of hunting activities. Additionally, researchers on the ground are now employing more advanced pieces of software such as ArcGIS Spatial Analyst to do density mapping of wildlife observations. January has developed several story maps as well, including one called *Wildlife Camera Trap Locations* (http://p.ctx.ly/r/3269) that shows Lomami wildlife videos captured by park cameras. And now that field staff are managing most of the on-the-ground GIS for Lomami, TL2 is currently exploring how it can use ArcGIS Online as an innovative education platform through which to reach audiences around the world.

For more information on the TL2 project and Lomami National Park, visit lukuru.org and bonoboincongo.com; email the project's director, Terese Hart, PhD, at teresehart@gmail.com; or contact the Canadian Ape Alliance's Nick January, GISP, at nickjanuary@gmail.com.

↑ Congolese field biologists used GIS to collect field data all over this unexplored wilderness—sometimes having to form human supply chains to get all their materials across rivers.

← Simeon Dino, the program coordinator for Tshopo Province, leads a research team across a savanna in Lomami National Park.



→ It is now known that Lomami is home to several important primates, including populations of the bonobo chimpanzee.

Automating Oil and Gas Field Mapping in Wyoming

By Jim Stafford, Rachel Toner, and Ranie Lynds, Wyoming State Geological Survey

As one of the United States' top oil- and gas-producing states, Wyoming relies heavily on geological data, which needs to be current and organized. The Wyoming State Geological Survey (WSGS)—which promotes the beneficial and environmentally sound use of geologic, mineral, and energy resources—has published regularly updated maps of oil and gas field locations since 1972. This series of maps is popular with industry professionals and local governments, as well as the general public.

Over the last few decades, Wyoming's oil and gas data has moved out of filing cabinets and into digital databases; what used to be presented as lithographic maps has now become interactive with GIS. Yet, even with the transition to digital records and methods, WSGS's veteran geologists were still drawing the state's oil and gas field delineations by hand. As these highly skilled geologists began to retire, however, the organization needed a new way to produce its map series. So WSGS turned to the ArcGIS platform.

Model-Assisted Data Screening

To begin the process of updating the map, WSGS obtains the basic oil and gas well data from state permitting agencies. It then rigorously screens the data and prepares it to be mapped, calculating associated statistics and attributes such as primary production type, the production age of reservoirs, and the total number of wells.

In the past, this process was undocumented, so only those who had authored previous maps knew how to screen and prepare the data. Figuring out why certain wells were assigned to a particular field or excluded from another was difficult—and sometimes impossible.

This time around, however, WSGS used ModelBuilder to put together an extensive, 223-element model diagram that makes any needed corrections to the data before screening, attributing, and aggregating it. The model then identifies wells whose attributes (well status, class, production history, etc.) need to be checked for accuracy.

The information kept in this digital record can be quickly accessed and easily replicated. The diagram has eliminated a considerable amount of human error as well. And it allows WSGS to share its log of data updates with permitting agencies, which not only enhances the agencies' data but also makes it possible to streamline future updates.

Mapping with Models

After screening and preparing the oil and gas well data, the next step is to map it. At the most basic level, this entails clumping together collections of spatially and characteristically similar oil and/or gas wells to create fields. WSGS then relates its fields to the field names that other organizations use to assign permits and track production. Being able to document the spatial extent of the fields is also important for comparing and analyzing geologic patterns, so representing them correctly is important.

Due to their popularity, paper maps of Wyoming's oil and gas fields are still being produced by WSGS. But polygons on paper maps can only express a limited amount of information about each field.

Thanks to the data model, WSGS now has several dozen additional classes of information (such as field status, well type, and drilling direction) about each fossil fuel-producing unit. So this time, the organization also created a map in ArcGIS Online that allows interested users to dig down into a much greater pool of information about each oil and gas field and its associated wells.

The most difficult part of mapping Wyoming's oil and gas fields is automatically generating polygons that accurately represent the data but also resemble the hand-drawn aesthetic of WSGS's time-honored map series. Following extensive testing of the polygon tool parameters, WSGS used ModelBuilder to develop another data model that helps mapmakers emulate the traditional look of the paper maps while also preserving all the data.

This iterative cartographic model, which has 62 elements, uses multiple levels of buffering, aggregation, simplification, smoothing, clipping, and querying to generate an exceptional representation of nearly 1,400 named oil and gas fields in Wyoming—and no manual intervention is necessary. In most cases, the fields look better than in previous map versions that were digitized at a variety of scales. That is because, unlike the old hand-drawn maps that varied—even slightly—depending on who drew them, the model produces the same result each time until the underlying data is updated. Using the model makes the whole process a lot less time-consuming as well.

Streamlining Future Updates

Revamping how WSGS screens its oil and gas data took a few months, and setting up and testing the two models required several more months of work. But now, the organization has all the preliminary data work saved internally in the data models. Thus, the groundwork has been laid for future updates, and the process is now mostly automated.

Unlike before, oil and gas well characteristics that have been checked once won't need to be analyzed each time. And when the map series is updated, only new wells that have been permitted since the previous iteration will need to be examined. This immensely reduces the number of data points that have to be checked.

Previously, the map of Wyoming's oil and gas fields was only updated every three to six years because of how much time the project required. Even after regulators made the basic well data available online and ArcGIS enabled WSGS to accurately map spatial data in a timely manner, it still took two WSGS employees almost a year to update the map because of all the redundant plotting, drawing, scanning, georeferencing, and digitizing they had to do.

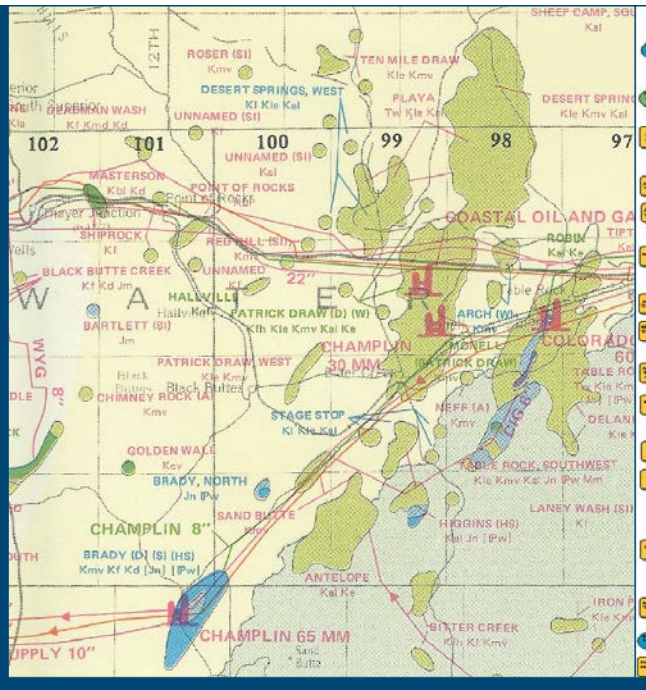
With its new models and digital methods, however, WSGS can now update the oil and gas field map in just a few weeks, which means the map series can be updated every other year. What's more, the map can instantly be uploaded to ArcGIS Online for easy and quick distribution.

"WSGS's ArcGIS Online map allows users to create their own customized experience through the tools provided by the web map," said WSGS director Tom Drean. "Users can view only those layers they are interested in, zoom in to a specific location, search for user-defined datasets, create simple charts, measure distances and/or locations, view more detailed layer attributes, change the basemap, and print a simple screen shot of their map."

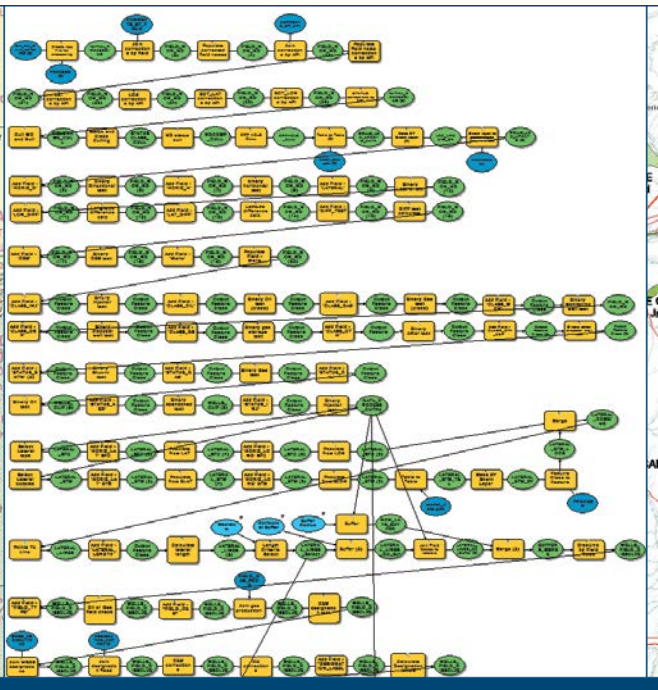
This greatly enhances WSGS's ability to fulfill its mission of advocating the favorable and environmentally conscious use of Wyoming's natural resources, which benefits all the state's residents.

About the Authors

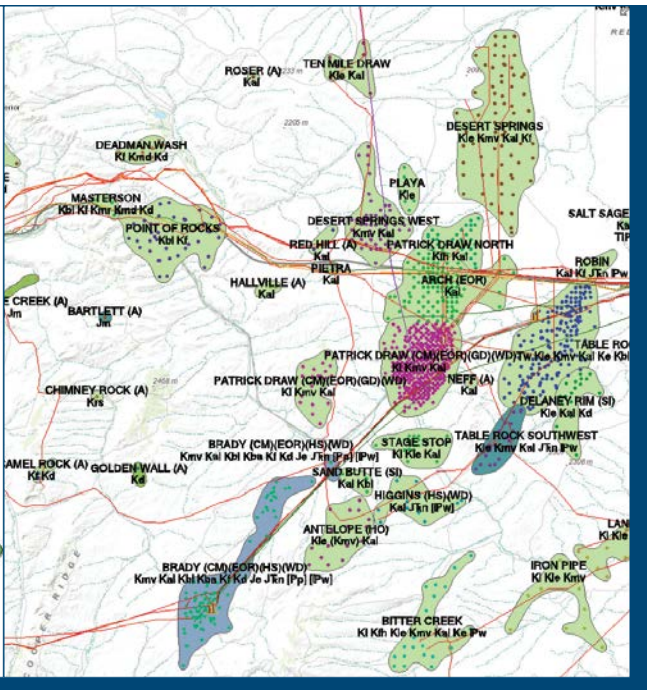
Jim Stafford, GISP, is a natural resource analyst at WSGS, and Rachel Toner and Ranie Lynds are both oil and gas professional geologists there. For more information on this project, email Stafford at james.stafford@wyo.gov or Toner at rachel.toner@wyo.gov. Additional details, including the *Interactive Oil and Gas Map of Wyoming*, can also be found at wsgs.wyo.gov.



↑ The Wyoming State Geological Survey has published maps of Wyoming's oil and gas field locations since 1972. This one is from 1984.



↑ WSGS used ModelBuilder to create two data models that quickly process and draw Wyoming's nearly 1,400 oil and gas fields.



↑ With its new data models, WSGS can update its map of oil and gas fields in just a few weeks, and the map can be uploaded to a web-based interface for easy distribution.

Oakland County Launches ArcGIS Open Data Initiative

Site Boosts Civic Engagement, Economic Growth, and Government Transparency

← Oakland County, Michigan, built the Access Oakland open data portal using ArcGIS Open Data, which is hosted and managed by Esri.

Oakland County, in southeastern Michigan, is making rich information available to the public through its Access Oakland open data portal. The county built the portal—available at accessoakland.oakgov.com—using ArcGIS Open Data, an Esri-hosted and managed solution included with ArcGIS Online.

"We have hundreds of datasets that can become meaningful information in the hands of people," said L. Brooks Patterson, the county executive for Oakland. "When put to good use, these datasets can ultimately improve the quality of life for Oakland County residents. Making these datasets available to the public also improves government transparency."

Oakland County executives say the Access Oakland open data portal increases civic engagement by enabling government agencies, residents, businesses, and other community organizations to share data. Transparency, inherent in the portal, increases trust and improves relationships. Businesses and other organizations can use government data to promote economic development. Citizens can go to Access Oakland to find property information, such as addresses and boundaries, as well as parks, trails, and floodplain locations. The portal also includes ready-to-use apps that help residents find fun places, such as cider mills or campgrounds, and functional locations, such as where to dispose of expired or unneeded prescription medications. People can also explore or download data to use in their own maps and apps.

Interactive maps on the open data site highlight key Oakland County initiatives as well, like Tech248, a program to attract and foster talent at local tech companies, and Medical Main Street, an effort to maximize growth for area health care and life science sectors.

The portal is expected to reduce costs across the county and save the time it typically takes to obtain data. All data on the portal is free of charge and free from use restrictions.

"Oakland County is consistently ranked among the most digitally advanced counties in America because of our innovation in IT," Patterson said. "Open data will enhance the way we serve residents and businesses and improve transparency in government."

The county's GIS mission is to provide a progressive, location-based solution that promotes informed decision-making, improves citizen services, and encourages collaboration across all levels of government. The open data portal is one way the county is working toward that mission.

ArcGIS helps the county maintain a mature GIS composed of more than 350 datasets that, together with other nonspatial data, supply a rich source of information used to perform governmental duties and provide services.

"Making these datasets widely available benefits both the private and public sectors by reducing costs; reducing the time involved in obtaining the data; and providing agencies with the most accurate, up-to-date information for use in their business processes and decision-making," said Phil Bertolini, the Oakland County deputy executive and CIO.

To see how ArcGIS Open Data can improve transparency at your organization, visit esri.com/opendata.

Researching Parcel History in Seconds

County in Minnesota Uses App from ArcGIS Marketplace to Easily Store, Retrieve Property Records

Parcels of land have their own history. When a parcel is subdivided, each new parcel created is assigned its own parcel identification number (PIN) and associated documentation. Often, a parcel is affected by multiple zoning ordinances that have been adopted over the years.

Traditionally, doing research into property abstracts—to find deeds, mortgages, probate records, tax sales, and more—is tedious work. But having these records is critical for making zoning decisions.

Most cities are behind in digitizing their paper land records, so a typical cadastral database rarely contains comprehensive digital archives. This means that uncovering a parcel's ancestry can require conducting long and often inconclusive research in the filing cabinets at the local registrar.

To address this common challenge, Clay County, Minnesota, speeds up parcel investigations and improves the county's property, zoning, and planning decisions by using Parcel Lineage, an app available from ArcGIS Marketplace. The app, developed by Esri partner Pro-West & Associates, displays the entire PIN history for any recorded piece of land.

Parcel Lineage provides parcel information that correlates to historical zoning ordinance dates, meaning that parcels can be analyzed according to historical boundaries to establish which ordinance should be referenced for the request. The same process is applicable to floodplain ordinance adoption that affects historical parcel divisions, as well as to other issues such as billboard and cell tower siting requests.

"Traditionally, Clay County provided the data for abstractors to research property information in person or through a subscription service," said Mark Sloan, the information services director at Clay County. "The Parcel Lineage tool empowers abstractors to do that work themselves by opening the app."

The parcel fabric, a model that Esri introduced in 2010 to simplify parcel editing, makes it easy to track changes to a parcel over time. The parcel fabric is made up of key feature classes including the Parcel History layer, which contains the history of all boundary changes made to a parcel.

"By publishing the full Parcel History layer as a feature service in ArcGIS, that history can be brought into any web map and incorporated into the Pro-West Parcel Lineage app," said Sloan.

Additionally, if a county has older digitized records that exist in document imaging systems (such as Laserfiche), those records can be easily linked and displayed within the app alongside the rest of the history.

Clay County receives requests for building permits and to create new subdivisions all the time. Requesters have high expectations when they visit a county recorder's office to get information.

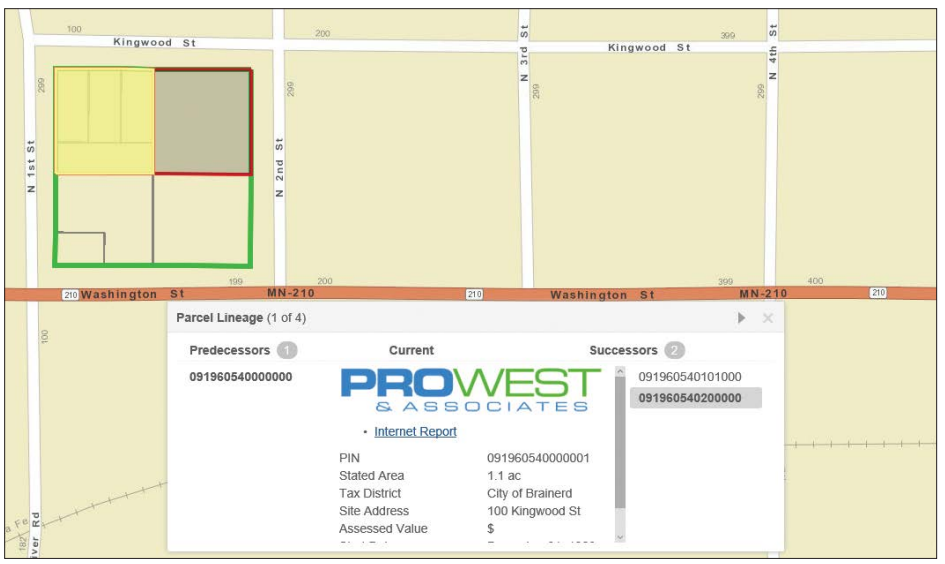
Previously, Clay County's staff had to look through tract indexes, assessors' sketches, old subdivision plats, and deeds to reconstruct any underlying divisions of the property. Staff often had difficulty fulfilling simple document and image requests.

But now Clay County uses Parcel Lineage to find that information. The app has proved valuable in speeding up the county's customer service. Recorders can simply open the app for the requester, search for a PIN, and print out documents and images on the spot.

"Before the app, people who made requests for historical parcel information became frustrated being sent around from department to department to find a simple document," said Sloan. "This app accesses information right away, since all of our real estate documents are indexed by PIN."

Use of the app has been so successful that Pro-West and Clay County foresee greatly expanded use.

"It has huge potential for our land records staff," said Sloan. "Its consistency with the rest of our online mapping applications will let them get started using it and achieving value from it very quickly."



↑ Clay County staff can visually navigate through a parcel's history to research splits, joins, and legal transfers.

Web Maps and Apps Accelerate Disaster Assessment, Recovery

Wisconsin Emergency Management Leveraged ArcGIS Online Following Destructive Floods

By Chris Diller, Wisconsin Department of Military Affairs

Saxon Harbor, on the south shore of Lake Superior, was destroyed by the July 12 floods.

In the early morning hours of July 12, 2016, heavy rains began to fall in northern Wisconsin, with a storm stretching from Douglas County, just northwest of Minneapolis, to Ashland County, south of Lake Superior. Some areas received 8 to 12 inches of rain, which caused flash flooding, and faced strong winds that damaged public infrastructure, including many roads and all-terrain vehicle trails. The Canadian National Railway line between Ashland and Glidden, Wisconsin, had to be closed. Numerous bridges got washed out as well, and Saxon Harbor, along the south shore of Lake Superior, was destroyed.

Even though the storm hit a very rural part of Wisconsin, the impact on local communities was immense. The Bad River Indian Nation in Ashland County took the brunt of it. At one point, there was no road access into the Bad River Reservation, and electricity, natural gas, and the water treatment plant were all knocked offline. The Wisconsin National Guard (WING) had to be called in to assist with lifesaving services at the reservation, mostly to fly dialysis patients to nearby hospitals via helicopter.

GIS played a significant role in supporting the state and local response to this destructive storm. And while GIS has been used to support government operations for nearly 10 years, the State of Wisconsin employed ArcGIS Online in this capacity for the first time. It delivered magnificently.

When Paper Maps Were Prime

Wisconsin Emergency Management (WEM) and WING—both divisions of the Wisconsin Department of Military Affairs—first used GIS prominently during the Midwest floods that inundated Iowa and Wisconsin in 2008. That event caused $500 million in damage to public and individual property in Wisconsin, and 33 counties received federal disaster assistance.

At the time, emergency and relief operations relied heavily on paper mapping products created with ArcGIS Desktop. During the more than two weeks that the State Emergency Operations Center was active, responders used more than 350 custom (paper) mapping products, such as simple incident maps, infrastructure status maps, landing zone maps, reconnaissance planning maps, and map books for the governor.

A lot has changed since 2008.

Testing Out ArcGIS Online

When WEM was introduced to ArcGIS Online a few years ago, the agency immediately began evaluating how the software could be incorporated into its response activities. The GIS team, which started off as one person and expanded to three, spent a lot of time figuring out the types of Esri Story Maps and other apps users might want to see and how they would interact with them.

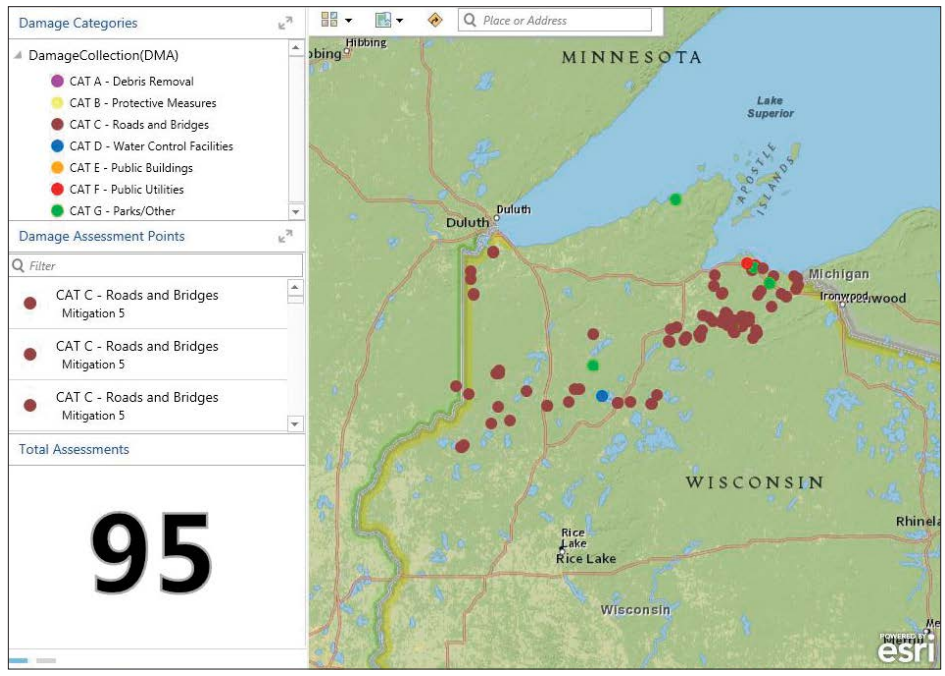
This was a major game changer. With paper maps, the GIS staff only has to decide what goes on the map, which cartographic styles would be the best fit, and what the paper size should be. Incorporating ArcGIS Online, however, required that additional decisions be made regarding user experience, such as which fields should display pop-up windows, what the visibility range for different map scales should be, and which tools users should have available so they can adapt the map to their needs.

With support from senior leaders at the Department of Military Affairs, both WEM and WING decided to test out how to operationalize ArcGIS Online. In June 2016, the two agencies conducted a full-scale, weeklong exercise called Miles Paratus to measure GIS readiness; evaluate the sharing capabilities of ArcGIS Online; test how imagery from the Civil Air Patrol could be integrated into a Story Map Tour app; and evaluate how the WING Joint Operations Center could better manage its resources before, during, and after an event. The exercise comprised 2,500 military and civilian personnel at the federal, state, and local levels to assess interagency coordination and readiness.

The results were impressive. Participants in Miles Paratus provided positive feedback about the story maps, the Civil Air Patrol was excited to see its imagery used in a different way, and GIS staff members in the State Emergency Operations Center were able to learn valuable workflow lessons that would—unknowingly—benefit them greatly a few short weeks later.

A Rapid Response When Disaster Strikes

When the July 12 storm hit and the State Emergency Operations Center was activated, GIS staff were ready. Almost immediately, local counties started asking for assistance, so the GIS team swiftly developed plans to produce web maps and apps using ArcGIS Online—just like it did during Miles Paratus the previous month.



↑ Decision-makers at Wisconsin Emergency Management (WEM) and the Federal Emergency Management Agency (FEMA) used Operations Dashboard for ArcGIS to see the damage cost assessments as they came in from the field.

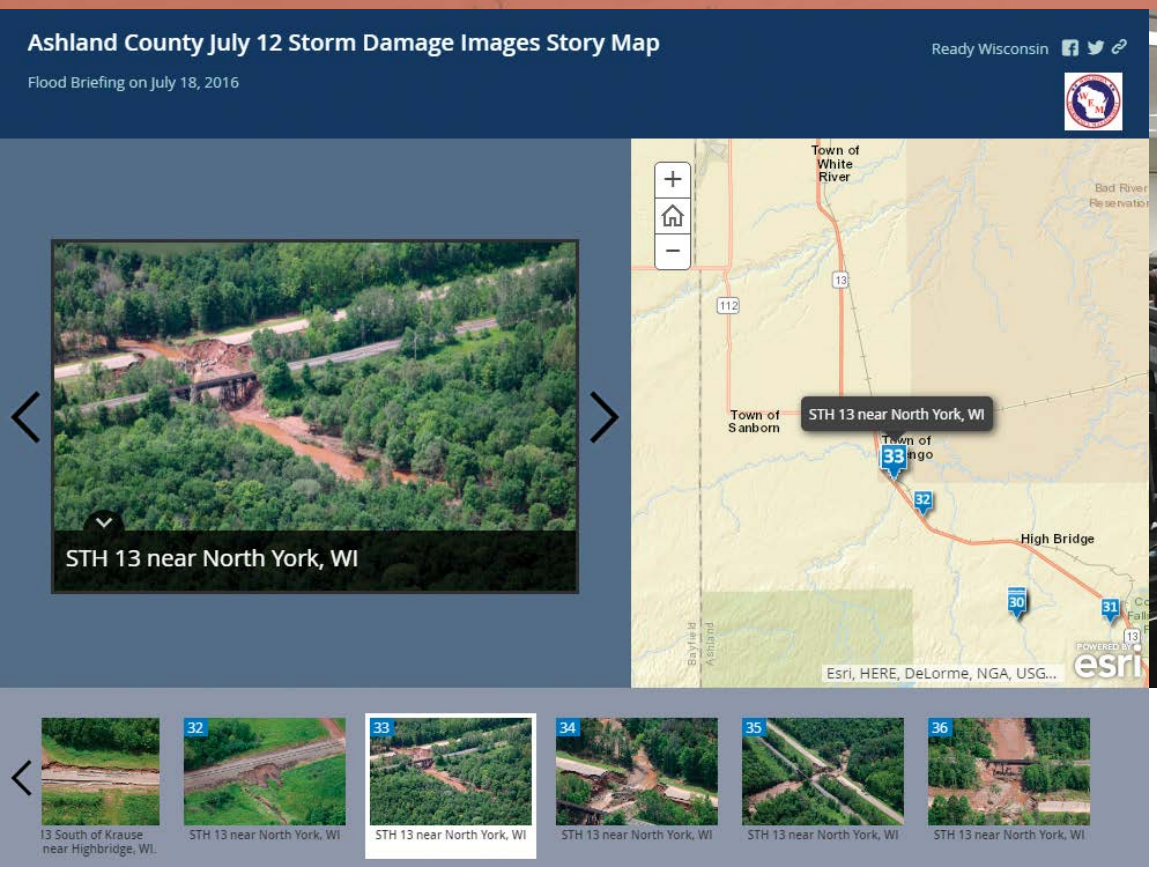
After the storm, the Civil Air Patrol and other air assets deployed to capture 35 mm still aerial photographs of specific points of interest, such as flooded areas and washed out roads and bridges. Once the aircraft landed and the imagery was uploaded to a central repository, GIS staff got to work making the Story Map Tour app. Although it took some time for GIS team members to evaluate each photo for its usefulness, annotate the images, and publish them for consumption, it only took a few short hours to put the story map together.

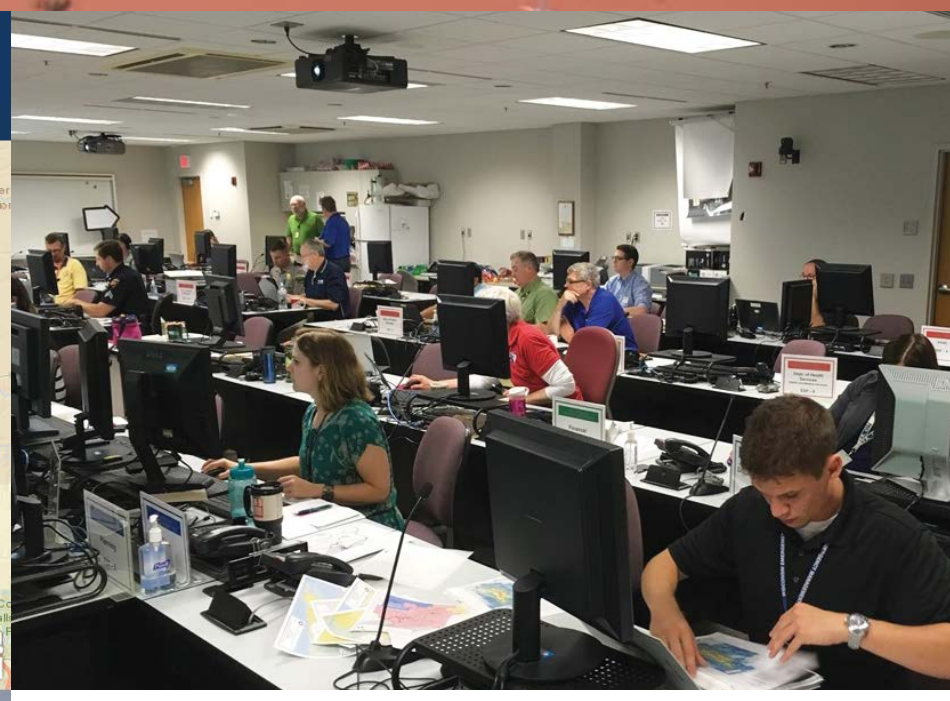
The GIS staff also created an incident viewer in ArcGIS Online as a catchall for data layers. The map included road closures, detours, critical facilities, stream gauging stations, geotagged photos, and the state-of-emergency status for each county. This information was updated hourly and became the principal mapping source that kept decision-makers and the public informed about what had happened and how the situation was changing.

Speeding Up Requests for Assistance

Things were going so well with ArcGIS Online that, not long after the storm, WEM decided to conduct a preliminary damage assessment in the field using Collector for ArcGIS so that the agency could electronically request assistance from the Federal Emergency Management Agency (FEMA), speeding up the process. Having tested out Collector before, members of the GIS team felt confident that they could configure the app quickly and train WEM staff to use it right away.

The GIS team started by downloading the Damage Assessment solution from the ArcGIS for Local Government solutions page. This special configuration of ArcGIS Online and Collector makes it easier to administer damage assessments in the field and determine whether damage costs exceed state or federal declaration thresholds. From there, GIS staff customized the program so that it contained only relevant fields and affected counties. WEM reached out to the Esri Disaster Relief Program as well to get some extra assistance with configuring Collector. And GIS staff set up Operations Dashboard for ArcGIS so decision-makers at WEM and FEMA could see the total damage costs come in as they were being collected. This helped WEM report damages more quickly, saving days—if not weeks—of time.





← Using aerial imagery from the Civil Air Patrol, it took the GIS team only a few hours to build a Story Map Tour app of the flood damage.

↑ When the State Emergency Operations Center was activated for the July 12 storm, GIS staff promptly developed ArcGIS Online maps and apps to help local counties that were asking for assistance.

The whole setup worked so well that Wisconsin governor Scott Walker mentioned GIS and Collector in the letter he sent to then-US president Barack Obama to request federal assistance for disaster recovery, indicating that the technology assisted greatly with the overall response.

Not Completely Out with the Old

While ArcGIS Online was certainly extremely valuable in doing damage assessments and beginning the recovery process after the July floods, GIS staff did still produce static PDF and paper products like in 2008. Emergency Operations Center managers still needed emergency declaration maps; helicopter pilots still needed landing zone maps; and senior leaders, including the governor, still needed political district maps—and they wanted them on paper.

WEM initially wanted to brief the governor in a helicopter using ArcGIS Online, but the Internet connections in those remote areas of the state were questionable. So the GIS team recreated the briefing book that had been put together eight years earlier. It was easier this time, however, because GIS staff were able to print out the map along with many of the images from the Story Map Tour app and place them in the three-ring binder.

In fact, the story map proved to be the most sought-after GIS product during the flood assessment and recovery period. Being able to connect a picture to its location on a map offered context, helping people better understand the size and scope of the disaster. The National Weather Service's Duluth office and Ready Wisconsin both published the Story Map Tour app and the incident viewer on their websites.

Subsequent Disasters Get Expanded GIS

When western Wisconsin experienced a small flooding event in September, the GIS team again used many of the techniques it learned during Miles Paratus and the July disaster.

Currently, the Wisconsin Department of Military Affairs is planning to expand its use of ArcGIS Online and build an ArcGIS Open Data portal. WEM recently began working with the ArcGIS Extension for WebEOC as well to ensure that emergency responders have good access to GIS data. And the WING Joint Operations Center has contracted with Esri's defense team to build out new, customized tools for Web AppBuilder for ArcGIS.

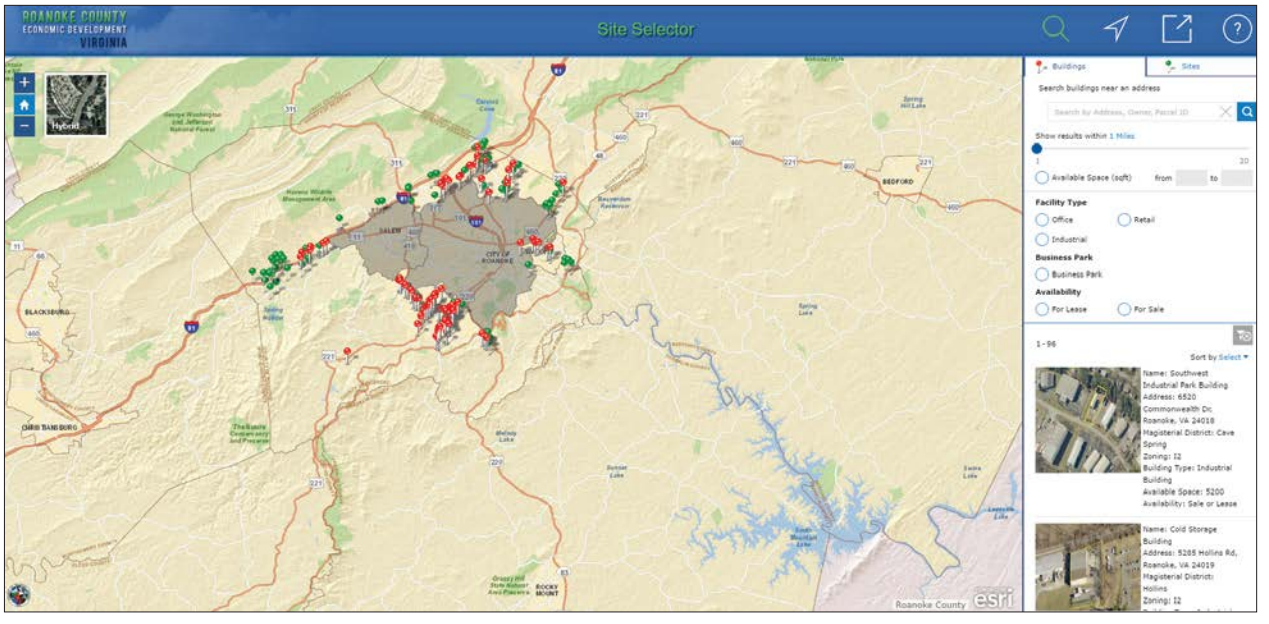
While nobody ever wants disaster to strike, the GIS staff at WEM and WING like knowing that GIS—and especially ArcGIS Online—are key to managing emergencies when they occur.

About the Author

Chris Diller is the GIS coordinator for the State of Wisconsin's Department of Military Affairs.

Esri Partners Introduce GIS to Unique Markets, Circumstances

Esri partners around the world are taking GIS into new and growing markets, spawning entirely new groups of users. Their focused solutions and apps help nonprofits, companies, and governments reduce costs, increase efficiencies, and make data available to staff and citizens on any device.



↑ Roanoke County's Site Selector app, developed by GISinc, helps businesses find available buildings and sites.

Getting County Mapping Apps to Staff, Residents

Roanoke County, Virginia, wanted to better serve its staff and citizens by opening up its GIS data. The county needed to come up with a comprehensive mapping app for its employees, as well as simple, focused mapping apps for residents.

GIS staff at the county worked with **GISinc** (gisinc.com) to create a solution. Using GISinc's OneView, an HTML5/JavaScript app, the team built an online portal that operates as a robust GIS viewer. Through this, county staff members can access Roanoke's rich datasets using sophisticated visualization controls and query tools.

The team also developed business-specific apps such as TaxView, GovView, VoterView, and Site Selector, which let the public search for information about property taxes, government services (like trash pickup schedules), polling locations, and buildings and sites available for businesses. To make these apps easy to use, GISinc customized the search bars to autocomplete based on multiple data fields and feature classes, such as address, parcel ID, owner name, and place-name.

Because of these apps, Roanoke County has saved hundreds of work hours on field data collection. The county can also deliver information more quickly to users, which is improving customer service. The apps have helped save lives as well: emergency personnel have used them to locate hikers stranded on the Appalachian Trail.

The county's new public-facing online portal allows the public to go to one place to find detailed information about county services, which saves people time. Residents can also find what they need 24 hours a day, 7 days a week, on many types of devices.

Roanoke County has seen upshots to this kind of citizen engagement too: the Real Estate Valuation office alone has experienced a 79 percent reduction in calls to the customer service department.

Planning for Storm Water Runoff Using GIS

When Rapid City, South Dakota, needed a new drainage plan, city engineers turned to **Ferber Engineering Company** (ferberengineering.com) to implement the Box Elder Drainage Basin Design Plan (BEDBDP), which aimed to improve how the city controlled storm water runoff in the Box Elder Drainage Basin.

The goal was to help local agencies, engineers, and developers efficiently construct drainage facilities for this large watershed area. To achieve this, the plan focused on sizing the system appropriately during development, which would help the city avoid additional costs to retrofit it later.

↑ Ferber Engineering Company put together story maps to help staff at the City of Rapid City easily access the findings and recommendations from the Box Elder Drainage Basin Design Plan.

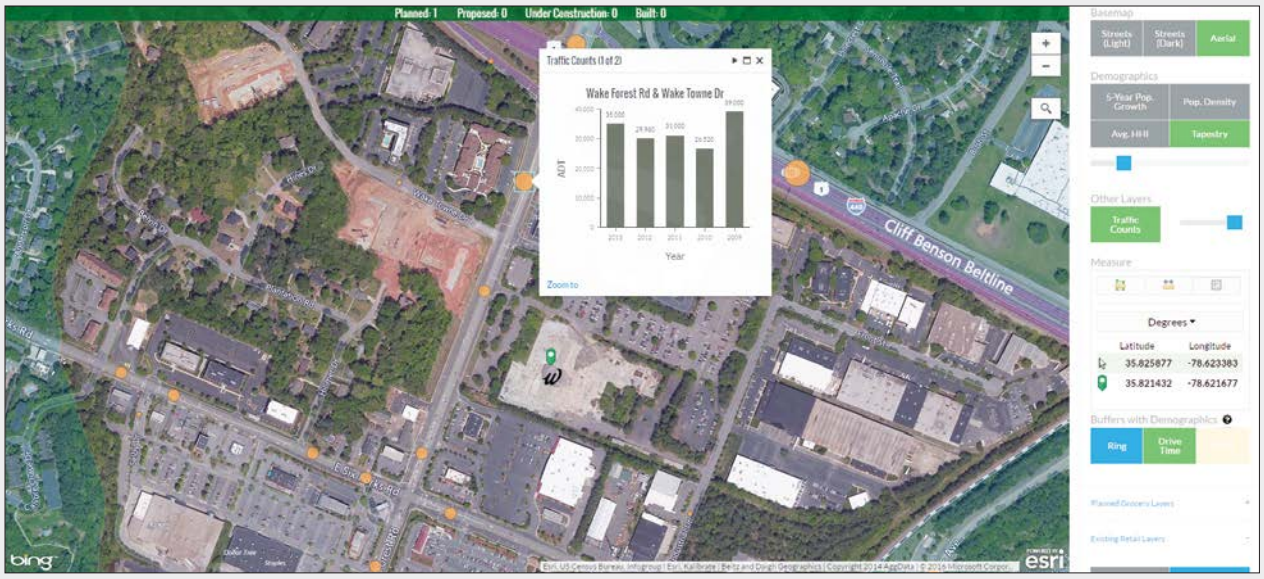
As part of the BEDBDP, Ferber used ArcGIS to help model and analyze major drainage routes that need protection, as well as locations where drainage facilities are needed to adequately manage storm water runoff throughout the basin. The study area covered about 1,200 acres across two cities and counties and contained hundreds of subbasins, conveyance elements (such as streams or pipes), junctions, and retention centers.

Ferber had to be extremely careful when managing the details of each of these elements and analyzing their complex interactions. In ArcGIS, the team employed imagery analysis tools to calculate impervious areas and spatial analysis tools to investigate soils, flow rates, and other factors. Ferber also applied 3D tools to analyze lidar, surface, and elevation data.

Once the modeling and analysis were complete, Ferber used Data Driven Pages in ArcGIS to present summary data for each element of the design plan. It also put together story maps to share the plan and any historical information with users across the city.

The BEDBDP has helped Rapid City more effectively determine where capital improvement projects are needed. And because the city manages the data using a web-based platform, staff can access information digitally on any device, rather than having to bring binders with paper copies into the field.

"Engineers now have everything in their pocket," said Linda Foster, Ferber Engineering's GIS manager.



← Knowing when and where a competitive store will open, and being able to assess traffic counts and basic demographics within certain drive times, helps grocery retailers plan for a new store's impact on sales.

Locating Grocery Store Expansions Across the Nation

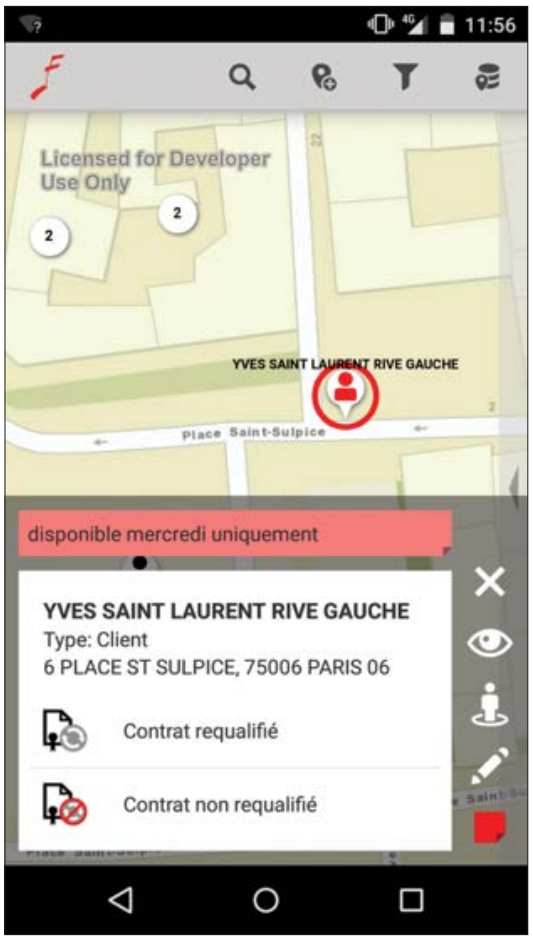
To help retail real estate companies with site selection and market planning, **Beitz and Daigh Geographics** (beitzanddaigh.com) created Planned Grocery, an app that finds and tracks planned locations for new grocery stores across the United States.

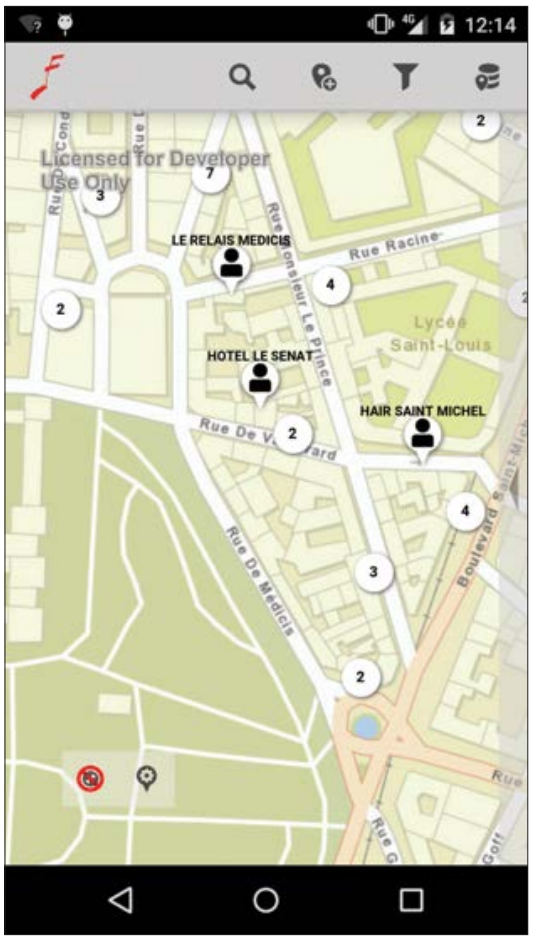
With the app—which runs in ArcGIS Online and is accessible via desktops and mobile devices—users can research grocery store locations that are proposed, planned, or under construction or have been built in the previous six months. The data is provided by another Esri partner, **AggData**, and the app lists the location, status, and square footage for each development, as well as the average daily traffic and demographics of the surrounding areas.

Knowing when and where a competitive store will open—and being able to quickly and easily assess basic demographics within certain drive times—helps grocery retailers retain their existing customers and plan for any new store's impact on sales. That is why companies such as Wegmans, MTN RetailAdvisors, Ram Realty Services, and Lowes Foods have invested in the app.

The corporate office of one leading natural food grocer used Planned Grocery for several months and liked it so much that it offered the app to the company's regional offices. More than half of these offices adopted it within the first month.

Users report that being able to see the locations of planned grocery stores alongside existing ones speeds up their site selection process. In addition, shopping center brokers are using the app to keep clients informed of market activity that may affect acquisition and disposition decisions.





↑ Sector managers can search a map on their smartphones to find client locations. They can also view client contracts with the Société des Auteurs Compositeurs et Editeurs de Musique (SACEM) on their phones.

Mapping Out Royalty Collections in the Music Business

Whenever music is played publicly—at concerts or music festivals, as background music at shopping centers, or in movies and video games—the artists are supposed to receive royalty payments. But all these public performances can be difficult to track.

Société des Auteurs Compositeurs et Editeurs de Musique (SACEM) is a nonprofit in France that helps music creators collect the royalties owed to them when their works are played in public. SACEM negotiates licensing rights and distributes royalty payments to creators.

About 200 employees working from more than 70 locations across France collect general rights payments. These payments make up almost a quarter of SACEM's income. Facing strong growth in digital distribution and the use of background music, SACEM's goal for 2015–2016 was to improve its general rights collection tools so it could better serve society members.

At the end of 2015, SACEM recruited **Sword Group** (sword-group.com) and Esri France to apply GIS to its operations. The nonprofit focused on adopting GIS at three different levels: national planning, campaigns for individual regions or sectors, and real-time updates from the field.

For national planning, Sword used ArcGIS API for JavaScript to build a web app for SACEM. The organization now uses Esri Business Analyst Desktop together with Esri's geocoding tools and segmentation data to define goals at the national level for all the regional teams. Once those teams receive this guidance, they can refine the goals to better suit their specific objectives. They can also establish campaigns that focus on individual sectors, such as hotels.

Employees can then take campaign information into the field using a mobile app that Sword built with ArcGIS Runtime SDK for Android. With the app, users can see the locations of client businesses, as well as geocode locations that haven't been captured yet. They can also view and edit facts about clients, such as the status of their contracts and their hours of operation.

These tools have been widely adopted across SACEM, and users are very satisfied. In particular, the mobile app has helped employees more efficiently collect licensing rights in the field.

GIS Invigorates Innovative Startups

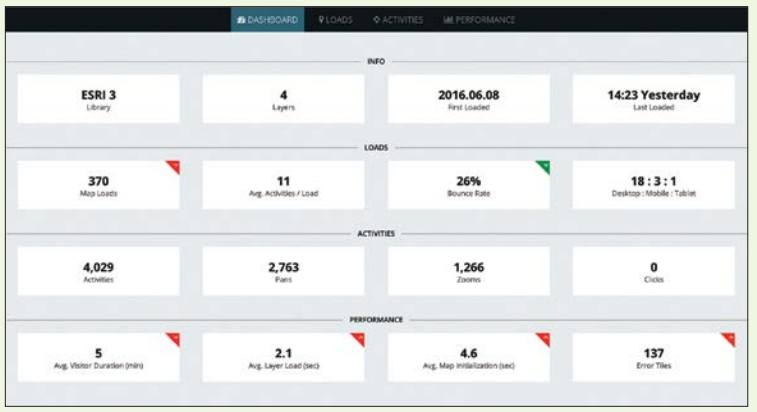
Esri gives promising startups a boost by helping them incorporate location analytics into their services and solutions. With the goal of bringing truly innovative products to market, the Esri Startup Program offers select new businesses access to the ArcGIS platform at no cost. Participants also receive training, support, and marketing opportunities.

Hundreds of startups from around the world are enrolled in the program, including the following three inventive companies.

Analyzing Web Map Movements

Most marketing departments use web analytics to determine how effectively their websites are grabbing and holding readers' attention. Now, **Sparkgeo**'s Maptiks provides businesses with insight about their web maps' activity.

The tool shows how people navigate a web map—zooming in and out, panning, and clicking on or tapping specific features. It calculates the user velocity as well, which measures the speed at which a user views the map and how he or she interacts with it, indicating where a viewer slows down to read the content or speeds up to skip it.



↑ The Maptiks dashboard tracks web map user interactions so the map author can see what interests site visitors.

With this kind of business intelligence, companies can increase the returns on their web investments by building more effective maps.

Consider how this would be useful for a real estate company. Most realty websites include maps locating properties that people might be interested in viewing and, ultimately, purchasing. Maptiks analyses reveal how potential buyers use the mapping app to find neighborhoods that interest them. By tracking readers' navigational habits, real estate professionals can see on which areas of the map people slow down and determine what is catching their attention. Using these indicators, the Realtor can make better inferences about the neighborhoods that interest prospective buyers and then build marketing strategies around that.

Local governments can use Maptiks as well to determine how engaged citizens are in particular topics. That way, governments can gear their open data efforts toward community concerns. For example, if constituents show a lot of interest in a road rehabilitation map—panning and zooming considerably and slowing down when certain content appears—then this topic is likely important to community members and may demand more attention.

Through the Esri Startup Program, Sparkgeo gained access to ready-to-use templates in ArcGIS Online and ArcGIS API for JavaScript, which helped the company build its tool.

"The Startup Program has been a really valuable way for us to engage with the Esri community," noted Sparkgeo CEO and geospatial developer Will Cadell. "Esri provided the right introductions to the right people *[not only]* within Esri, *[but also in]* its partner ecosystem and among its clients."

Discover how Sparkgeo can help you create more effective web maps at sparkgeo.com.

Evaluating Pavement Conditions

Before beginning a citywide transportation project, the City of Newton, Massachusetts, contacted **StreetScan** to help assess road conditions throughout the city.

StreetScan's ScanVan uses a range of sensors—including GPS, microphones, and video cameras—to automatically measure cracks in the pavement. It also has ground-penetrating radar that detects pockets of air and pools of water in the pavement's subsurface layers. The ScanVan gathered information on 276 miles of roadway in Newton.

The startup then used its pavement monitoring system, PAVEMON, to model the data. PAVEMON uses the ScanVan's sensor data, along with traffic and climate information from other sources, to generate road condition maps. It also predicts future pavement conditions and determines what it would cost to fix any problems. PAVEMON then rates the road conditions of every mile on a scale from zero to 100, with zero being the worst and 100 being ideal.

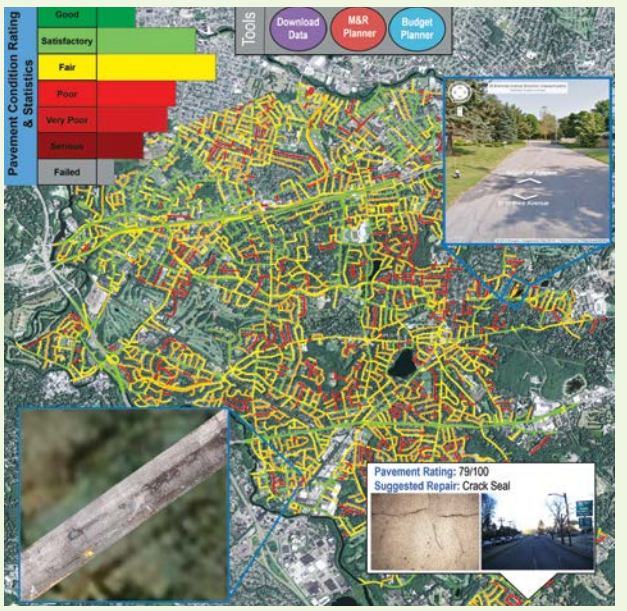
StreetScan reported that Newton's overall pavement condition index (PCI) was 59.3—almost 13 points below what is considered industry standard. Some roads were rated as low as 35.

With this science-based documentation, the city council was able to prioritize a 10-year road improvement strategy.

StreetScan designers used Esri's custom toolboxes, ArcGIS API for JavaScript, and ArcGIS API for Python to build its apps. Additionally, ArcGIS Desktop and ArcGIS Online enable PAVEMON to efficiently combine large amounts of different types of data to produce a comprehensive and georeferenced inspection.

Now, public works departments can figure out the various and specific stresses on asphalt and pavement, which allows them to prioritize needs, plan projects, and develop long-term maintenance strategies.

Get more information about StreetScan's intelligent roadway inspection services at streetscan.com.



↑ StreetScan's pavement monitoring system, PAVEMON, uses the ScanVan's sensor data, along with traffic and climate information, to produce road condition maps.

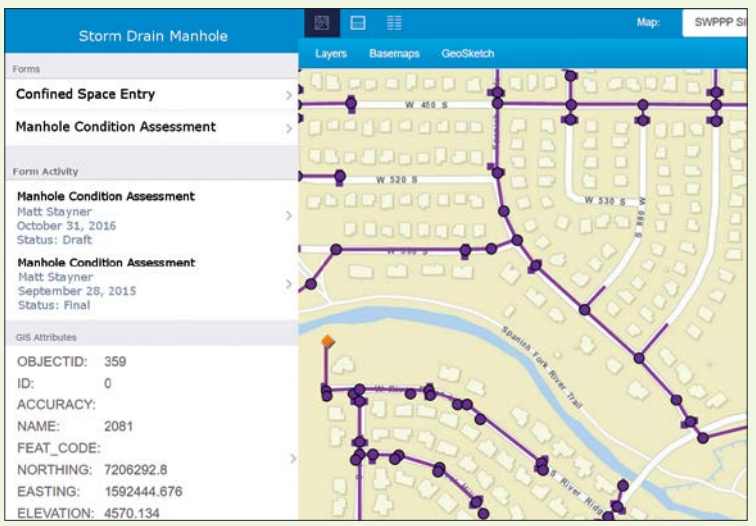
Automating Compliance Documentation

Even if a utility company complies with the Environmental Protection Agency (EPA) regulations enacted by the state in which it operates, that utility might not have enough staff or the proper technology to complete the required inspection documentation.

This was the case for Salt Lake County, Utah, when it didn't have its storm water documentation together for the EPA's inspection. The county was fined $280,000.

In an effort to prevent this from happening again, the county turned to **UtiliSync**, which helps companies manage documents. The startup used ArcGIS API for JavaScript to build a GIS-based solution.

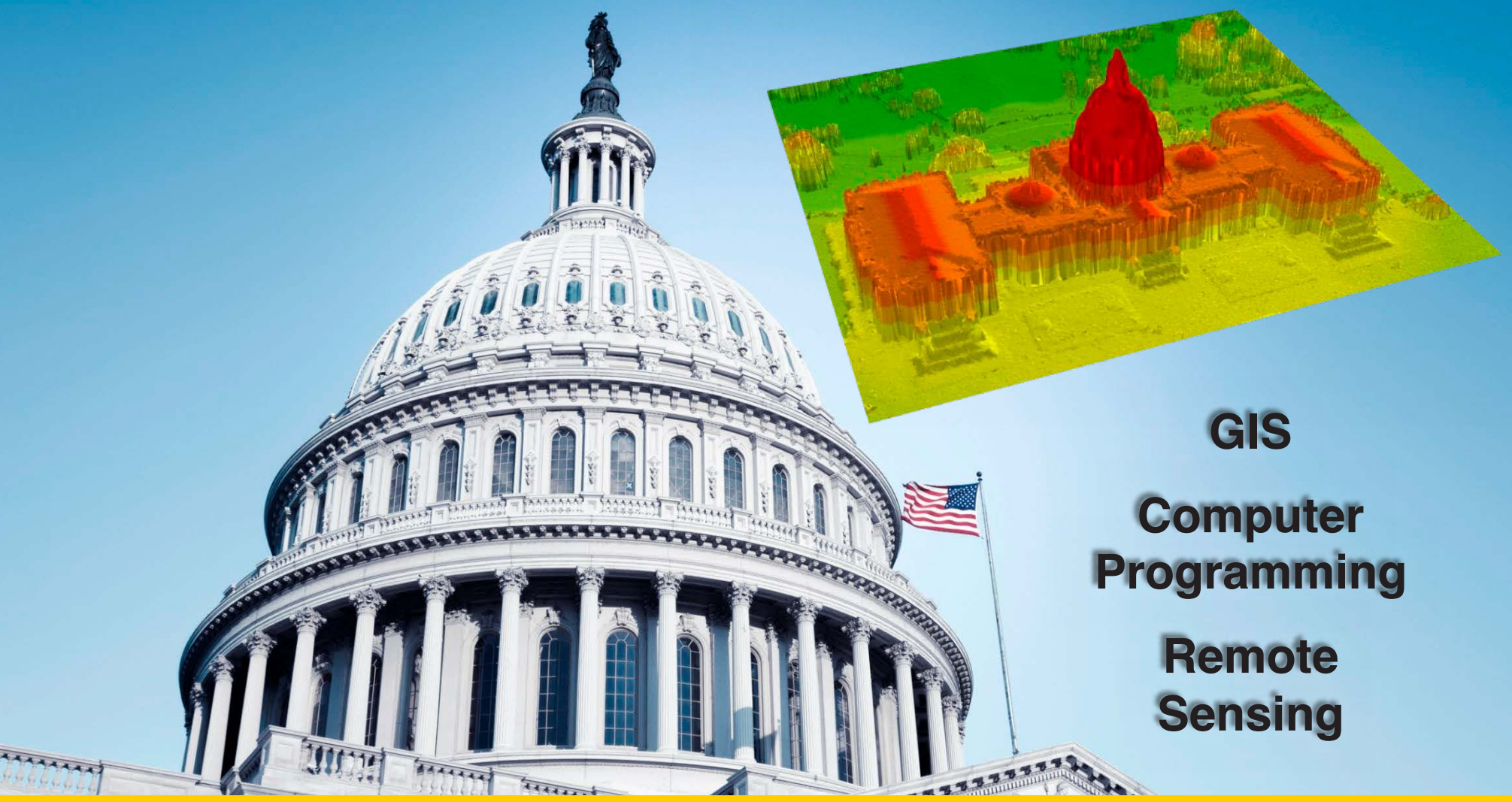
Using UtiliSync on their mobile devices, field crews from Salt Lake County now complete their inspection reports on-site. Because the solution is tightly integrated with ArcGIS, staff members can just tap on a map feature—such as a manhole, water valve, or construction site—and immediately find the correct form for that asset. After the inspection form is completed, UtiliSync automatically generates a PDF report and distributes it to the appropriate parties. It also saves a copy within the program itself for compliance purposes.



↑ Fieldworkers can use UtiliSync on their mobile devices to record inspection data and push it to a cloud-based database where the record can quickly be found during an audit.

Now, Salt Lake County uses UtiliSync to document all its storm water inspections. So the next time the county gets audited, the auditor will be able to open a map, click on a feature, and instantly see the up-to-date inspection documents that verify the utility's compliance with EPA regulations.

To see how UtiliSync improves operational efficiency, view an interactive demonstration at utilisync.com.



Master of Professional Studies in Geospatial Information Sciences

The **MPSGIS Program at the University of Maryland** is dedicated to providing the most up-to-date education on geospatial technology, theory, and applications. The courses cover spatial analysis, statistics, programming, databases, modeling, remote sensing, Web GIS, Mobile GIS, Open Source GIS, and more. Both **MPS degree** (31 Credits) and **Graduate Certificate** (12 Credits) in GIS are offered.

Quick Facts

- All courses are **scheduled in the evenings (5:30 to 8:00pm)** to accommodate working professionals.
- All courses are offered in **traditional classrooms** or GIS labs and **simultaneously broadcast online**.
- Entire lectures (lecture slides, presentations, and Q&A interactions) are **video-archived for reviewing**.
- Our program is one of the ESRI Development Centers.

UNIVERSITY OF MARYLAND 18 56

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Making Spatial Awareness Stick at Miami-Dade County

GIS Hero

↑ Mary Fuentes

When Miami-Dade County, Florida, began using GIS 29 years ago, Mary Fuentes was there.

Fresh out of Florida International University with a degree in computer science, she was hired as one of the county's first programmers. The information technology department had five staff members—two analysts and three programmers—and Fuentes implemented the county's first computerized budget system before she was enlisted to help develop Miami-Dade's GIS from the ground up.

"I did not become interested in GIS; GIS recruited me," she recalled. "I did not know what something like *topology* meant…or *connectivity* or *polygon*. It was brand new."

But she dove right into the project.

"We started to look into the technology and *[analyze]* what would be the best, most economical way to really proliferate *[it]* in the county," she recalled. "We learned how to look at things in a totally different way"—spatially.

With executive support from the get-go, Miami-Dade implemented GIS as an enterprise system straightaway, rolling it out first to the police, fire, and building departments. Fuentes was initially paired with the police department.

"People didn't know where the bulk of the crime existed," she said. "I designed the county's very first crime analysis system in 1988"—becoming the first programmer at Miami-Dade County to implement an app in GIS.

From there, Fuentes was instrumental in getting GIS up and running in the solid waste department. The fledgling GIS team had managerial support to build a routing app for garbage truck drivers, but the mostly male field crews were resistant to the technology. They said they knew their routes and didn't need maps. So Fuentes, still in her 20s at the time, boarded the trucks.

"We got on those garbage trucks, and we helped them," she said. "We saw everything they did. *[…]* When you do their work through their eyes, you start out as a partner."

While the garbage truck drivers knew exactly what they were doing and where they were going, Fuentes and her colleagues focused on the amount of time it took them to complete their jobs.

"What if you could finish two hours earlier?" they proposed.

That stuck. And now Miami-Dade County's solid waste department is a huge user of GIS.

"We've come a very long way," said Fuentes, who is now the director of enterprise GIS at Miami-Dade County. GIS is "in every department, every line of business in the county."

And although Fuentes manages other enterprise systems as well, she says GIS is her favorite.

"It's all about the map!" she exclaimed.

GIS in Everything

Miami-Dade County, which comprises more than 30 cities and around 2.7 million residents, is known as an innovator in GIS.

"I am really proud of the adoption of GIS in Miami-Dade County," said Fuentes. "One of the ways that we have, throughout my career, looked at technology is that we are not users or developers but partners."

With that mind-set, GIS has become fundamental to everything the county government does—from managing public safety, transportation, economic development, and neighborhoods and infrastructure to administering health and human services, recreation and culture, and internal government operations.

"GIS is in everything," said Fuentes. "It's part of the fabric of Miami-Dade County's technology."

And according to several of her colleagues, Fuentes is a chief reason that GIS has been extended so successfully across the county.

"She's a visionary," said Karen Grassi, the GIS technical support manager at Miami-Dade County. "She has a vision, and she goes with it."

"She's one of those persons that has grasped ahold of *[GIS]*, understood it, and…can advertise it, put it out there, meet the higher-ups, and make it understood," said Charlton Lewis, Miami-Dade's IT/GIS manager.

"She's worked very hard—because of her knowledge and passion for GIS—to try and integrate it everywhere," said Patty Madrid, the county's computer services manager. "What I've seen her do is make sure the departments understand that we can give them more than just a map."

GIS is now an integral part of so many systems at Miami-Dade County. For public safety, it was instrumental in building a multijurisdictional 311—reportedly the first in the country—and is entwined with the county's 911 operations. Crime mapping has evolved significantly, and a lot of it is available online. GIS helps police geolocate various kinds of crimes, and the county has created an array of apps, including one for arrest warrants that lets officers easily record where an arrest takes place, where the crime happened, where the offender lives, and where the victim lives. This is a good way to share information with other municipal departments, and it allows the police to see patterns, such as whether people typically commit crimes close to home, in certain neighborhoods, or near particular businesses.

The fire department uses GIS to do things like predictive analysis and maintain fire hydrants, sending work order forms for out-of-service hydrants directly to the water and sewer department so they can get fixed quickly. There's an app called Parks 305 that lets people look for picnic tables in any park in Miami-Dade County. And the popular Artificial Reefs app helps residents and visitors find artificial reefs to explore off the coast.

"We probably have about 1,200 layers that are updated all the time in our central repository," said Fuentes.

But it's not the layers that bring the most value to the county.

"The value that GIS has in Miami-Dade County, as an asset to Miami-Dade County, would never have been realized without *[enterprise GIS]* because part of that value is not one type of layer—it's not a park layer; it's not a parcel layer; it's not a water line," said Fuentes. "All of that works together."

Evolving Citizen Engagement

Just like GIS layers are most valuable when they work together, so, too, is Miami-Dade County when it works with its citizens.

"I think it's really important to engage citizens," said Fuentes.

The county did this over the summer when cases of the Zika virus popped up in and around Miami.

"As soon as this Zika issue started becoming a crisis, she jumped in there and said, 'We can help you,'" said Madrid about Fuentes. "We ended up doing a lot of work for Zika."

Much of that included working with residents.

"We had to make tons of phone calls to let people know that *[their neighborhoods]* were going to get sprayed the next morning," recalled Fuentes.

The county also planned sprays around events. If there was a football game at the local high school, for example, the county would spray before the game.

Fuentes is pleased with her department's citizen engagement strategies and proud of having been "part of something in this county that has touched every citizen." This is also where she sees Miami-Dade's enterprise GIS continuing to grow.

"Citizen engagement through the deployment of more and more and more mobile technology, I think, is the next step," she said. "I want to see everything we do readily available at the tap of a phone…and I think we have all the tools to do that."

A Spatially Aware Metropolis

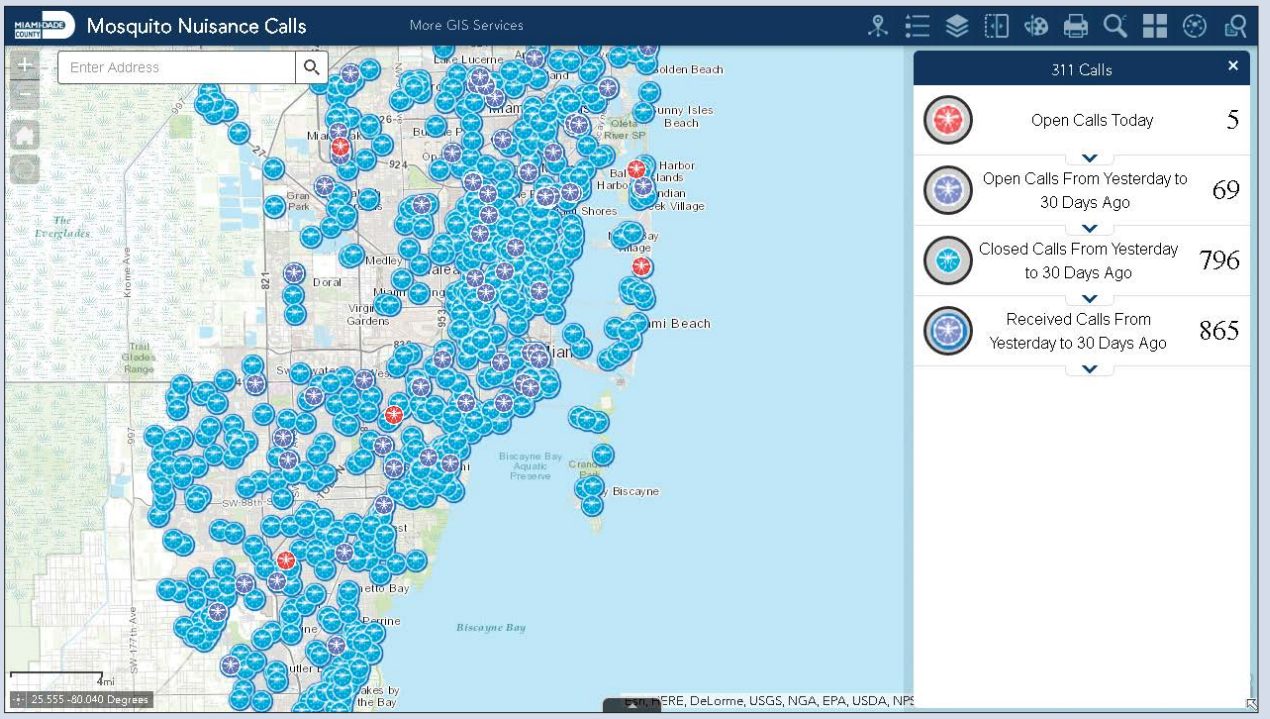
To get this done over the next few years, before she retires, Fuentes will need to continue working closely with her team members—every one of whom she admires.

"They take such pride in their work," she said. "Everybody feels a strong sense of commitment; everybody feels a strong sense of pride; and everybody feels a strong sense of teamwork. They're always looking for what to do next."

She will also need to continue evangelizing GIS to everyone at the county. But that's where she excels.

"She has really shown—from the mayor all the way to the IT staff and end user—how GIS can work for them, what it can do for them, and how GIS can help them get their point across," said Madrid.

"This metropolitan is now spatially aware because of, I would say, 80 percent of what she's done," said Lewis about Fuentes. "Mary has taken GIS from day 1 to day 10,001 and held it together and let it grow to where it needs to be. She's a true leader."



↑ When cases of the Zika virus emerged, Fuentes and the GIS team jumped right in to help Miami-Dade County by mapping spray zones and mosquito-related 311 calls.

Establishing the Relevance of GIS in Your Organization

By Toby Soto, City of Riverside, California

Does your organization seem to lack interest in GIS? Are you frequently left out of discussions about how GIS can play a vital role in a project or system interface? Is your team being asked for GIS assistance midproject? Do you have to keep explaining the purpose of GIS to others in your organization, frequently pointing out that it is more than a cartography tool?

If you answer yes to any of these questions, your GIS program is suffering from lack of relevance. The good news is, you're not alone.

Over a period of four months, I polled GIS managers through LinkedIn and my MuniGovGuy.com email subscription list about their biggest GIS challenges, and lack of relevance ranked high among the responses.

Lack of relevance usually results from having executive management that is uninformed about GIS technology and, therefore, can't explain the merits of GIS to their business peers. GIS can also suffer from a dearth of awareness when the GIS team is ineffective at marketing its services. There's no immunity to this issue, as it can happen to small or large GIS programs. The one-person, multi-hat-wearing GIS organization can get buried in endless mapping requests and never be able to explore new technologies or promote alternative mapping options, while large organizations can be subject to managerial changes and lose GIS champions, reducing the sphere of influence around the technology and ultimately resulting in loss of funding.

To help you revamp the relevance of GIS within your organization, I have come up with a four-step framework that refocuses your vision and makes executive management more conscious of everything you and your team can do.

1. Build a Foundation

It's important to establish a foundation on which to build your GIS program. Setting up guiding principles for your team will help institute organizational trust in the technology and open up opportunities for you to expand your GIS capabilities. I recommend basing your foundation on the following six principles:

- Provide first-rate customer service
- Have open communication both within and outside your team
- Set your team's goals to match departmental objectives
- Develop analytical, collaborative, and creativity skills among your team members
- Provide organizational GIS training
- Learn your organization's business

With a foundation like this in place, that leaves your GIS team open to building its arsenal of GIS techniques and solutions that become invaluable to your organization. So listen to and learn about business processes and workflows, and then, using the business language of your organization, propose how GIS can help. Don't forget to celebrate the small successes, and give credit to your staff for a job well done.

2. Develop a Vision

Show that you have a plan to take your organization from point A to point B. Perform a GIS needs assessment for your entire organization and take the knowledge you gained in building your team's foundation to develop a strategic plan for instituting and maintaining an enterprise GIS. Get the strategic plan approved by executive management and reference it often when determining which projects to work on and to justify the procurement of project resources. Revise and update the plan annually, given that projects get completed and technology changes.

3. Form Dependencies

Using your strategic vision, identify GIS solutions that solve a business problem or impart spatial perspectives to tabular data. The power of spatial analysis and the ability to quickly automate solutions that provide accurate and reproducible results will spawn dependency on GIS technology throughout the organization.

The ultimate dependency, however, comes when GIS interfaces with another enterprise business system such as computer-aided dispatch, a permit system, or an outage management system. This is the surest way to increase your organization's return on investment in GIS. It also ensures continued funding for GIS, since the GIS will need to be maintained to uphold the business system interface.

Thus, always be on the lookout for opportunities to integrate GIS. And be sure that your GIS program can handle the requirements for operating and sustaining any interfaces.

4. Market Your GIS Services

You've worked hard to develop your foundation; you've come up with a strategic vision; and you've built dependencies into your GIS program. Now it's time to put your public relations hat on and market your team's capabilities and successes to your target group—executive management. The following are four proven ways to market your GIS services within an organization:

- **Present at executive meetings:** Build on the momentum of your successes and offer to share a GIS vision update at the next executive meeting.
- **Devise a GIS steering committee:** If one doesn't already exist, create a GIS steering committee with directors and/or managers. Use this opportunity to get in front of the decision makers and provide status updates, demonstrations, strategy ideas, and support, in addition to soliciting feedback. Have a consistent meeting schedule, and book the gatherings far enough in advance to ensure good attendance.
- **Conduct in-house training:** On-site instruction can include how to make and use enterprise GIS apps, general GIS tutorials, and learning basic concepts to spur healthy discussions about where in the organization GIS can have an impact. Reach out to GIS vendors for help in providing a presentation on specific GIS-related topics.
- **Participate in GIS Day:** This event comes around every year on the third Wednesday of November. GIS Day is an opportunity to reach out to everyone in your organization and showcase GIS. You'll be amazed at how many coworkers will say they never knew GIS could do everything it does. In my experience, that single day generates scores of project ideas.

Making GIS Relevant

Increasing awareness of GIS in your organization is imperative for your GIS program and team. Putting in consistent effort to build a foundation, create a vision, construct dependencies, and market your GIS services will move the needle of relevance in the positive direction. And that will engender a successful GIS program.

About the Author

Toby Soto is the GIS manager for the City of Riverside, California. He is also the editor of MuniGovGuy.com, which focuses on GIS strategies and technologies, as well as techniques to advance GIS in local government. Soto has spent 25 years working in IT in local government and is recognized as a leader in his field. He has a proven track record of successful system implementations and GIS integrations that save money, make staff members more efficient, provide additional services to citizens, and open up data for transparency. For more information, email Soto at tsoto@riversideca.gov or find him on Twitter at @munigovguy.

Managing a GIS Program with Built-In Business Intelligence

Florida Department of Transportation Uses ArcGIS Server Log Files to Monitor, Improve GIS Usage

By Claudia Paskauskas and Keith Smith, VHB

↑ The **Department View** in the Analytics Viewing Application, or AVA, shows how each cost center within District Five of the Florida Department of Transportation (FDOT) uses GIS.

At District Five of the Florida Department of Transportation (FDOT), which manages transportation systems in Orlando and other surrounding cities, GIS coordinator Joe Duncan and GIS program services manager Steve Smith wanted to get a better idea of how GIS was being utilized within the organization. Using historical and real-time analytics, they wanted to see which departments were accessing certain data, what services and layers were most used, which apps were making the data requests, and what the daily GIS use looked like.

Tangible metrics like these can inform the allocation of GIS program funds and guide maintenance cycles for data and apps. They can also identify stakeholders that, on one hand, consistently employ GIS or, on the other hand, have not yet experienced its direct benefits.

With ArcGIS for Server (known as ArcGIS Enterprise starting at 10.5), the log files—which record every event that occurs on a server—have all the data needed to perform these analyses. Which is why, when District Five contacted Esri partner VHB to help build a solution, the consulting firm opted for a hybrid system that works directly with the log files while providing a full array of detailed metrics in a user-friendly way.

Building the Hybrid System

From the outset, the project had five goals:

- Identify seasonal peaks for various kinds of data
- Discern users who are not taking advantage of the established GIS program and educate them about its benefits
- Nurture and improve collaboration with active users
- Identify life cycles for apps and data based on usage statistics to support budget planning and schedule data maintenance
- Demonstrate the tangible impacts of GIS for FDOT

To be able to analyze all this, VHB wanted to develop an easy-to-use custom app that allowed FDOT to see quantitatively how services, apps, and layers were being used throughout District Five. This new app—called the Analytics Viewing Application (AVA)—would read the log files from the ArcGIS Server Manager and the Internet Information Services (IIS) for Windows Server (which is what FDOT uses to host its apps) to generate relevant and specialized reports from inside FDOT's firewall, keeping compliant with the department's data privacy policies.

VHB used HTML5, JavaScript, Bootstrap, and SQL database tables to build the new hybrid system, as these technologies were readily available and already in use at District Five. To add complexity to the analytics extracted from the log files, VHB relied on a multiphased process. In each of the three phases, VHB incorporated a new, focused component into the app's analytics and reporting capabilities, such as representing the number of hits a service layer received during a specific time frame or adding metrics to AVA's different components. Additionally, the development team identified high-value information—such as users, layer visualization, and requesting apps—and extracted that from existing fields in the ArcGIS Server Manager.

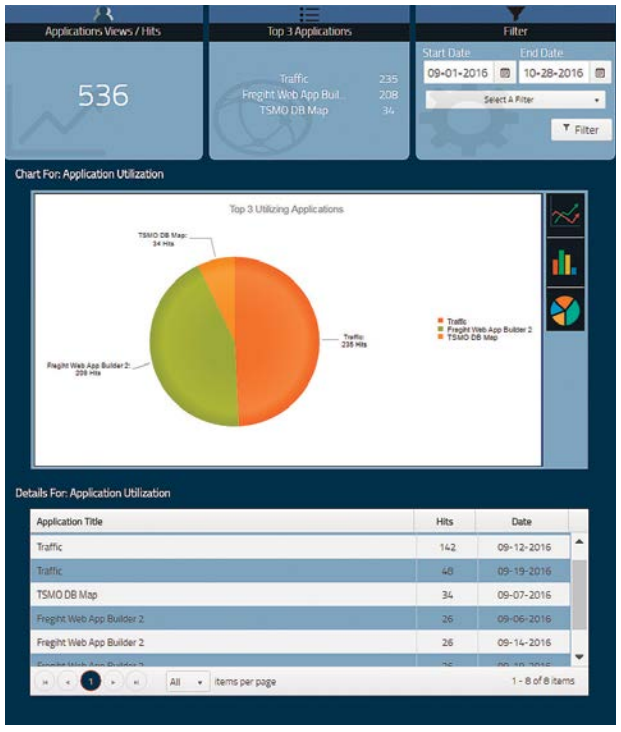
To further understand individual code entries and the source data used to create the app, the development team consulted ArcGIS for Server documentation, Esri documentation for log files, the GIS development community, the ArcGIS for Developers community, and GeoNet. Within a year, VHB and FDOT's District Five refined AVA into a user-friendly app that could visualize GIS usage statistics all the way down to the layer level.

Evaluating How GIS Is Used

AVA, which works with ArcGIS 10.2 for Server and up (including ArcGIS Enterprise), contains four different views: Department, Application, Service, and Layer. Each view cross-references the others, enabling users to comprehensively visualize relationships between each of the reported variables.

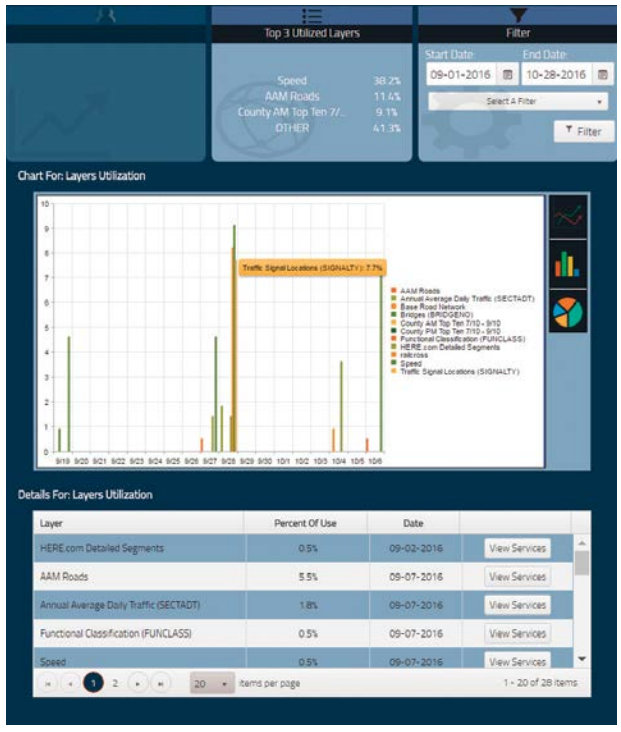
Users can make queries according to a range of dates or specific data categories (department, application, service, or layer). For each of the categories, AVA presents the query results as general counts (for the number of users in a department, as well as the amount of app and service requests) and percentage of use (for layers). Users can also see the top three analytics representing the components of each data category that are engaged with the most.

The metrics are easy to read and interact with, viewable as clean and nontechnical tables and charts. This way, project managers and decision-makers at FDOT can understand the usage rates of apps, services, and data and gain more knowledge about the department's GIS users.



↑ The **Application View** allows AVA users to identify which apps and URLs are requested most or least frequently, which helps when making decisions about upgrades and redesigns.

↑ The metrics in the **Service View** can help identify GIS services that are in high demand so they can be evaluated for caching opportunities.



↑ The greatest level of detail in AVA is provided in the **Layer View**, which lets users see how often specific data and layers are employed in comparison to others.

"It's important to know who your customers are and what information is being utilized," said Smith. "Knowing *[which]* departments are using the system the most allows us to focus our training and outreach efforts in the right place. Also, having statistics on the data being used gives us the opportunity to weed out the old and only support what is being used."

From each perspective, here's how AVA provides in-depth analysis of GIS usage at FDOT:

- **Department View:** Department View shows how each cost center within FDOT uses GIS resources. This can be helpful in identifying which departments are the most extensive users of certain feature classes, datasets, or apps. It can also highlight which departments are lagging in use and need more outreach about GIS. A GIS coordinator could employ this view to determine which apps and data need to be configured in a highly available manner. He or she could also use the Department View to better understand demand for certain types of data and figure out whether particular apps and data are used heavily at specific times of the year to help put together data maintenance schedules.
- **Application View:** This view, which utilizes the IIS logs, allows AVA users to identify which apps and URLs are being requested most or least frequently. It also employs analytics to track usage statistics for individual apps. For example, Duncan can use this metric to determine if an app is seasonal or whether an underused app should be upgraded, redesigned, or phased out. The Application View also sheds light on demand for certain kinds of data and can inform data and app maintenance cycles as well.
- **Service View:** Service View provides direct access to the GIS services in ArcGIS Server that are being turned on within an app. This metric can help GIS coordinators and managers identify GIS services that are in high demand so they can be evaluated for caching opportunities to make them easier and quicker to use. Service View also delivers a detailed list of which layers belong to which services, helping to identify data that should be refreshed and republished during regular data maintenance cycles.
- **Layer View:** The greatest level of detail in AVA is provided in the Layer View, which lets Duncan and Smith see how often specific data and layers are employed in comparison to others. This view also helps identify the services a layer belongs to, which can be beneficial when evaluating maintenance and recycling options during conventional data maintenance cycles. Additionally, by providing an easy-to-access list of all layers and services published within a GIS program, duplicate names that refer to different data can be easily spotted. The Layer View demonstrates how important it is to have comprehensive GIS program standards in place, especially regarding naming conventions.

With these analytics from AVA, Duncan and Smith can evaluate exactly how GIS is being wielded throughout District Five. The metrics help them gauge how important certain apps, services, and layers are to specific departments, guiding efforts to streamline and improve FDOT's overall use of the technology. These details also reveal which cost centers are the greatest users of GIS and which ones need a little more education and coaxing, so the district can channel its GIS funding to the most relevant areas.

Prioritizing Everyday Decisions

With the metrics available on AVA, FDOT leadership now has a tangible record of how valuable GIS is to the organization. Decision-makers at District Five can easily see how each department uses GIS, as well as which types of data and services are used most or least at certain times of the year.

Having data hot spots like this enables Duncan and Smith to prioritize everyday decisions.

"AVA is a tool that *[helps]* us maximize our resources, focus our energy in the right place, and allows us to utilize our GIS to its fullest extent," said Smith.

Organizations that are not taking advantage of the log files that are built into ArcGIS are missing out on a great deal of business intelligence that can inform how to build, maintain, and expand a GIS program. Considering that each GIS program is unique—with distinct departments, different GIS implementations, and particular ways of bringing GIS into play—the solutions offered through VHB's AVA are inexhaustible.

About the Authors

Claudia Paskauskas, GISP, PMP, MCSD, SSGB, is the southeast technology development manager at VHB. Keith Smith, GISP, is a GIS lead at VHB. For more information, contact Paskauskas at cpaskauskas@vhb.com.

Esri Pledges Continued Participation in ConnectED

Company Will Donate Software and Support Teachers Through 2019

A high school teacher is nervous as he enters his fifth-period US history class. His tenth graders are restless and distracted. It's late in the semester, and the last thing they want to think about is today's dry lesson on the Dust Bowl—when a severe four-year drought in the 1930s swept incredible amounts of dirt across the Great Plains of the United States.

Reluctantly, the students turn to the assigned chapter in their 15-year-old textbooks. Then, the teacher makes his move.

He asks the class to look up from their books' faded maps to the whiteboard, where he's projected a map from ArcGIS Online. With growing confidence, the teacher zooms, pans, and toggles map layers on and off to illustrate his narrative. The students watch the map come alive.

The teacher guides his class through the geographic inquiry process. Students ask questions about the population and farming in the affected states at the time. They acquire additional information, such as data about the soil and dust, as well as precipitation trends. They explore and interpret evidence of migration. They analyze the environmental causes of the dust storms. Finally, they reach evidence-based conclusions about the effects of human interactions with the environment.

For most of the 15-minute activity, the students forget to be bored. And in the breakroom after class, the teacher shares with colleagues his newfound, end-of-semester success with GeoInquiries and ArcGIS Online.

This teacher, like many across the United States, heard about Esri and ArcGIS through ConnectED, an initiative launched by then-US president Barack Obama in 2013 to make American schools more technologically savvy. The administration encouraged private technology companies to make in-kind contributions to ConnectED, and in 2014 Esri founder and president Jack Dangermond offered to donate ArcGIS Online to every public, private, and home school in the United States.

Approximately 4,000 schools have activated ArcGIS Online accounts, and Esri receives new requests every day. Users have viewed and downloaded hundreds of thousands of GeoInquiries lessons; attended and conducted a few hundred teacher training events; and volunteered a thousand times over as GeoMentors, helping teachers across the country implement and teach with ArcGIS Online.

After having invested more than $40 million in ConnectED software donations, curriculum solutions, training, and support for K–12 teachers in the United States, Dangermond pledged in September to continue participating in ConnectED through 2019.

This renewed commitment means that teachers and schools can take advantage of software donations and teacher support for years to come. Esri will also create additional GeoInquiry collections and persist in supporting the American Association of Geographers' efforts to recruit GeoMentors and pair them with schools and teachers around the country.

Additionally, Esri pledged in December to offer ArcGIS Online free of charge to 300 primary and secondary schools, as well as vocational institutions, in 10 European Union member states by the end of 2017. Dangermond also announced in October that Esri will launch ConnectED programs for schools in Australia and New Zealand. And talks about establishing similar programs for schools in other countries—supported by Esri's international distributors—are currently under way.

This means that more educators and students around the world will discover the power of GIS and spatial thinking. Also, more teachers will find out about GeoInquiries, concise classroom activities that guide learners through the geographic inquiry process. These free, one-page, Creative Commons-licensed instructional guides include web maps that are accessible even without logging in to ArcGIS Online.

Esri and its educational consultants, along with content producers maps.com, GISetc, and the University of Minnesota, have created GeoInquiry collections for US history, environmental science, earth science, integrated elementary (fourth grade), and advanced-placement (AP) human geography courses. Collections for world history, American literature, mathematics, and more, are in the works.

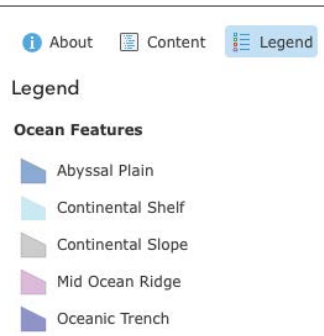
Each collection includes 15 GeoInquiry activities that are expertly aligned with educational standards and widely used textbooks. They are designed to fit into existing lesson plans and take only a few minutes to acquire and master.

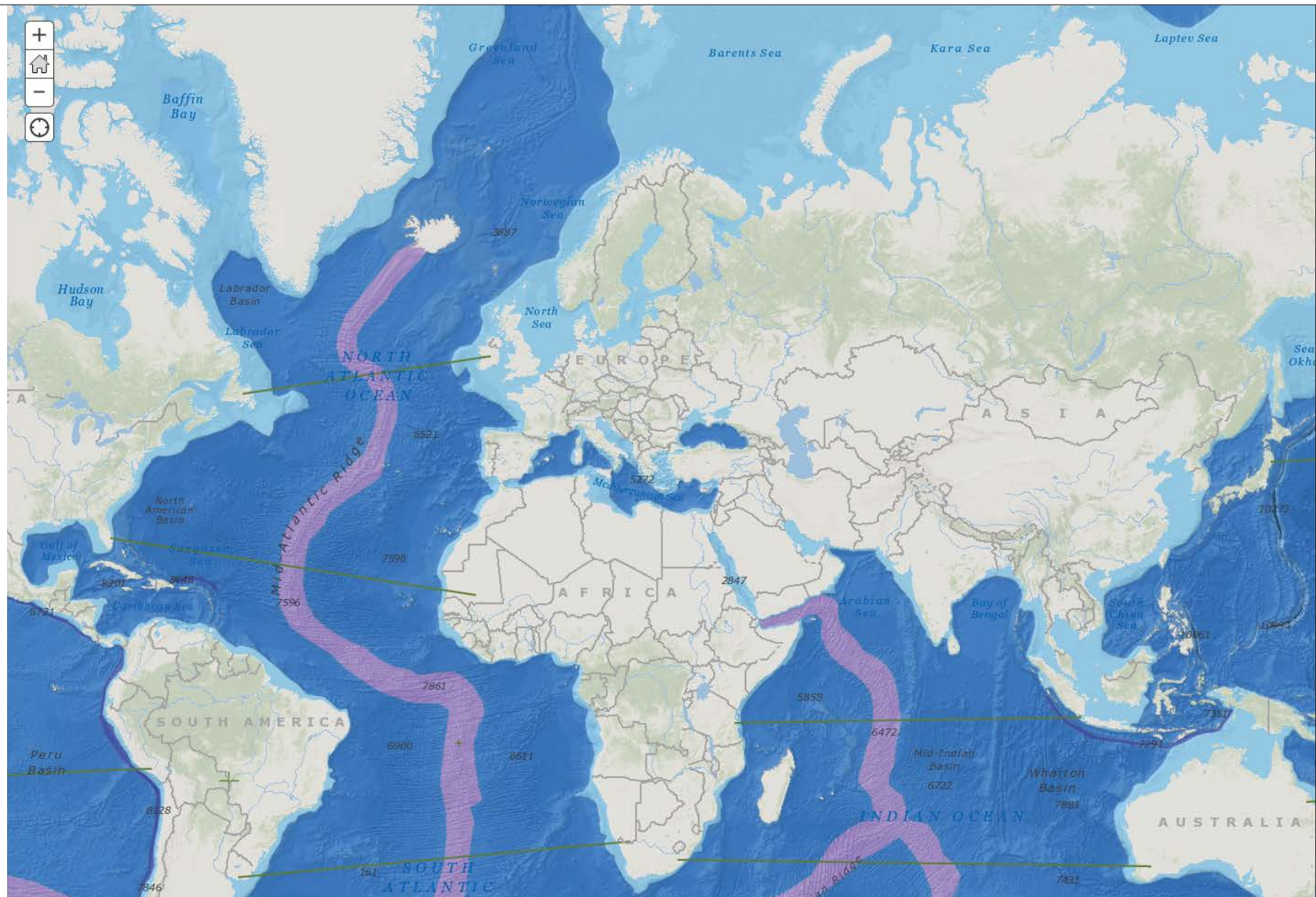
With GeoInquiries, any teacher can be a quick study in GIS.

Meanwhile, back in the breakroom, the history teacher listens to his colleague share how she has been helping her students learn environmental science with GIS for the last 20 years. She talks about how GIS technology supports problem-based learning. She describes the challenges and triumphs of coaching teams of students as they conduct citizen science-based inquiries into social and environmental problems such as pollution, habitat restoration, and environmental justice.

The history teacher quickly realizes that GeoInquiries and ArcGIS Online are a gateway to a wide world of possibilities in teaching and learning from a geographic perspective.

For more information about Esri's ConnectED program, visit esri.com/connected.





→ GeoInquiry collections include materials for integrated elementary, US history, advanced-placement (AP) human geography, earth science, and more. This ocean features activity for earth science, grades 6–9, helps students categorize areas of the ocean and understand their significance.

Breaking Down the Barriers to Geospatial Education

By Robert Kolvoord, James Madison University

Spatial thinking and geospatial technologies are important for today's students for a number of reasons. Many problems have significant spatial components or present themselves spatially. Long-term studies of people who have entered careers in the fields of science, technology, engineering, and mathematics (STEM) have shown that these individuals possess strong spatial thinking and problem-solving skills. And geospatial technologies are a very accessible platform for problem-based learning.

Spatial thinking cuts across K–12 curricula. So shouldn't everyone be doing it? Absolutely. However, because it isn't pegged to a specific area of study, no one discipline is a champion for it. All too often, then, spatial thinking and geospatial technologies don't get brought into the classroom.

Interestingly, though, the world rarely presents problems that are split cleanly into the fields of physics, chemistry, biology, or engineering. The problems we need to solve combine disciplines and very often have a spatial component. So maybe it is time to rethink how we are teaching STEM courses, rather than grafting on different technologies.

At James Madison University (JMU), we have been involved in a variety of projects for more than 20 years to introduce K–12 students to geospatial technology. Many of these initiatives have focused on providing curriculum and professional development for teachers of grades 4–12. Some have involved direct teaching, such as when I was engaged in a coteaching effort with the Department of Defense Dependent Schools in Germany, where I cotaught lessons with teachers to introduce GIS to their students. Through all these efforts, we have focused on partnering with teachers to provide them with what they need to make good things happen with their students.

In 2005, JMU adjunct professor and Esri K–12 trainer Kathryn Keranen and I developed the Geospatial Semester to help high school seniors reclaim their final semester of school. Instead of enduring the doldrums of those last few weeks before graduation, we envisioned students engaging in a project-based class that would help them get ready for the transition to higher education or work. The class is taught by a teacher at the students' high school, and JMU faculty make regular visits to mentor the teacher and the students in the use of geospatial technologies. The high school seniors have an oral midterm and give final presentations to JMU faculty, and they can earn JMU credits for the class.

When the Geospatial Semester started, it was implemented at just four high schools scattered across the state of Virginia. My colleagues and I learned a lot about what K–12 teachers and schools need to innovate. We also discovered how much interest teachers had in geospatial technologies.

Over the years, we've seen some first-rate work. Many students have gone on to get internships and jobs in geospatial fields. Four of them even presented at the Plenary Session of the 2012 Esri User Conference. As a result of the program, we've seen an increase in the number of geographic science majors at JMU—and current enrollment is at an all-time high. Additionally, nearly 3,000 high school seniors have earned JMU credits for the class.

Through the decade-plus of the Geospatial Semester, we have seen hundreds of fascinating projects that employ geospatial technologies and feature spatial thinking. We have watched a number of students with special needs use geospatial technologies to help motivate their STEM learning. And we've seen students alter their career trajectories toward geospatial fields.

Something very interesting is happening with all this. But at the end of the day, all we had were these stories. We had very little hard data to back any of this up.

That is why we put together a project to carefully analyze what is actually going on. Working with psychology professors Adam Green from Georgetown University and David Uttal from Northwestern University, and with funding from the National Science Foundation, we are looking at what happens to Geospatial Semester students' spatial thinking skills from the start of the class through its culmination, comparing any changes in behavior or cognitive skills to similar students who are not taking the course.

To do this, we are administering spatial thinking tests, assessing students' projects, and interviewing them. We are also taking a group of students to Georgetown to undergo testing in an fMRI machine so we can get a sense of changes in their brain function. We believe that this is the first time anyone has looked at functional neuroimaging to assess a K–12 curricular change, so we are very excited to see the results. Should we find that the use of geospatial technologies brings about a positive effect, it could have a dramatic influence on the adoption of these tools in the K–12 setting. At long last, we might have the kind of quantitative data that supports the use of geospatial technologies in primary and secondary schools.

That is not to say that we won't still face hurdles. The two greatest challenges to gaining extensive use of geospatial technologies in K–12 schools are high-stakes testing and an overly dense curriculum. We seem to have lost the forest for the trees in K–12 education, so it is difficult to get teachers' attention. And while there are some very interesting pockets of activity in getting geospatial technologies and education into schools, we have not yet managed to scale them up. The Geospatial Semester was designed so that other universities could adopt it in their service areas. But to date, only Pacific University in Oregon has done the experiment.

We are hopeful, however, that the availability of ArcGIS Online will help motivate teachers to introduce geospatial problem solving earlier in the curriculum and develop demand among students to delve deeper. In fact, Loudoun County schools in Virginia are doing an extended rollout of ArcGIS Online at younger grades, and we are working with them to see how this affects Geospatial Semester enrollment.

What we do know is that kids will flourish with geospatial technology if given the chance. The challenge, then, is to offer those opportunities to students of a variety of ages and work with them to develop their spatial thinking skills. As GIS professionals know, the technology is just the beginning for spatial problem solving.

Helping K–12 education evolve is not an easy task. It requires hard work and perseverance from both inside and outside the system. A combination of student, parent, and industry demand coupled with solid research will start to break down some of the barriers we have encountered so far. We also need to continue to work with universities and their colleges of education to set up the next generation of teachers who will successfully bring geospatial technologies into their classrooms.

About the Author

Robert Kolvoord, PhD, is dean of the College of Integrated Science and Engineering at James Madison University in Harrisonburg, Virginia. He became involved with GIS almost 25 years ago. In 2012, Kolvoord traveled to Ghana as the inaugural instructor in Esri's Education Ambassador Program, which was formed to introduce GIS to secondary students living in developing countries. Together with Kathryn Keranen, he has also authored the Making Spatial Decisions series, which is available from Esri Press.

Crossing Borders

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

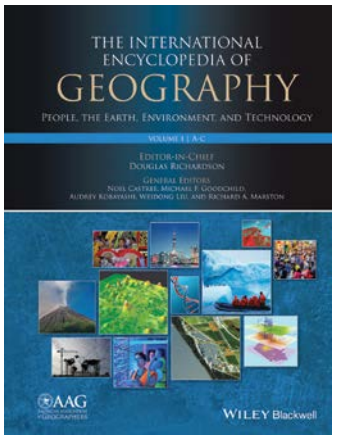
A New International Encyclopedia for Geography

Geography is a rapidly growing, dynamic, and highly relevant field. It provides groundbreaking research and leads the way in developing meaningful apps that address the world's major challenges. Building on its tradition of being an interdisciplinary and integrative science infused with vibrant critical theory and revolutionary technologies, geography increasingly occupies a central place in society. Geographic theories, concepts, methods, tools, and apps now permeate environmental science, the social sciences, health sciences, international studies, and the humanities, generating productive new research and extending knowledge frontiers.

It is in this context that an unprecedented new resource comes into play for the global GIS community: *The International Encyclopedia of Geography: People, the Earth, Environment, and Technology*. This ambitious, 15-volume reference set addresses the concepts, research, and techniques of geography and related fields and is published both in hard copy and online, which allows for continuous updates.

The International Encyclopedia of Geography (*IEG* for short) provides an enormous body of new content and analysis that teachers and professors at all levels can use to educate students in geography and the geosciences, environmental studies, and the social sciences and humanities. It is also an indispensable resource for government ministries, planning agencies, private sector firms, and even society at large, what with the explosive proliferation of new geographic technologies and geospatial information.

The *IEG* is designed to address a global audience. It contains accessible introductions to basic concepts, as well as sophisticated coverage of complex and rapidly changing new topics. To furnish cutting-edge analyses and discussions written in an accessible style, the editorial team took considerable care to create an appropriate taxonomy of entries penned by fitting contributors. In addition to the entries themselves, the encyclopedia includes a lexicon by subject, an index, and an appendix of geographic associations worldwide.



↑ *The International Encyclopedia of Geography: People, the Earth, Environment, and Technology* consists of 15 volumes and more than 1,000 detailed entries about the concepts, research, and techniques of geography and other related fields.

In 8,000 pages, the 15 volumes that constitute the encyclopedia consist of more than 1,000 detailed entries, complete with illustrations, graphs, charts, and color photographs. An international editorial team verified the entries' high quality by ensuring that they are relevant, accurate, and consistent. At least three peer reviewers assessed each entry to assure that it conforms to well-established standards of scholarly publication and clearly and adequately presents state-of-the-art coverage of the subject matter.

The online version includes advanced search functions and links extensively to related entries and other supporting information available on the Internet. It also has easily accessible foreign language autotranslation functions.

Another distinguishing aspect of this encyclopedia is that it has the institutional support of the American Association of Geographers (AAG) and other major geographic associations from around the world. This backing will ensure that the *IEG* is updated on an ongoing basis and has the potential to persist in being the authoritative reference for the fields of geography and GIScience for decades to come.

To inform the overall project and ensure that the encyclopedia provides balanced and comprehensive coverage, the AAG selected an experienced and distinguished editorial team to help develop topical entries that knit together geographic and GIScience research. The core editorial team consists of myself as editor in chief and five outstanding general editors: Michael Goodchild of the University of California, Santa Barbara, who is responsible for GIScience and technology in the encyclopedia; Audrey Kobayashi from Canada's Queen's University, who handles human geography; Weidong Liu from the Institute of Geographical Sciences and Natural Resources Research at the Chinese Academy of Sciences in Beijing, who edits the economic geography and regional development sections; Noel Castree, a professor of geography at Australia's University of Wollongong, who deals with articles about human-nature interactions; and Dick Marston, a professor emeritus from Kansas State University, who takes charge of the physical geography sections. They all have broad networks of contacts in their fields, as well as editorial experience with leading journals and other publications. Additionally, this core editorial team worked closely with 34 section editors, each a leading subject matter expert in a relevant subfield.

This six-year project, initiated by the AAG and publishing company Wiley-Blackwell in 2010, has engaged geographers, GIScientists, and geographic societies around the globe. The encyclopedia's editors and authors reflect the interdisciplinary and international nature of geography's scholarly and research activities. The sheer scale of this undertaking—both in terms of the encyclopedia's depth and breadth of coverage, as well as its international scope—has not, to our knowledge, been attempted before in the contemporary discipline of geography.

The project has also involved reaching out to, listening to, and working globally with thousands of geographers, editors, authors, educators, and reviewers. Significantly, one of my reasons for undertaking this daunting venture was the opportunity to engage with and build international collaboration around a major project for geography's future. As former AAG president Ken Foote pointed out, the *IEG* not only "will be an influential work for years to come but also represents an important community-building project within the discipline, both nationally and internationally."

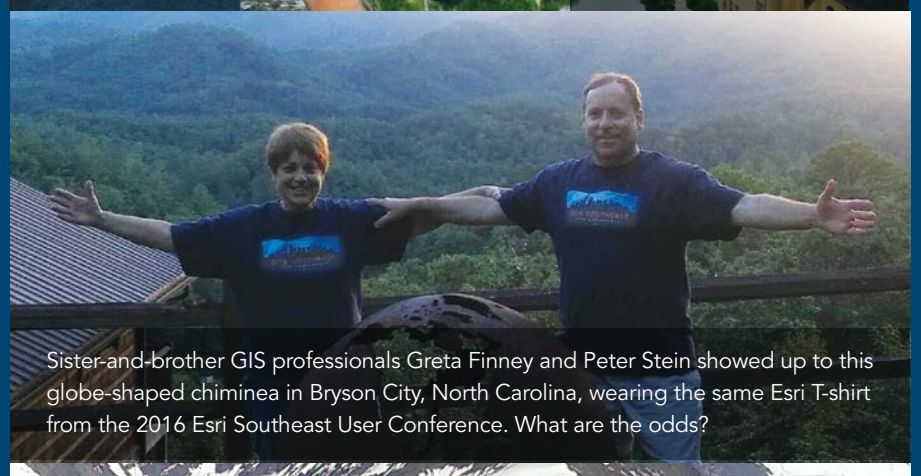
That is, in part, why this first edition of the *IEG* includes distinguished editors and authors from 45 different countries. And as we move forward with regularly updating key entries, we encourage suggestions (of others or yourself) for candidates to fulfill editorial and authoring roles.

I am deeply grateful for everyone who has participated in creating this remarkable *International Encyclopedia of Geography*, which I hope will play a role in contributing to greater understanding of—and in—our world.

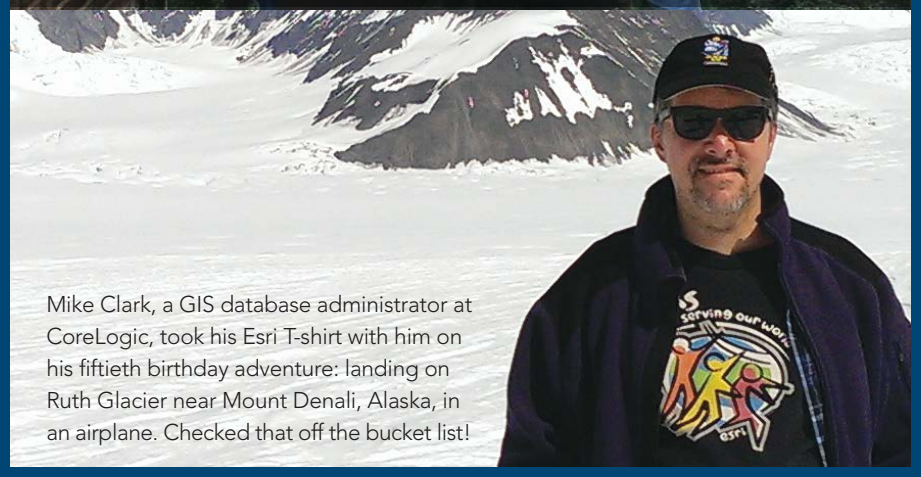
For more information or to order a copy of the new *IEG*, visit geographyencyclopedia.com. Contact Richardson at drichardson@aag.org.

Esri T-shirts Make Their Way Around the World

Dan Seidensticker, a GIS specialist for the Madison Area Transportation Planning Board in Madison, Wisconsin, wore his Esri T-shirt to Luxembourg City, Luxembourg, where he saw the Bock Casemates (in the background), part of a tenth-century fortress built into the cliffs.



Sister-and-brother GIS professionals Greta Finney and Peter Stein showed up to this globe-shaped chiminea in Bryson City, North Carolina, wearing the same Esri T-shirt from the 2016 Esri Southeast User Conference. What are the odds?



Mike Clark, a GIS database administrator at CoreLogic, took his Esri T-shirt with him on his fiftieth birthday adventure: landing on Ruth Glacier near Mount Denali, Alaska, in an airplane. Checked that off the bucket list!

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.

- **Putting ArcGIS to Use Across Your Organization**
  This course is a comprehensive introduction to the ArcGIS platform, preparing users to take full advantage of its capabilities. Through exercises, learners get to map, perform analysis, do field data collection, manage field operations, and build apps. Such in-depth exposure to ArcGIS lets participants experience how organizations apply location-based insight to address common business challenges, streamline operations, and improve decision-making.
- **Configuring Web Apps Using Web AppBuilder for ArcGIS**
  Learn how to easily create intuitive, focused web apps without writing any code. In this course, users discover how to employ existing web maps, themes, and widgets to build apps that deliver the desired functionality, are accessible on desktops and mobile devices, and feature any organization's branding.
- **Introduction to Web Development Using ArcGIS API for JavaScript**
  This course is for GIS analysts and technical leads who want to create custom web apps that feature ArcGIS content and capabilities. Work with ArcGIS API 4.0 for JavaScript to create apps that incorporate 2D web maps, 3D web scenes, and different types of GIS layers.

View all instructor-led courses at esri.com/coursecatalog.

- **E-Learning Spotlight: Videos**
  The Training website provides easy access to dozens of educational videos, including technical sessions presented at the Esri User Conference and other events. This video collection covers a wide range of topics and is a great resource for developers, GIS professionals, managers, and anyone who wants to better understand ArcGIS capabilities and workflows.

To view all available videos and explore the entire e-Learning collection, go to esri.com/coursecatalog.

Certification

Discover Esri Technical Certifications (arcg.is/2fKvnwi) is a free 30-minute training seminar packed with essential information for those planning to pursue an Esri Technical Certification. Program coordinator Tracy Lynn shares how the available certifications support distinct professional development goals; where to find exam preparation resources; and how Esri Technical Certification benefits recent graduates, established GIS professionals, and career pivoters of all persuasions.

Candidates who are ready to schedule an exam appointment may visit the Pearson VUE website (pearsonvue.com/esri) to select their preferred date and location. Pearson VUE operates more than 5,000 test centers worldwide.

To learn more about Esri Technical Certification exams, visit esri.com/certification. Join the Esri Technical Certification group on LinkedIn to connect with other professionals and discuss all things certification.

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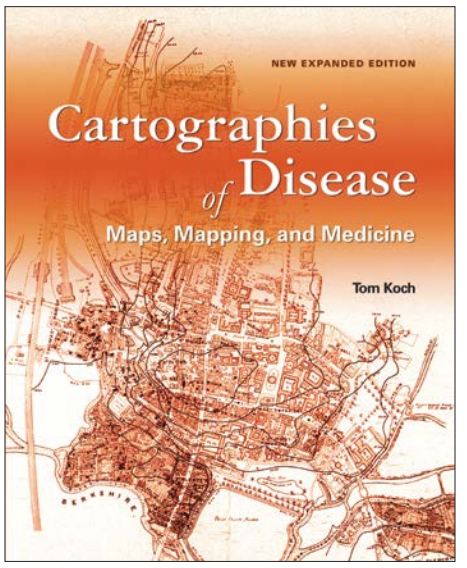
Esri Press

Cartographies of Disease: Maps, Mapping, and Medicine, new expanded edition

By Tom Koch



Cartographies of Disease: Maps, Mapping, and Medicine, new expanded edition, is a comprehensive survey of mapping technology and its relationship to the battle against disease. With minor updates to the original text and two new chapters, the book advances the argument that maps are not merely representations of spatial realities but are a way of thinking about the relationships between viral and bacterial communities, human hosts, and the environments in which diseases flourish. *Cartographies of Disease* traces the history of medical mapping from its growth in the nineteenth century, during a period of trade and immigration, to its renaissance in the 1990s, when a new era of globalization transpired. It pulls from historic maps, including the plague maps of the 1600s and John Snow's famous cholera maps of London from the mid-nineteenth century, while addressing current issues concerning the ability of GIS to track diseases worldwide. The new Chapter 13 attempts to understand how the hundreds of maps of Ebola revealed not simply disease incidence but also the way in which the epidemic itself was perceived. Chapter 14 continues that discussion by looking at the spatiality of the disease and the means by which different cartographic approaches may affect how infectious outbreaks like Ebola can be confronted and contained. January 2017, 528 pp. E-book ISBN: 9781589484764 and paperback ISBN: 9781589484672.

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QA Engineer—ArcGIS Enterprise: Design and build the next generation of ArcGIS Enterprise software. Develop, analyze, test, document, and support new releases to identify workflow enhancements and boost overall product quality.

Software Developer—JavaScript/HTML5 Web Applications: Use your creative design and development skills to build innovative and powerful web apps and user interface (UI) modules for large-scale deployment and management.

Scrum Master: Join Esri's ArcGIS Runtime SDK team and help product owners define user stories, disable roadblocks, and motivate the team to get to the next level.

Story Map Developer: Design and develop focused, storytelling web apps and lead a team of developers to support overall content.

Map Layout Product Engineer: Do you love maps, cartography, and desktop publishing? Help define and build the page layout and map book functionality in ArcGIS Pro and ArcMap.

Product Management

Product Manager—Imagery: Be the in-house expert on Esri's imagery offerings, guiding the development of new ArcGIS functionality and extending its reach into new markets.

Professional Services and Consulting

Systems Design Analyst: Employ your technical knowledge and superb customer service skills to consult with users and support their enterprise GIS objectives.

Solution Architect: As an experienced consultant with knowledge of IT frameworks, translate business, operational, and technical requirements into guidelines and specifications that support ArcGIS-based enterprise solutions.

Platform Configuration Engineer: Work closely with customers and Esri partners to identify, design, and certify key GIS workflows for the ArcGIS platform.

Educational Services and Technical Support

Sales Consultant—Training Solutions: Proactively seek out training opportunities from part of Esri's existing customer base by consulting with federal defense and intelligence agencies to clearly understand their needs.

Training Sales Specialist: Leverage your consultative sales experience to enable Esri's state and local government users to fully take advantage of ArcGIS.

Instructor—GIS: Teach Esri software classes in traditional and online instructor-led courses to help customers stay on the leading edge of GIS technology.

Support Analysts: Draw from your extensive GIS knowledge base and collaborate with other team members to help ensure that customers successfully use Esri products to improve their workflows and achieve their organizational goals.

Business Development

Sales Manager—Manufacturing or SMB Utilities: Lead, develop, and engage sales activities that ensure the attainment of sales goals and company growth.

Account Manager—Manufacturing, Retail, or Local Government: Work with an account team to encourage organizations to adopt and use the ArcGIS platform.

Presales and Solution Engineering

Solution Engineer—Manufacturing or Retail: As a problem solver and natural evangelist, define and deliver strategies to address users' business challenges and clarify how GIS brings value to a company.

Marketing

Regional Marketing Specialist—Europe: Draw on your excellent communication skills, creativity, and understanding of marketing principles to support Esri's growth in international markets.

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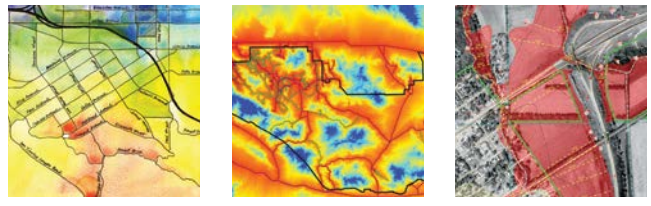

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