Summer 2018

ArcUser

The Magazine for Esri Software Users

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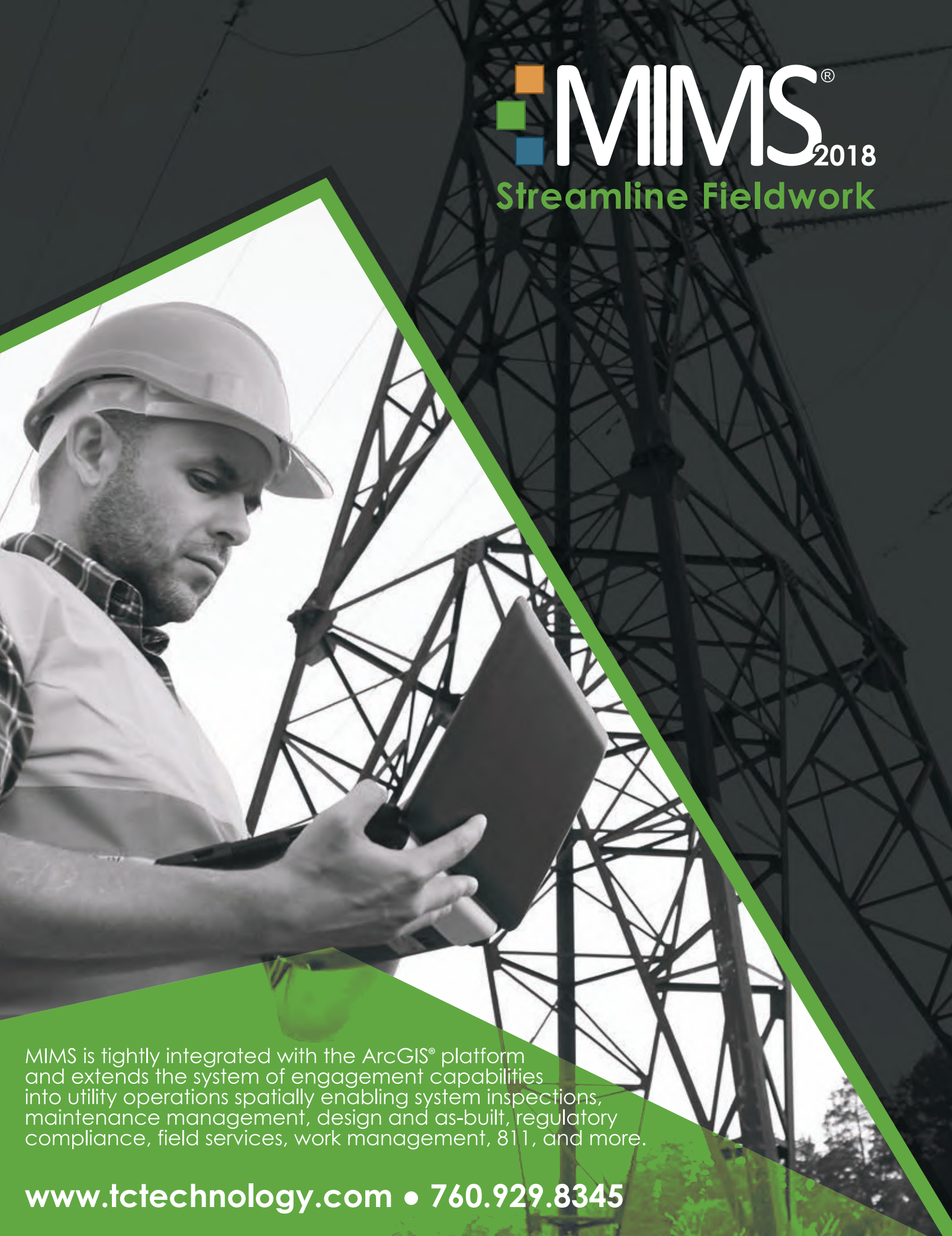
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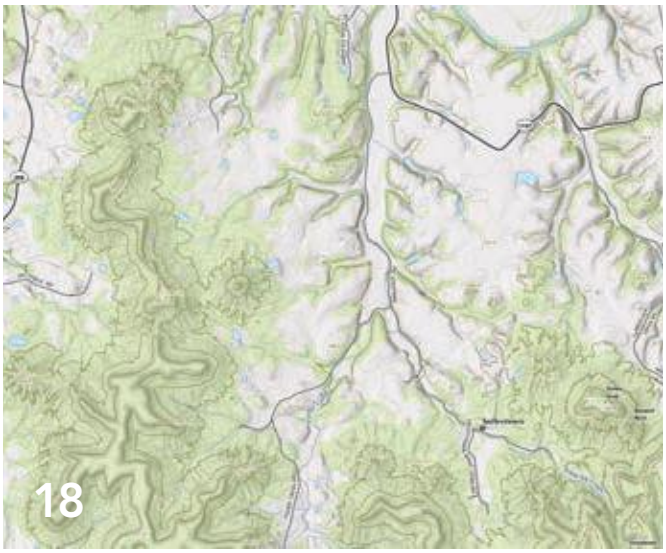

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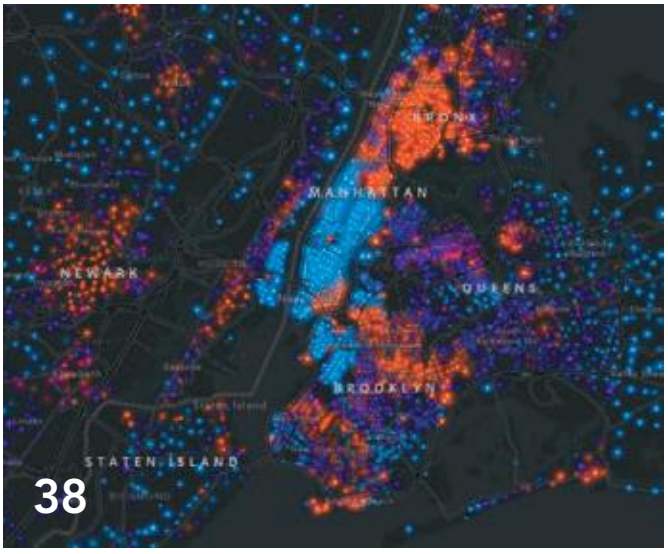

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Pervasive GIS Is What's Next

Making location intelligence more universally available—a promise made just six short years ago at the Esri User Conference—is being realized through the widespread adoption of Web GIS. The Web GIS pattern leverages web services that make exponentially growing data streams readily accessible for visualization and analysis.

By empowering non-GIS staff, Web GIS enables both GIS professionals and non-GIS knowledge workers in organizations to get more meaningful work done. It relieves GIS professionals from previous roles as data gatekeepers and on-call mapmakers so they can engage in analytical activities that provide greater value to their organizations.

The power of data integration and computational geography can be available to everyone in the organization. Through converting massive amounts of data into actionable information, web maps are becoming a kind of language that supports problem solving.

Using apps, this work can be shared and taken everywhere: referenced and updated in the field, presented in the boardroom, and disseminated on the web. The Web GIS pattern brings together web maps, web apps, hubs, location analytics, and other technologies that improve understanding, collaboration, and communication.

Since their introduction six years ago, Esri Story Maps apps have become a communication medium that is used to tell the stories of individuals, organizations, communities, events, and processes. The more than 600,000 story maps that have been published have been viewed millions of times.

The Special Section in this issue highlights how story maps are used to promote the unique characteristics of communities, present city council agenda items in context, and share the significance and beauty of collections maintained by the Library of Congress.

With Web GIS, location intelligence is easier to apply and more accessible so society can truly benefit from The Science of Where.

Monica Pratt
ArcUser Editor

ArcUser

Summer 2018 Vol. 21 No. 3

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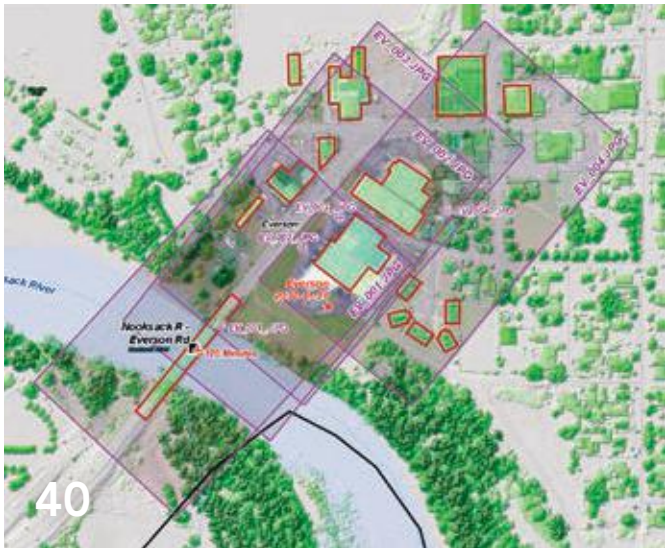

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Briefly Noted

→ Sentinel-2 in ArcGIS Living Atlas of the World

Sentinel-2 imagery is collected and managed by the European Space Agency (ESA) and hosted in Amazon Web Services. Sentinel-2 image services, available through ArcGIS Living Atlas of the World, provide temporal, multispectral imagery of the entire globe to improve monitoring of agricultural and forest conditions and land-cover changes and assist with natural disaster management. Full service access, including a rolling 14-month archive of the Sentinel-2 data, is available to all Esri ArcGIS users. For more information on the Living Atlas, visit go.esri.com/Sentinel.

↑ Sentinel-2 image services provide temporal, multispectral imagery of the entire globe and are available to all Esri users at no additional cost.

→ Esri Achieves FedRAMP Authorization for Cross-Cloud Location Intelligence

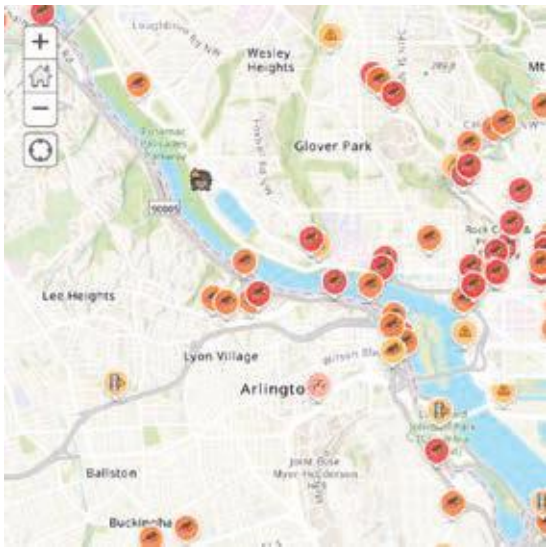
ArcGIS Online has been granted authority by the United States Department of the Interior (US DOI) to operate as a secure platform to deliver cloud-based spatial analytics services to the US federal government. Esri's technology has achieved Federal Risk and Authorization Management Program (FedRAMP) authorization on both Microsoft Azure and Amazon Web Services Cloud platforms. FedRAMP is a US government-wide program that provides a standardized approach to security assessment, authorization, and continuous monitoring for cloud products and services. FedRAMP authorization ensures that Esri can continue to provide its users with the benefits of security controls that are tailored to cloud services. The authorization also makes it easier for other federal agencies to obtain security documentation and authorize their own ArcGIS Online offering within days or weeks, instead of months. To learn more, visit trust.arcgis.com.

→ Spatial Business Initiative Fosters Location Intelligence in Business

The University of Redlands School of Business partnered with Esri to launch the Spatial Business Initiative. The project will offer innovative educational programs, groundbreaking research, and national and international advisory offerings designed to help businesses realize the value of location intelligence. The University of Redlands has been a leader in spatial education for more than a decade through its School of Business and College of Arts and Sciences. As part of the Spatial Business Initiative, the University of Redlands will offer a one-of-a-kind online MBA with a concentration in location analytics starting in September 2018, followed by the launch of a formal certificate in location analytics in January 2019, which will be offered on campus. In addition, the Spatial Business Initiative is surveying businesses to better understand how they use location intelligence to develop strategies, overcome challenges, identify trends, control costs, and mitigate risks. Other initiative projects include an annual research conference, executive training, and an Esri Press book.

→ Waze Traffic and Infrastructure Live Alerts Available in ArcGIS Marketplace

Waze live alert data is available in Esri's ArcGIS Marketplace at no cost to members of the Waze Connected Citizens Program. The Connected Citizens Program, a two-way sharing of publicly available traffic and road condition information, offers governments a stream of data—updated in real time—so staff members can make data-driven infrastructure decisions and improve incident response. Waze, the free, crowdsourced traffic and navigation app, is now fully supported by ArcGIS Online. Mapped Waze data is available in all ArcGIS apps. Governments can sign up for the free Waze Connected Citizens Program and start working with the alert data in ArcGIS to create operational dashboards that departments can use right away. To learn more about the newly available Waze live alert data in ArcGIS Marketplace, visit go.esri.com/waze.



↑ Waze live alert data is available in Esri's ArcGIS Marketplace.

→ Use Purchase Orders at the Esri Online Store

US customers can purchase term licenses and subscriptions through the Esri Store by submitting a purchase order (PO) during checkout in addition to paying with a credit card, PayPal, or wire transfer. Orders that include a PO are fulfilled after a standard credit review. If the order is below the threshold requiring a manual credit check, it will be fulfilled immediately.

→ Esri Official Statistics Modernization Program Launched

The Esri Official Statistics Modernization Program provides access to Esri ArcGIS Enterprise technology to support census counts that all countries will undertake during the 2020 round of population censuses. Esri will donate perpetual use licenses for ArcGIS software to eligible official statistical agencies in Least Developed Countries (LDCs) and Small Island Developing States (SIDS). By using authoritative methods of collection and cutting-edge mapping and analytics tools, developing nations can leapfrog paper-based workflows and adopt more efficient digital and mobile ones. For more information on the program and nation eligibility, visit go.esri.com/officialstatisticsprogram.

→ Esri on the *Forbes* List of Best Midsize Employers

Esri was fifteenth on the *Forbes* 2018 annual list of the 500 best midsize employers. Work-life balance, outstanding benefits, collaboration with colleagues around the world, and the opportunity to make a difference by providing users with constantly developing technologies are some of the reasons behind Esri's inclusion in the list for the third consecutive year.

The Top Six Features in Operations Dashboard for ArcGIS

By Elleni Rogers, Esri UK

Operations Dashboard for ArcGIS now includes features that will make working with the app easier and enhance dashboard information feeds. Operations Dashboard for ArcGIS, a configurable web app included with your ArcGIS Online subscription, provides engaging views of your organization's data, giving you insights that improve the decision-making process. Here are six of the most useful new features in Operations Dashboard for ArcGIS.

2

← The new embedded content element makes it easy to embed documents, images, and videos in your dashboard app.

1 Charts Can Trigger Actions

Dashboards are composed of maps, lists, gauges, indicators, charts, and other elements that bring your data to life. These elements inform you when your data changes, but you can also configure them to communicate with each other to improve interactivity through dashboard actions. In addition to maps and selectors, charts can now trigger actions. Selecting a single data point or multiple data points in a pie or serial chart can cause changes in another element such as a map or list.

2 Embedded Content Element Added

The new embedded content element makes it easy to embed documents, images, and videos in your dashboard app. Embedded content can be configured as static with respect to the URL. In that case, all you need to provide is the direct URL. For example, if you want to display weather information, a video from YouTube, or even an app or survey form, simply enter the URL as a document to embed it.

You can also embed content by features. This means that each feature's attribute information can be used to dynamically construct a URL at run time. This is a terrific way to display content from external web pages that are based on a common key, shared in a feature attribute such as images from closed circuit television (CCTV) cameras. When configured by features, embedded content can be the target of an action such as a selection on a map or list.

3

← Drive the value type, as well as the minimum and maximum values, directly from attributes of a feature.

↓ Operations Dashboard has more than 100 new icons, and you can still continue to add your own icons.

3 Feature Mode for Gauges and Indicators

Until now, you could only configure a gauge or indicator to use a fixed summary statistic such as an average or sum. With this release, you can drive the value type, as well as the minimum and maximum values, directly from attributes of a feature.

4 Share Premium Content in Dashboards

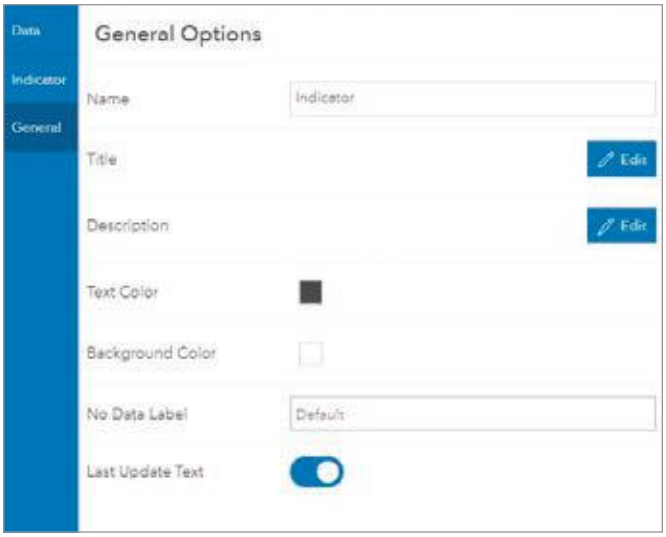
ArcGIS comes with ready-to-use map layers that require an organizational account to access. Some subscription content—premium content—consume credits. If you include premium content in your dashboard, you can limit the number of requests the dashboard can receive to manage costs.

5

5 New Icons

When adding an icon to an indicator or gauge, you will find that Operations Dashboard has more than 100 new icons, and you can still continue to add your own icons. You can also use a scalable vector graphics (SVG) icon as a logo in the header element.

6



6 NoData Label Is Available

Sometimes your visualization may not have any data to display. This could happen when a visualization is driven by a layer that is currently empty, waiting for data to be added from field apps like Collector for ArcGIS, or when the element is the destination of a selection within another element.

If an element lacks data, Operations Dashboard will display a NoData label. Now you can provide your own custom text that will make sense to your dashboard users. That text could tell users how to populate the element with data.

In addition to these new features, actions are no longer triggered by a button that's separate from the rest of the configuration experience. Actions are now available in a unified configuration so that they are easier to find and manage.

See the full list of the new features in the web app.

About the Author

Elleni Rogers works at Esri UK in a two-year graduate program. She is interested in spatial analysis, computer software, and GIS.

← If an element lacks data, Operations Dashboard will display a NoData label.

An Open Data Strategy Pays Off for Johns Creek

By Monica Pratt, *ArcUser* Editor

If you want to know when the next city council meeting will be held, you live in Johns Creek, and you have an Amazon Echo, just ask Alexa, Amazon's voice control system for its wireless Echo smart speakers.

Alexa can respond appropriately to your question because the City of Johns Creek, Georgia, developed an Alexa skill that makes key data about the city's operations more accessible to citizens via natural language questions.

An Alexa skill is like an app that performs a specific task. Johns Creek, the first city in the world to use its open data with Alexa, won the Best Practices Award for Amazon's City on a Cloud Innovation Challenge in June 2018.

The development of the Alexa skill is just the latest manifestation of the city's commitment to using GIS and open data to enhance city services and drive its economic development.

An Exceptional City

Johns Creek, nestled along the Chattahoochee River in the gentle foothills of north Georgia, became a city on December 1, 2006. With an ethnically diverse population estimated at slightly more than 84,000 in 2017, it is known for its nationally ranked schools and abundant recreational opportunities.

The city motto is "Be the Exception." Johns Creek has an exceptionally large entrepreneurial population—half the city's licensed businesses are home based. It is a constituency that expects its city to be responsive and efficient. From its inception, Johns Creek has relied on technology, including GIS, to deliver a high level of service to citizens.

The city's GIS department is a two-person

← Residents of the City of Johns Creek benefit from many city-sponsored events such as the free summer concert series held in the Mark Burkhalter Amphitheater in Newtown Park. Photo courtesy of the City of Johns Creek

team. That team is currently composed of Julie Kutz, a GIS analyst, and Nick O'Day, the city's chief data officer (CDO). GIS falls under the IT department structurally and budgetarily, but the CDO reports directly to the city manager. Although there are no plans to add GIS staff, O'Day wants to expand their capabilities and deputize staff in other departments to do some of the work they currently handle.

This strategy has added benefits, observed O'Day. "In my experience, it's better to develop other non-GIS staff to help do the work than it is to just add GIS staff. You get advocates for your work in other departments, and you also spread the knowledge and capability around."

Making More Possible with Data

O'Day believes that the city realizes value from the democratization of information that the city's open data site makes possible. Reaping the benefits from open data involves first making everyone—the public, businesses, and developers—aware that the city has high-quality data that is freely available.

In 2016, the city stood up the Johns Creek OpenData portal. Built using ArcGIS Open Data, the portal gave the public free access to its high-quality GIS data. Johns Creek wanted not only to provide better government transparency, it also wanted to encourage and enable businesses from mom-and-pop entrepreneurs to large corporations. In contrast, other cities in Georgia charge for this data. Access to data that is both trustworthy and free mitigates many of the risks faced by startups and small businesses.

The DataHub (datahub.johnscreekga.gov/), launched in 2017, expanded the availability of city data by incorporating nonspatial as well as spatial data to become a one-stop shop for all city data. By building automated methods for pulling in data, the DataHub included data from all city departments except human resources.

Not only was more data readily available but the site also provides interactive tools that help users discover, understand, and work with large amounts of city-generated data. Data can be inspected using the dashboards and charts available for some datasets or added to a web map in ArcGIS Online to take advantage of its smart mapping and analysis tools.

Videos show how to use the data to locate potential customers, find vacant and commercial sites, discover restaurants along a commute, and incorporate data services into an app. To provide instant information on popular topics, the site also has web maps with names such as Find A Business, Road Projects, and Parks & Recreation.

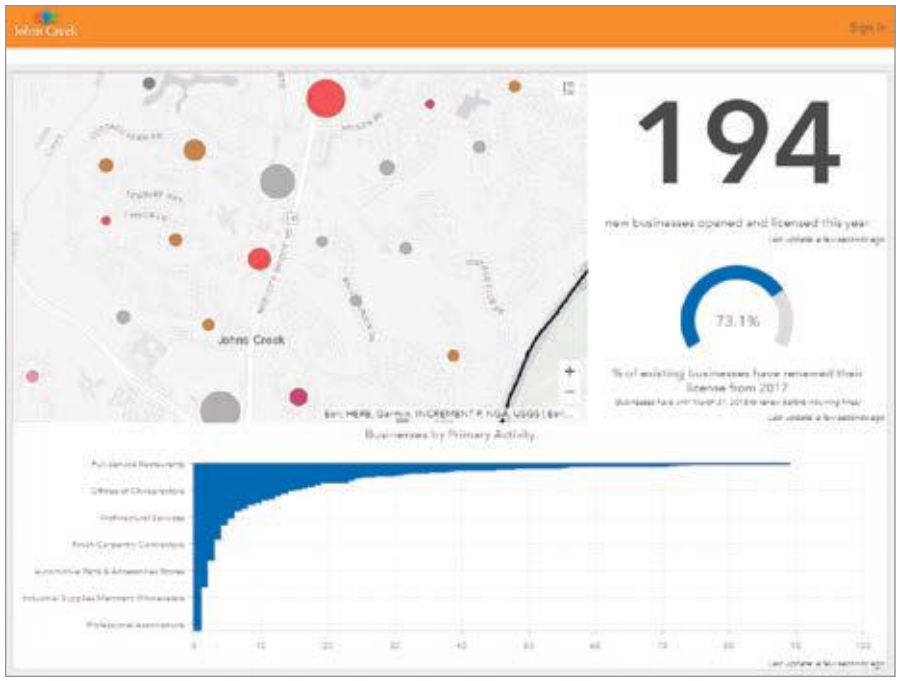
O'Day said the site has been engineered specifically to push dashboards and charts first and data second because "We want to drive understanding through the data, instead of just post a bunch of data layers and hope that people have the time, talent, or desire to dig into it." Those dashboards and charts are embedded throughout the city's website with links to the DataHub. The city's communications department also Tweets and posts facts gleaned from the DataHub.

At the 2017 Esri User Conference, Johns Creek received the Special Achievement in GIS Award for its innovative application of technology, data collection, geospatial information visualization, and thought leadership related to its launch of the DataHub. Winning awards for DataHub has been a great way to validate GIS work in the eyes of skeptical citizens and provides an opportunity to say something new about the site.

The DataHub saves staff time that had been spent responding to requests for data. Contractors and developers have 24/7 access to the latest city data. Because the DataHub is built on ArcGIS technology, city data is accessible using the familiar ArcGIS REST API so developers and tech companies can build apps and support existing services.

The five most frequently accessed data layers are police calls, fire calls, public works work orders, business locations, and financial expenditures. Nearly 10 percent of all DataHub traffic comes to the CreekView app. Originally built eight years ago with the ArcGIS API for Flex as an internal web

→ Nearly 10 percent of all DataHub traffic comes to the CreekView app. The app was originally built with the ArcGIS API for Flex as an internal web viewer for GIS data and updated using the ArcGIS API for JavaScript and Web AppBuilder for ArcGIS.



← DataHub has been designed to push dashboards and charts that make data easy to understand.

viewer for GIS data, it was updated using the ArcGIS API for JavaScript and Web AppBuilder for ArcGIS.

Data Quality Is Key

Maintaining high-quality data is critical to the success of the city's open data use. O'Day has a philosophy for promoting data quality.

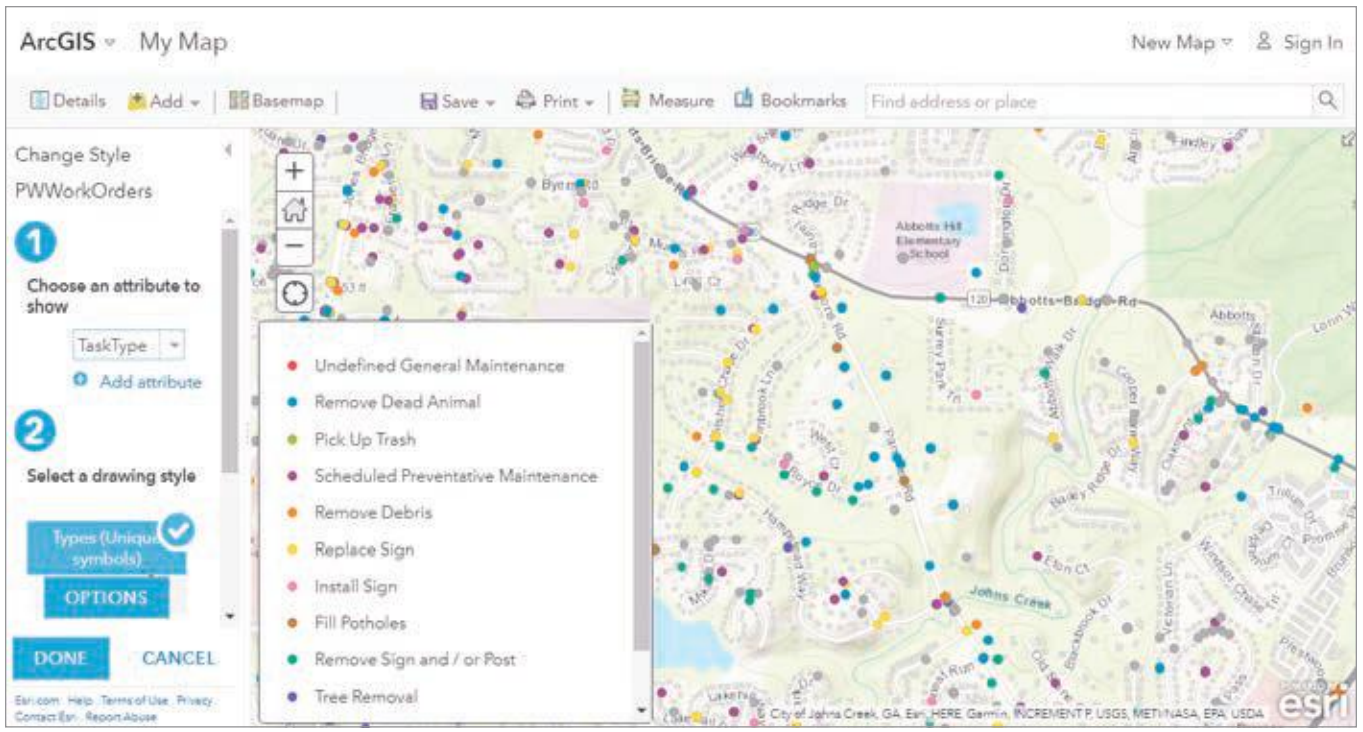
"The key to good data is making sure that the people collecting it—from the GIS intern to the business license folks—all know why we need the data and what we can use the data for. Once you get staff to understand that an accurate address point means that firefighters can respond to someone's house faster, or get a customer to a new bakery, or help count people for the census to ensure that funds are allocated fairly—and not just make a map look pretty—quality data collection is easy."

The GIS staff and other key staff review the plans required to permit any new development or redevelopment project to ensure documents and CAD drawings are accurate and complete. Data is verified in the field using Collector for ArcGIS on iPads with an external GPS unit.

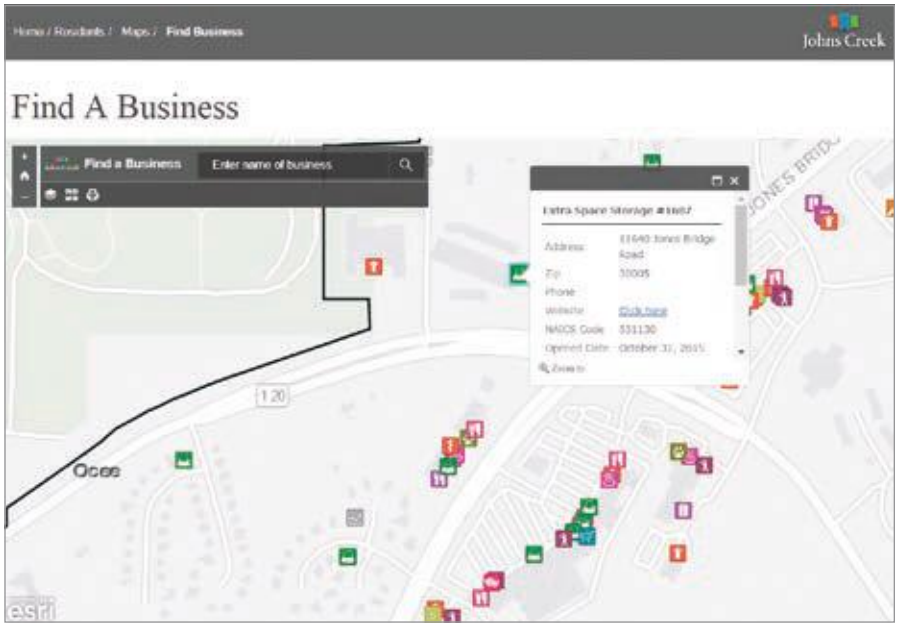
The city is working with Esri partner Mapillary on the #CompleteTheMap initiative to inventory the number and types of city street signs. The project uses the position of crowdsourced street-level photos submitted to the city by residents and Mapillary's machine learning capabilities to derive street sign locations.

Making the DataHub Even Better

As beneficial as the DataHub could be for many applications, O'Day realized it was not intuitive for most people. A way for improving that situation occurred to him while he was listening to a presentation by Esri's Andrew Turner at the 2017 Esri Developer



→ To provide instant information on popular topics, the site also has web maps with names such as Find A Business, Road Projects, and Parks & Recreation.



Summit. He was talking about a project by the Esri R&D Center in Washington, DC, that would use Alexa to tell residents about garbage pickup days. He realized he could make getting information from DataHub a lot easier.

"Most of us are used to asking a question and getting an answer," O'Day reasoned. By creating an Alexa skill, users wouldn't have to use an app or search—they could just ask a question, and Alexa would use data the city was already collecting and maintaining to answer it. This would be a more natural way to find information.

O'Day worked with Gavin Rehkemper of Esri Professional Services to develop the Alexa skill and launched it in April 2018. The Alexa skill is free to enable so just by speaking to Alexa, not only can you bid Alexa to play music or control your smart thermostat, but now you can also ask her for information about the City of Johns Creek.

Enabling an Organization

By making information and tools easy to use, other departments will be more productive and self-sufficient. O'Day sees this as the best strategy for GIS departments. "When this happens, it elevates the kind of work that the GIS department does because it can focus on delivering analysis and insight instead of a stack of maps."

A lot of GIS departments are so focused on making maps all day long that they don't have the time (and haven't developed staff) to do more powerful things," said O'Day. "If someone is going to take the time to come and ask a question, I'd rather it be a deep question that takes some work to solve than 'hey, can you look up what the zoning is of this property and make a site map for me?'"

Adopting this approach transforms the GIS department from an information bottleneck to an information conduit that powers the organization, helping improve efficiency and driving economic growth.

← Data can also be added to a web map in ArcGIS Online to take advantage of its smart mapping and analysis tools.

Many Benefits from Sharing Data

Johns Creek is the first municipality in the world to provide business data to Waze, the crowdsourced traffic navigation app. By sharing the city's constantly updated business license data in addition to road closure and other data with Waze, residents and visitors can use the app to more easily shop, dine, and do business in Johns Creek while avoiding traffic delays.

Getting city data into the popular Waze app, rather than replicating its functionality in its own road closure app, lets Johns Creek amplify its road work notifications while alerting city staff to traffic congestion and other issues in real time. Johns Creek uses ArcGIS Online to share its data with Waze, and ArcGIS GeoEvent Server to pull data back from Waze into its system and make it actionable. An added benefit from this approach: Instead of reinventing Waze and other popular apps, the GIS department can concentrate on apps and data products that don't exist and could benefit the city.

Johns Creek also shares data with Esri, HERE, TomTom, home builders, and others, to promote the use of spatial data for the city that has a uniformly high level of currency and accuracy.

What's Next?

Johns Creek is a relatively new and modest-sized city with a two-person GIS department. That limits the number and size of projects the department takes on. However, the city is not burdened with legacy systems or GIS staff who work in siloed departments. Its GIS department is centralized and built on much newer technology.

"This helps us be a lot more nimble and also lets us experiment with cutting-edge technologies faster with key staff," said O'Day. "If something doesn't work, we dump it. We don't invest a lot of time or money into a project unless we have a pilot or a really good use case ahead of time. This means that if we fail at something, we only lose the staff hours and maybe a few thousand dollars at most. If we were a large city or county, we'd have hundreds of hours and tens of thousands of dollars (or more) sunk into a project just to see if it is viable."

With this startup-like approach, the GIS department continues exploring new information tools. Recently, it enhanced planning for a project to widen a major road by adding a dimension. The GIS department used Esri CityEngine and the Esri Labs ArcGIS 360 VR *[virtual reality]* app to create an immersive 3D environment so residents could see what the corridor would look like.

"I've seen a lot of different governments that have staff that are very entrenched in 'this is what we've always done it' and 'why change it' mentalities," said O'Day. "None of that exists in Johns Creek. This staff is constantly trying to do better, do more with less, and to find new and smarter ways to deliver services."

Automated Data Sharing Helps Commerce

Flow through US Ports

By Steve Snow, Esri Mapping, Statistics, and Imagery Team

The United States moves 95 percent of its imported and exported goods by ship, so keeping its ports open is critical to the economy.

The US Army Corps of Engineers (the Corps), maintains the country's waterways and wages a constant battle against the forces of nature. If a storm hits causing underwater sediment to shift and makes a port too shallow for cargo ships, the Corps must dredge that port to keep it open for shipping. To avoid getting grounded in the mud, ship captains and harbor pilots rely on the Corps for this work and for updates about port conditions,

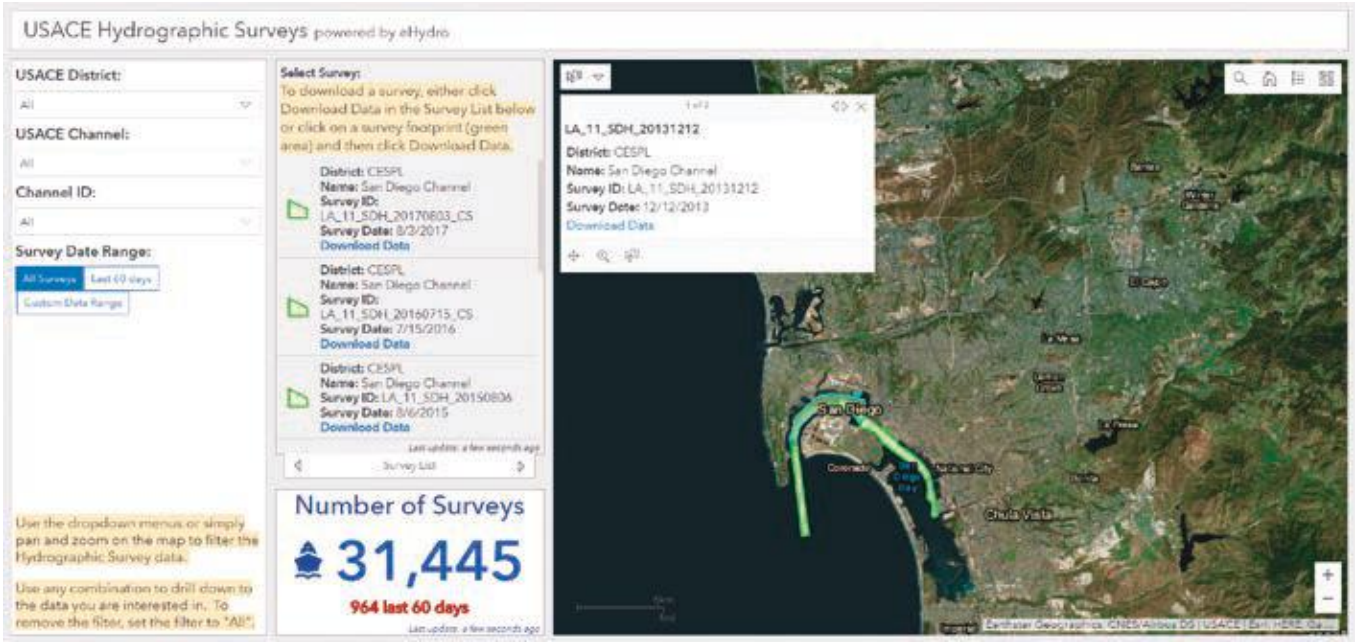
With the 2016 Panama Canal expansion, the cargo capacity of ships traveling through this important channel nearly tripled. Along with an increase in the number of ships, those ships had increased drafts. Draft is the distance between waterline and keel and it marks the necessary water depth for safe travel. These "New Panamax" ships have a fully loaded draft of nearly 50 feet, placing constraints on navigation that favor the nation's deepwater ports.

Recent storm-related sediment buildup (known as shoaling) in the deepwater Port of Texas City in Galveston Bay restricted shipping from the typical 45-foot draft to just 41 feet. This four-foot difference had an economic impact on the port and the industries that rely on it. The lower draft meant that companies needed to use smaller ships to ferry cargo into the Gulf of Mexico for loading onto bigger ships or divert their ships to different ports.

The key Brazilian port of Santos experienced similar storm-related restrictions. The port estimated that every day a vessel is not operating, shipowners lose between $10,000 and $75,000, depending on the size and type of ship. Restrictions on shipping for

↓ The US Army Corps of Engineers use the dredge New York in the Port of New Jersey Channel. Photo © Vince Elias

"We've been working to arrive at an enterprise data collection process for 20 years."



↑ The Corps' operations dashboard makes information about the number of surveys and their extents readily available.

just one day in Santos collectively cost shipowners $1 million, to say nothing of losses to the port and the overall economic impact on Brazil's economy.

Dredging the Ports

Without dredging, many ports would become impassable. The Corps regularly performs this maintenance chore that keeps 400 ports and harbors along 13,000 miles of deep-draft coastal channels and 12,000 miles of shallow-draft inland and intracoastal waterways usable.

Storm debris increases the Corps' regular workload, adding 250 million cubic yards to the material dredged from the nation's waterways every year. The Corps conducts regular hydrographic surveys across 22 coastal and 16 inland districts to assess channel safety and prioritize dredging needs.

"The Corps is a decentralized organization with districts managing their own programs in their own geographic areas of responsibility," said Tony Niles, assistant director for Civil Works Research and Development, Headquarters US Army Corps of Engineers. "This structure proves effective for project management, but it poses challenges for pulling together enterprise data."

Recently, the Corps started using an enterprise-wide system dubbed eHydro that includes tools and workflows to catalog, organize, and share surveys. eHydro is an application and scripts that easily—and almost automatically—feed the data from each survey into a Corps-wide system.

"We've been working to arrive at an enterprise data collection process for 20 years," Niles said. "We realized this goal by inserting the reporting into existing project workflows—not changing any data collection methods or tools, just changing what they do with the dredging data once the boat is in."

Free Flow of Information

Each dredging effort is a project, so eHydro acts as a centralized system of projects. It captures the horizontal and vertical dimensions of each dredging project as the work is completed and records surveys periodically conducted to assess current channel conditions.

Since implementing the approach, the Corps has seen marked improvements in the accuracy, consistency, timeliness, and sharing of project information. The streamlined data aggregation allows for automation of regular reports on channel availability and condition.

"Previous to eHydro, channel information was sent to a central location, but after it was there a period of time, it was stale," said Mel Littell, engineering technician in the Portland District of the Corps where eHydro originated. "Now, when each district changes something in their channel, they just push a button, and it updates the national channel framework ensuring everybody works off the same current datasets."

Internal data sharing was a big advancement, but the full benefit comes from

"We can get surveys turned around quicker to know about changing conditions and prioritize trouble areas."

sharing with all stakeholders through the Corps Navigation Portal (navigation.usace.army.mil). Now information can flow to the National Oceanic and Atmospheric Administration (NOAA) to update the nation's navigational charts.

"The Corps' data is by far the biggest outside source of data that NOAA uses in its nautical charts," said Clint Padgett, chief, Spatial Data Branch, the Mobile District of the Corps. "In the past, they had to go to every district and normalize data provided in more than 20 different formats. Now, they just consume our data through a web service."

Knowing the Channels

Dredging projects are constantly in backlog given the workload plus time and budget constraints.

"If we're going to maintain all of our 25,000 miles of channels to authorized dimensions 100 percent of the time, we'd need billions more dollars," Padgett said. "We know that we'll never get that level of funding, so we work to manage impacts with the budgets that we have."

This means a constant weighing of tradeoffs for the Corps. If one channel is authorized at a 35-foot depth and it's only 32 feet, the Corps has to balance the $5 million additional cost to get the channel to that depth against other projects. In some cases, it's more beneficial to dredge a deepwater port from 40 feet to 45 feet to accommodate today's larger ships.

Now, the Corps has a means for evidence-based decisions to clearly compare present channel conditions and prioritize dredging funds against the impacts to commercial shipping. "We can get surveys turned around quicker to know about changing conditions and prioritize trouble areas," Littell said.

The Corps works in close coordination with cargo pilots who move large vessels. This group has become a big consumer of Corps data even though the Corps doesn't produce navigation charts on coastal deep-draft harbors. Pilots count on the Corps to know the latest channel conditions.

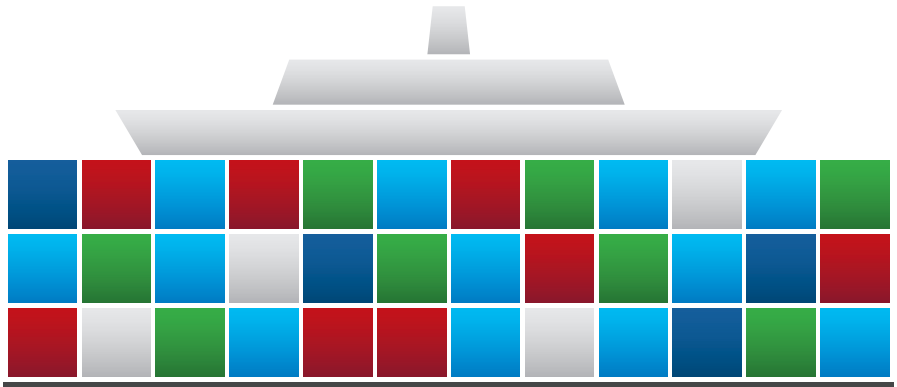
"The Columbia River Pilots Association depends heavily on this information," Littell said. "We meet once a month with the pilots to address their concerns. We go over every single chart and look at where material is building up and where we should do more maintenance."

Over the next 20 years, the volume of cargo traveling by container ships is projected to increase by 65 percent, according to the global management consulting firm McKinsey & Company. With demand at ports and waterways rising steadily, the Corps' streamlined data sharing efforts have an increasing impact on the flow of commerce.

Visit the Corps' operations dashboard to see the number of surveys and their extents. To learn more about navigational charting, visit ArcGIS for Maritime: Charting online.

About the Author

Steve Snow is an industry specialist for mapping, statistics, and imagery at Esri with more than 18 years of experience working in GIS, mapping, charting, and remote sensing. He focuses on applying remote sensing capabilities to solve user mapping challenges. Prior to joining Esri, Snow was a commissioned engineer officer in the US Army. He was also a corps officer with NOAA, whose work was focused on remote sensing, surveying, and charting for the US National Geodetic Survey Remote Sensing Division and NOAA's Office of Marine and Aviation Operations.



The Value of an Added Foot of Draft

In 2017, the Port of Los Angeles/Long Beach increased the draft of the port from 65 feet to 66 feet. Each additional foot of draft means that larger ships can enter it and each of those ships can carry more goods. Each foot of depth translates into considerably more cargo and value.

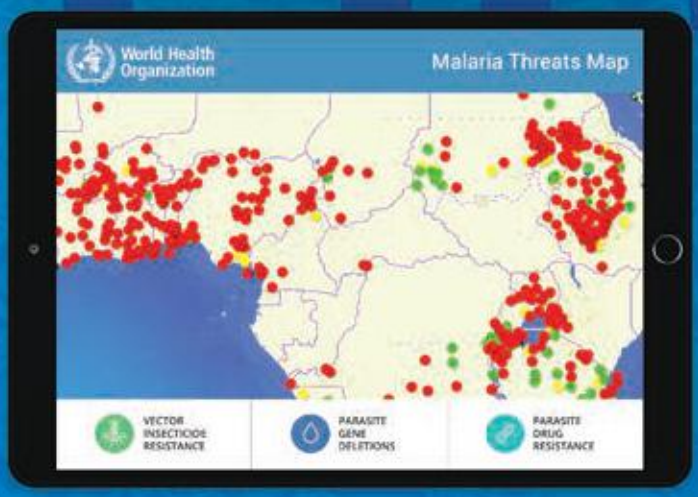
The National Ocean Service, a division of NOAA, puts this added capacity into perspective. With a foot more draft, a cargo ship can carry

- 684 more tractors, worth more than $45 million.
- 378,624 more laptop computers, worth more than $262 million.
- 9,274,800 more bushels of wheat, worth more than $720,000.
- 61,728 more 55-inch televisions, worth approximately $26 million.

The added capacity means fewer individual trips with less fuel consumed, which translates into dollars saved and greenhouse gas emissions reduced.

ANALYSIS | APPS | DATAVIZ

BLUE RASTER



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KyTopo!

Kentucky's New Topographic Map Series

By Kent Anness, Kentucky Division of Geographic Information

The new KyTopo map series, released as both a print-capable cartographic product and a cached web mapping service, has been lauded by William Andrews, the head of the Kentucky Geological Survey, as "an excellent and intuitive portrayal of the Kentucky landscape."

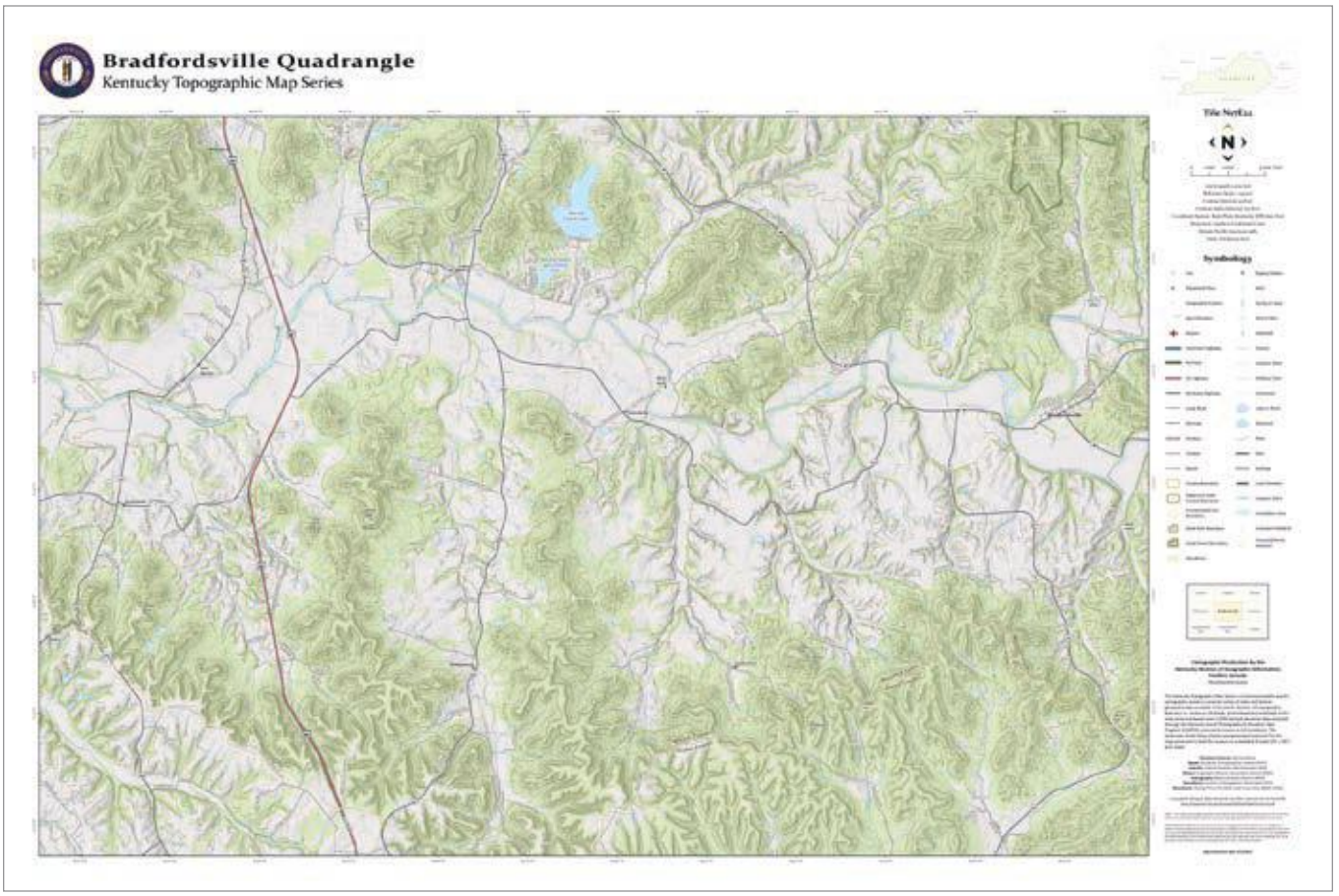
For many decades, the United States Geological Survey (USGS) topographic quadrangle map series was "THE" basis for mapping-related activity. The topo or quad maps framed our perception of the nation's surface and the planimetric features situated upon it. A wide array of federal programs required that these USGS maps be utilized for submittals. Surveyors included them on plats as inset maps. Kentucky-specific statutes relied on these maps when defining features such as blue line streams *[i.e., streams that appear as broken or solid blue lines on a USGS topographic map].*

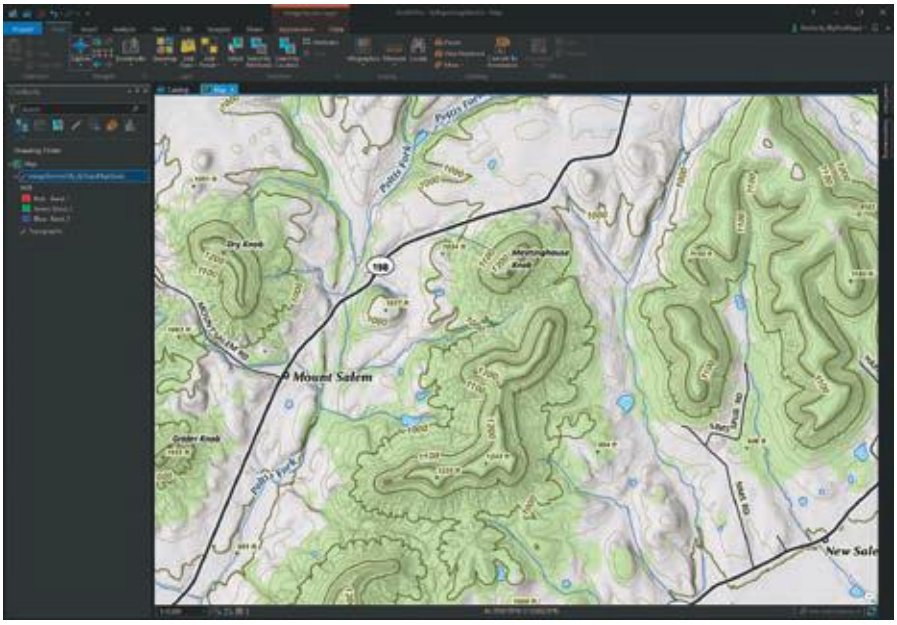
In the mid-1990s, USGS brought the topographic map into the digital age by releasing its digital raster graphic (DRG) product. These trusty basemaps were displayed in the background on the massive CRT monitors of that era, a mesmerizing sight as these raster images slowly rendered on screen.

GIS users quickly realized that the vector data they'd been creating and maintaining for years didn't always line up perfectly with DRGs. As a result, agencies scrambled to adjust points, lines, and polygons.

Flash forward to December 2011 when the Kentucky

↓ The KyTopo map series has an entirely new set of landscape-oriented quadrangle tiles that are in Kentucky's Single Zone coordinate system. When printed, the map area fits nicely on a standard Arch D sheet.





← The new KyTopo map series was released as both a print-capable cartographic product and as a cached web mapping service, shown here.

Aerial Photography and Elevation Program (KYAPED)—or KyFromAbove—became a reality. With a focus on acquiring state-of-the-art lidar data and full-color, high-resolution aerial photography, KyFromAbove promised a new view of the Commonwealth's surface with a level of detail and clarity that was previously unimaginable. Since then, and not surprisingly, one of the primary requests made by stakeholders in the GIS community has been for new lidar-derived contour lines.

In early 2017, as the impending reality of a statewide elevation model came into focus, the Kentucky Division of Geographic Information (DGI) began investigating the creation of a statewide contour dataset and associated cartographic products and web services. Consulting with the Commonwealth's GIS gurus prompted DGI to think outside of the box.

Although it was painful at times, this process led to a plan to create a print-capable cartographic product and a cached web mapping service—the KyTopo map series. All derivative datasets, such as the contours, hillshade, and spot elevations, would be made available for download and published to the Kentucky Geography Network (KyGeoNet), Kentucky's geospatial data clearinghouse.

After many months, two statewide contour datasets were created. One is somewhat aligned with the USGS 10-foot, 20-foot, and 40-foot contour intervals. The other is a statewide set of 5-foot contours that leverage scale threshold settings and group layer functionality to adjust dynamically to the viewer's map scale. The entire contour creation process was driven by a routine developed by Dean J. Tyler of the USGS.

The KyTopo map series is Kentucky-specific in several ways. First, an entirely new set of landscape-oriented quadrangle tiles were developed. These new tiles align with the state's existing 5k tiling scheme and are in Kentucky's Single Zone coordinate system rather than the traditional USGS universal transverse Mercator (UTM)-based coordinate system.

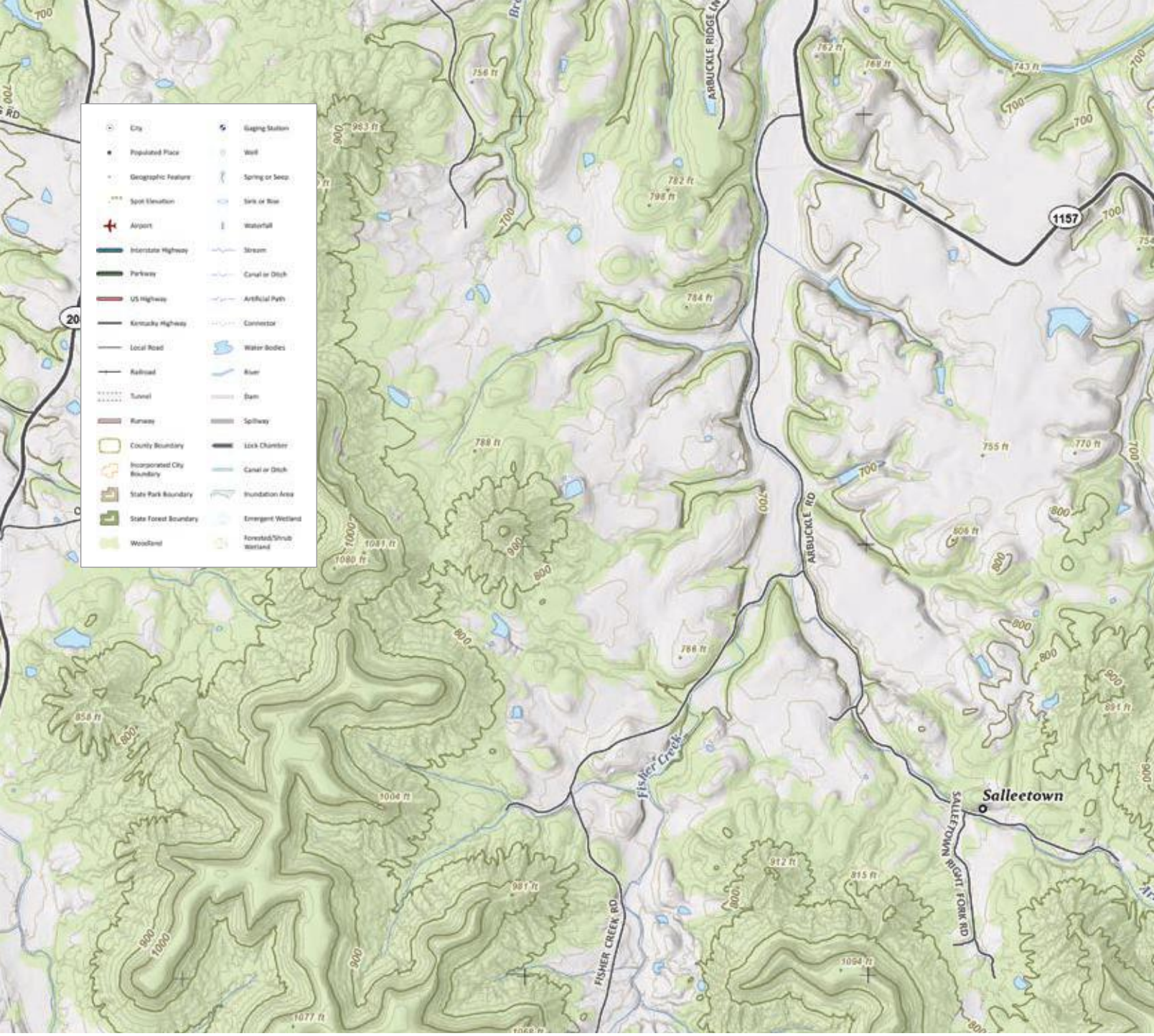
When printed, the map area is exactly 30 inches wide by 20 inches in height, which fits nicely on a standard Arch D (24 inches by 36 inches) sheet. The typical USGS quad scale of 1:24,000 (or 1 inch to 2,000 feet) has been maintained. Only 549 KyTopo map series tiles were required to map the state as compared to 779 USGS tiles. More important, the new Kentucky Single Zone tiles have square corners, unlike the UTM tiles.

The new map tiles needed names. In many instances, the names of the old USGS quads were adopted. However, sometimes this just didn't make sense. DGI staff studied the methodology used by the USGS in naming maps and employed it. The USGS approach used the most prominent feature within a given tile as the name of that tile. That feature might be the largest city or the most centrally located place-name. In undeveloped areas, state parks, state forests, and natural features, such as streams, ridges, or lakes, were used.

Contour interval and index values were considered, and the standard USGS 10-, 20-, and 40-foot intervals were embraced along with the associated 40-, 100-, and 200-foot indexes. Different interval levels are necessary to accommodate the great variations in elevation change across the Commonwealth from east to west. Generally, KyTopo intervals in individual tiles align well with corresponding USGS tiles.

Weeks were spent gathering authoritative data for the project and fine-tuning the map layout and symbology. Much thought was put into determining which layers should be included and which should be omitted. As previously noted, all data is in the public domain and available. Much of it has been sourced directly from Kentucky state government and a variety of federal agencies. More than 80 percent of the layers had already been published to KyGeoNet. The entire map series and associated web mapping services will be updated annually to incorporate changes in the transportation network, forest cover, boundaries, and other features.

↓ The KyTopo index map highlights the subject map tile in a statewide view.



The production hardware environment for the KyTopo project consists of one enhanced 64-bit GIS workstation with 4 cores, 16 GB of RAM, and 1.5 TB of solid-state drive (SSD) storage running Windows 10 Enterprise. ArcGIS Desktop 10.5.1 is used for cartographic production. Its Data Driven Pages functionality makes it easy to create a series of layout pages from a single map document. In addition, Esri Production Mapping extension has proved useful for handling layout constraints and customized map elements.

The map output process is done through a series of Python scripts that take advantage of ArcGIS's 64-bit background processing option to reduce output time for each map by 10 to 15 minutes. Initially, draft maps were output as 300 dpi PNG files for proofing and review. Feedback during the proofing process was used to further refine the map series.

Two types of maps have been produced for distribution: collared and uncollared. The collared version is a nongeoreferenced PNG file that includes all layout elements such as the legend, title, and any inset maps. The uncollared version is a GeoTIFF that is limited to the areal extent displayed in the data frame.

Significant effort was put into establishing an appropriate symbol set for this map series. DGI staff consulted the publication *USGS Topographic Map Symbols*. Some of its symbols were adopted, while others were adjusted to enhance readability. Once a symbol was selected, it was added to the KyTopo.style library using ArcGIS Style Manager. This tool effectively and efficiently manages symbology for large cartographic production efforts.

← The standard USGS 10-, 20-, and 40-foot contour intervals were embraced for the KyTopo map series.

Typography received a tremendous amount of attention. Feature labels, titles, legends, and notes are just some of the text components of any cartographic product. Using the correct typeface for each element is critical when compiling a quality map. Discounting the importance of typography during cartographic production can lead to a map that is difficult to interpret or one that draws the user's attention away from the subject.

Per the principles of thematic map design, serif typefaces were used for the map title, layout elements such as graticule labels, and hydrographic features. Sans serif typefaces were employed for road shields, road names, elevation features, and other selected layout elements. Maplex was enabled and used to handle the placement of feature labels. Hours were devoted to fine-tuning the Maplex labeling rules so more prominent features were placed prior to features of less importance.

Every great map series includes both index and inset maps so users can see the location of each map tile in context. On each map tile, the KyTopo index map was located in the upper-right corner of the layout, highlighting that map tile in a statewide view. The inset map, positioned below the legend, shows the eight tiles that surround the subject map. Including these components on each map has proved quite helpful. Using a separate data frame for the index and inset maps with Data Driven Pages functionality allows this task to be automated.

One of the most frustrating layout elements was the legend. The legend created with the automated tools didn't produce the most desirable results. For example, although the symbol for spot elevations appeared in the legend, the actual elevation value would not be placed beside it. Reluctantly, a cumbersome, partially manual process using Adobe Photoshop and Illustrator was adopted. The resultant legend is much nicer and better reflects the features in the map series.

The first edition of the KyTopo map series is now complete. All PNG and GeoTIFF images can be download and are easily accessible via an ArcGIS Online web map. An image service in the Kentucky Single Zone, and a cached map service in web Mercator, are also in production. These services are being leveraged using ArcGIS Desktop, and a wide array of web mapping sites are adding the cached map service as an optional basemap.

The KyTopo map series has been well received. The map series has garnered numerous positive comments relating to its readability, its landscape layout, the use of a Kentucky-specific coordinate system, and its currency. Many are thrilled to know that it will be updated on a routine basis.

The contours used in the map series and the statewide 5-foot contour feature class are now in production in the Commonwealth's enterprise geodatabases and are available for download from KyGeoNet. This great new resource is just one of the many valuable assets Kentucky realized through the KyFromAbove effort.

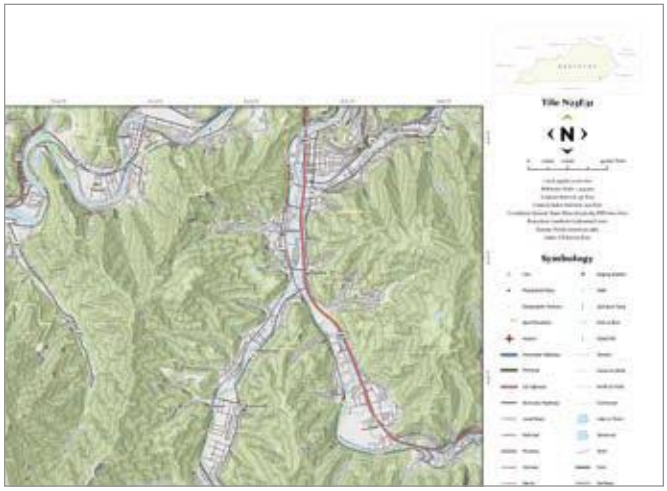
"The look of the topo maps delivered by the KyTopo map service is stunning. KyTopo is perfect for many of our mobile applications; providing a clean, fast, and location-rich basemap," according to David Carter, president of CDP Engineers. "The enhanced elevation data adds real value, especially in rural and rugged terrain settings. The KyTopo map service is a great addition to Kentucky's public GIS resources."

For more information, contact Kent Anness at kent.anness@ky.gov.

About the Author

Kent Anness is the GIS operations manager at the Kentucky Division of Geographic Information in the Commonwealth Office of Technology. As the primary technical staff person, he maintains the Kentucky Geography Network (KyGeoNet), manages the Commonwealth's Enterprise GIS, develops and configures web-based mapping applications, and collaborates with geospatial publishers. He creates and customizes Esri Story Maps apps, implements KyGovMaps, and manages the KyFromAbove effort. When Anness was the GIS manager at the Bluegrass Area Development District from 1988 to 1998, he managed GIS specialists, technicians, and interns. He served as the GIS manager for the Water Resource Information System (WRIS) in the Kentucky Infrastructure Authority (KIA) from 1998 until 2004. In that position, he oversaw the technical aspects of developing and maintaining the WRIS.

↓ Using the correct typeface for each element is critical when compiling a quality map. Great effort was made to choose effective and pleasing fonts.



The Life of a GIS Professional

From improving cooperation to engaging citizens

The work of GIS professionals in the city of Jihlava in the Czech Republic benefits staff in departments across the city, communities in the surrounding area, and city residents. A regional center in the middle of the country, Jihlava has a population of 50,000 and is surrounded by hills in an area of natural beauty. It is located in the Jihlava District, which encompasses 78 towns and villages.

GIS staff not only maintain current landownership records used by many city systems but also enhance communication between different parts of the municipal government, the public it serves, and between towns and villages in the Jihlava District.

At the beginning of each month, Jihlava's GIS staff members eagerly await the release of new data from the Czech Cadastre Office. When they receive this data, they check changes that occurred the previous month and begin a process of using this data to update various map apps, the city's internal IT systems, and property maps.

By connecting current land records to other municipal records, they can create maps of ownership and identify parcels that have special legislative limitations. Combining land record layers with planned projects, green infrastructure, and other layers enables better decision-making.

Helping Colleagues

It's a typical Monday in the GIS office. Someone from the Urban Planning Office calls. Urban Planning is going to issue legal statements on which the building authorities will base the zoning permits they will issue. They also need to check how these statements have been

← GIS professionals aid in a variety of activities that support other departments and engage the public. In this photo, Soňa Krátká, coordinator of the Healthy City association and organizer of the Forum of Youth, is shown helping children who are creating the online Emotional Map of Jihlava.

completed. Can GIS help with these tasks?

"I like these projects the most," said Jana Havlíčková, GIS specialist at Jihlava. She likes them because by working together, GIS staff can create an app that will solve the problem while making things easier for colleagues in other departments.

A quick brainstorming session produces a wireframe for the new map app. Six building authorities in the Jihlava district will use a feature layer accessed from ArcGIS Online to view legal statements as well as create and maintain zoning permits. Through ArcGIS Online, privileges can be managed so staff in all offices can see the data, but only those who have created the data can edit it. Editor tracking helps monitor the data life cycle.

The mapping application should provide users with all available data so that the zoning permits can be considered in a spatial context. Current and proposed zoning plans, utility data, parcels, and other important data should be included along with the operational layer. GIS staff use Web AppBuilder for ArcGIS to actually create the app.

However, the work on the app is not yet done until the app creators consult with end users to ensure that the app meets their needs. If not, adjustments must be made. However, in this case, once users appreciated how much information they could access, they felt the app would solve their problem.

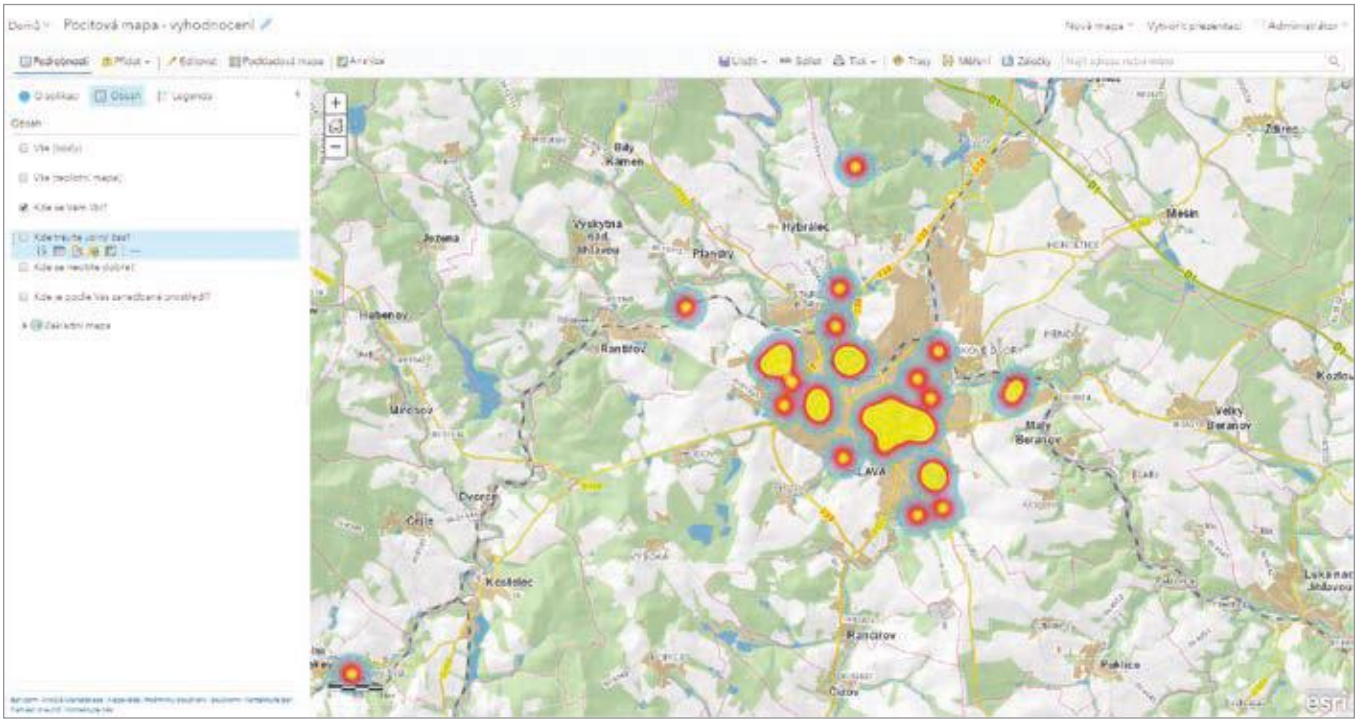
This cooperation extends beyond the town. According to Havlíčková, "Work with GIS is about cooperation. You can have a perfect system, but it means nothing without people who are using it." Jihlava invited other cities in the surrounding area to join the Jihlava Geoportal, share data, and use the great tools the ArcGIS platform provides to work with their data.

Constantly Innovating

The GIS department works to keep up. It is continually testing new tools, entertaining new ideas, and reflecting on how these innovations can help staff in other departments. Deploying mobile apps in common workflows was one result of this process. For example, the municipal police use Explorer for ArcGIS to access information about parcels, addresses, streetlights, traffic signs, and other aspects of the city.

Collector for ArcGIS is extensively used by the Department of Environment. Its ability to communicate with external GPS receivers is important for identifying parcels. Workers from the State Administration of Forests use Collector for ArcGIS to identify parcels marked as forestland. Using a Global Navigation Satellite System (GNSS) receiver,

↓ Instead of a paper map, the GIS staff made a digital version of the Emotional Map on which youth indicated areas they liked and ones that were problematic for them.



"You can have a perfect system, but it means nothing without people who are using it."

they can track their position deep in the forest with submeter precision enabling them to quickly navigate and complete their tasks without requiring surveying.

Better Communication with Citizens

While helping city staff and those from surrounding municipalities benefit from GIS is a priority, communication with citizens is equally important. The GIS department especially wants to provide tourist information in a useful and attractive way. Instead of trying to compete with Google or Mapy.cz, the staff focused on presenting information in a simple, intuitive fashion that used the minimum number of tools but still provided information in an interesting way. This led Jihlava to adopt Esri Story Maps apps.

Havlíčková said GIS staff were charmed by the simplicity of story maps, which also provided a variety of ways to present information. After looking at all the templates, they chose the Map Series Tabbed template to create their first story map, a simple tourist guide showing various points of interest and tourist trails on separate tabs. "But we didn't stop here, and we created more thematic guides—one for public transport in Jihlava, another for recycling waste containers, one that showed places to walk with dogs, and many more," said Havlíčková.

In the beginning of March, the staff faced another challenge. A bridge on the important road leading through Jihlava had to be repaired, which would cause traffic congestion and affect public transport lines. The GIS department had to communicate the road closure and the detours to the public. It decided to use the Story Map Cascade template. The story map provided a detailed guide for both motorists and pedestrians, explained how the closure would affect the public transport lines, and showed alternate routes for both light and heavy vehicles. The app was successful. In the first month, it was accessed more than 2,500 times.

Actively Engaging the Public

Instead of simply giving information to citizens, GIS staff wanted to involve the public. An opportunity to do that was the Emotional Map made for the Forum of Youth. Previously, Emotional Maps were paper maps created in ArcMap. People could put color stickers on the map showing places they liked or disliked.

This year the Emotional Map was created with the help of Survey123 for ArcGIS. Using the interactive form, members of the public could choose an emotion ("I like it here,"

→ Workers from the State Administration of Forests use Collector for ArcGIS with external GPS devices to identify parcels marked as forestland with submeter precision.

"I go there in my spare time," "I am not comfortable here") and put it on the map. At the Forum of Youth, children from elementary and high school could use tablets to contribute to the Emotional Map online. At the end of the event, they could browse the map and explore various areas symbolized as colored points and heat maps that showed the capabilities of GIS. Visitors to the Healthy City forum could also add their inputs to the Emotional Map.

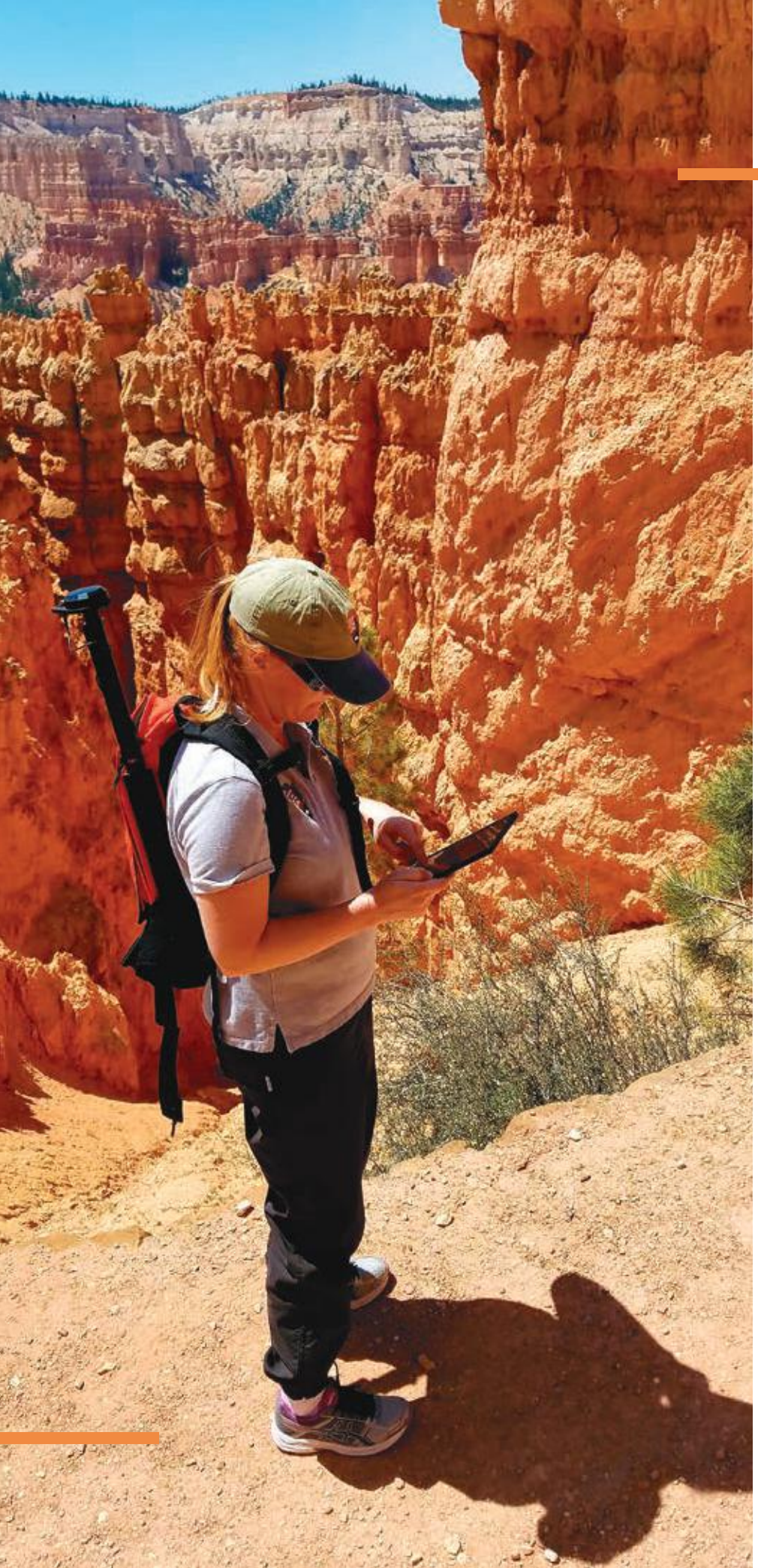
Last year, Survey123 for ArcGIS was used for the city transport survey. Citizens could choose a transportation type, locate and describe problems, and suggest solutions. This yielded 500 responses, identifying both problems and solutions that served as the basis for the new sustainability mobility plan for Jihlava. This proved that engaging the public captures valuable information.

← The GIS department used a story map to explain how a road closure would affect the public transport lines and show alternate routes for both light and heavy vehicles.

Variety Keeps Things Interesting

Havlíčková notes that the work of the GIS professional isn't limited to creating and distributing apps. GIS staff make sure apps fill the needs of their colleagues and manage technical support. In addition to tackling interesting new projects, they must perform routine tasks such as data management, source preparation, data exporting, communication with users, training, support, and popularizing the use of geospatial information. She believes this variety in tasks is one of the best things about a GIS professional's job. She never knows what interesting projects and collaborations the new month will bring along with new cadastre data.

For more information, contact Jaroslav Škrobák at jaroslav.skrobak@jihlava-city.cz.



Field Apps Can Be Better Together

By Jeff Shaner,
Esri Product Management

Esri's ArcGIS Apps for the Field help you complete specific tasks like capturing asset data, navigating to a jobsite, or completing an environmental survey. Individually, each app is powerful, but when they are integrated, you can complete a variety of workflows.

← Heidi Ogle, GISP, who works as a GIS specialist for the National Park Service, captures field information in Zion National Park. Photo courtesy of Eos Positioning Systems.

App integration comes to life using a custom URL scheme. The scheme is a well-known standard for interapp communication on mobile devices and is already used by Collector for ArcGIS, Explorer for ArcGIS, and Workforce for ArcGIS to remotely control other field apps and pass context to them.

Workforce App Integration

Workforce integrates with all Esri field apps. Its user experience supports interapp communication. As the owner of a Workforce project, you can choose which Esri apps are integrated and how they will work together. By integrating Workforce with other apps, you can maximize the efficiency of your fieldworkers by providing directions and the maps and forms they need to complete their work.

For example, the Workforce mobile app can open Collector to perform a hydrant inspection or Survey123 for ArcGIS to complete a water quality survey. Workforce can also pass the location of the new survey or feature to be collected and prepopulate the location description into a text field, the ID, or even the GlobalID of the assignment so that you can streamline the collection process and link the assignment to the newly captured data.

App integration within Workforce is achieved by creating a URL scheme for each point of integration and storing that scheme in the project JSON file. Workforce handles this for you, but you can also create and alternate URL schemes and modify the app integration in your Workforce project.

Navigator App Integration

The Navigator URL scheme is used by Workforce, Collector, and Explorer. However, you can generate the URL scheme yourself and remotely control Navigator from a third-party app, a text message, or an email. The Navigator's URL scheme can be parameterized as follows to

- Display directions to a single location.
- Specify a custom start point.
- Generate directions to multiple stops.
- Enable route optimization.
- Set travel mode.
- Automatically start navigating.
- Enable notifications when navigation completes.

See the documentation in the Esri GitHub repository navigator-integration, which describes this integration in detail.

Survey123 App Integration

In a fashion similar to Navigator, Survey123 can be remotely controlled by other apps. It is commonly used by Workforce to complete specific types of work assignments or integrate with Collector to complete forms. Integration is well documented in the Survey123 online reference under the "Integrate with other apps" topic. Using this integration you can

- Start the Survey123 app.
- Open a specific Survey by itemid.
- Pass location for a geopoint question.
- Pass predetermined answers to questions.

A GeoNet blog post, "Using App Links to Launch Survey123 from Explorer for ArcGIS," provides a step-by-step tutorial for integrating Survey123 and Explorer.

Explorer App Integration

When dropping a pin on the map or from the pop-up details of a selected feature, you can ask Explorer for directions. By default, Explorer will provide a menu of navigation apps that are installed on your device that can be remotely controlled. Using settings, you can alter that list so that it always launches your favorite navigation app.

Similarly, by using the Explorer URL scheme in your app, website, email, or text message, the recipient can open Explorer. You can even open a public mobile map package. Details regarding the URL scheme for Explorer are available in the Esri GitHub repository for navigator-integration.

Collector App Integration

As with the apps previously mentioned, Collector supports app integration natively from Workforce and to Navigator. Its URL scheme is relatively new, extensive, and well documented on the Esri GitHub repository collector-integration. You can

- Start the Collector app.
- Open a web map using its itemid.
- Center at a given location.
- Initiate a new feature collection and specify attributes.

Esri's field apps have introduced a significant pattern of integration leveraging the URL scheme concept. Using this pattern, apps can work together to complete a variety of workflows with greater efficiency.

About the Author

Jeff Shaner is a product manager in the Applications Group. He has been with Esri for more than 23 years.

Do More with More

By Julie Powell, ArcGIS API for JavaScript Team

Despite the conventional wisdom that urges "less is more," with the latest release of the ArcGIS API for JavaScript, more *is* more.

With faster feature layers, optimized querying via vector feature tiles, and a growing collection of client-side processing capabilities that enable rapid interaction and analysis, the ArcGIS API 4.8 for JavaScript removes performance barriers for developers.

WebGL-Powered Feature Layers

For years, browser limitations meant that developers had to be careful about how much data was brought into the browser for use in interactive visualizations. Processing was performed almost entirely on the server side, limiting the kinds of workflows that could be accomplished in web apps while still providing a good user experience.

Typically, a web app consists of a basemap and one or more feature layers that contain data that is downloaded to the client and used for interaction and analysis. In September 2017, the ArcGIS API for JavaScript's feature layer was enhanced to take advantage of WebGL. This enabled hardware-accelerated rendering of the graphics using the graphics processing unit (GPU) instead of the browser.

This has resulted in the far more rapid display of both small and large datasets. The number of features that can be displayed in 2D and 3D feature layers—while still maintaining a high level of performance—went from tens of thousands of features to hundreds of thousands of features.

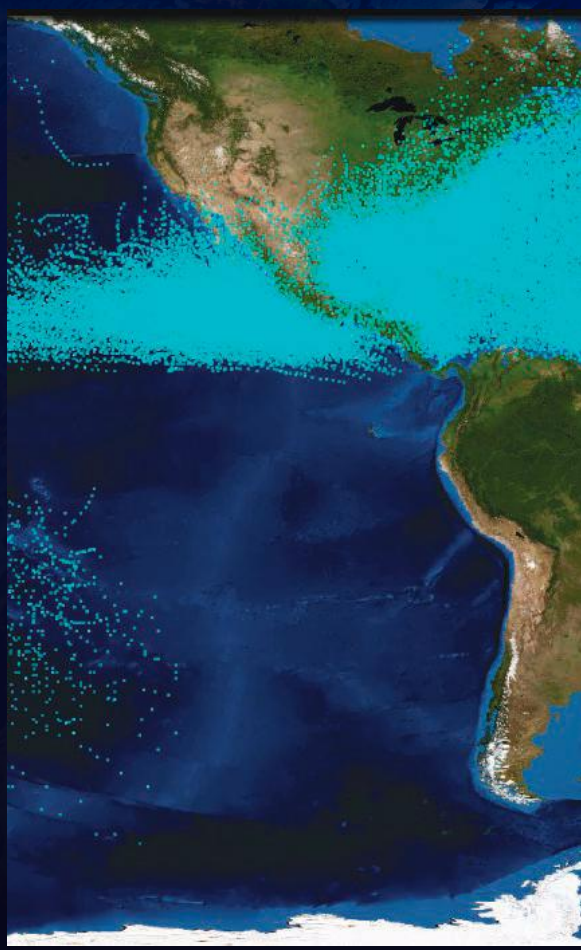
The ability to have access to large datasets on the client opened up new possibilities. Datasets that had previously been treated more like basemaps with only limited interaction can now be more effectively used as operational layers. For example, end users can explore large datasets completely on the client side by dynamically changing the visualization of layers to focus on the aspect of the data they are interested in or filter the data by attribute.

More Efficient Querying

Although WebGL enables large datasets to be rendered on the client, that doesn't address the challenge of optimizing the transfer of large datasets from the server. Vector feature tiles now make that possible and practical.

Feature layers published to ArcGIS Online now access the data via vector feature tiles. Vector feature tiles have many of the benefits of traditional vector tiles: requests are split into consistent, smaller spatial queries and server-side and client-side caching is enabled for quick response times. Queries are also performed using the Protocolbuffer Binary Format (PBF), which reduces the size of the data delivered to the browser. Feature layers powered by ArcGIS Enterprise feature services will be rendered using WebGL at 10.6.1. Full server-side caching and PBF will be in an upcoming release.

Vector feature tiles, unlike vector tiles, construct continuous layers containing the feature geometries and attributes that can be mapped and analyzed on the client without worrying about tile boundaries. Also, vector feature tiles are not "precooked." They are directly linked to their data source: as the data changes, features are updated.



Moving More Processing to the Client

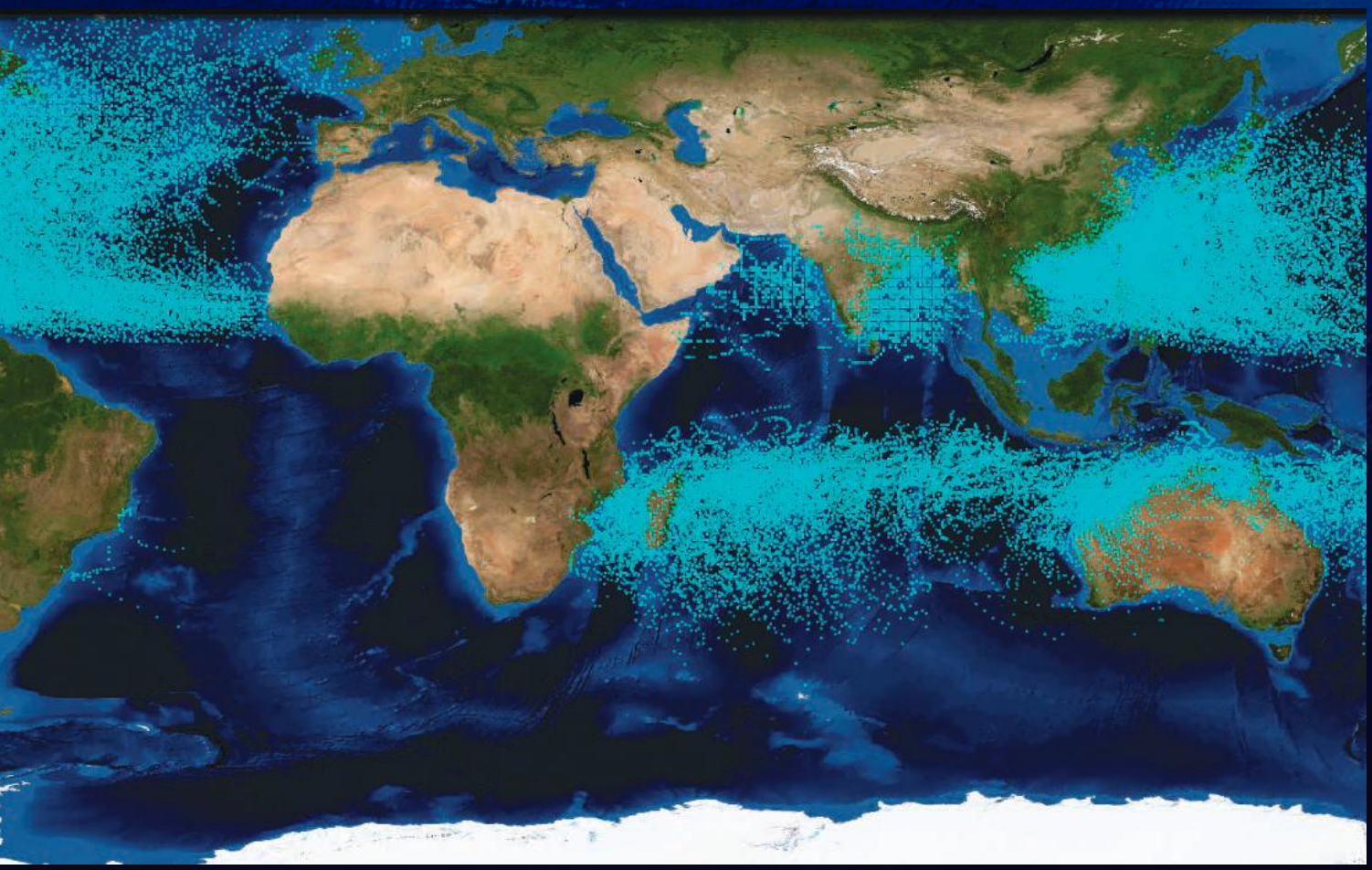
Once features are on the client, it makes sense to do as much processing as possible on the client rather than waiting for round trips to a server to perform tasks. Client processing using this approach feels almost instantaneous and allows for dynamic workflows.

Built upon some of the latest advances in web technology, the client-side capabilities of the ArcGIS API for JavaScript have been incrementally growing with each release. A few of these capabilities are the ability to query features in the layer, access the full geometry engine, and use client-side projection.

Developers can perform queries and calculate statistics using the data currently available for drawing. The API uses web workers to execute the query on a separate thread from the display. To perform queries, the API maintains an in-memory database and spatial index of all features, along with a SQL engine that is used to evaluate WHERE clause expressions.

Geometric operations, such as buffering and calculating spatial relationships, can be performed in a variety of scenarios including real-time validation while drawing.

The projection engine, used by ArcGIS Pro and the ArcGIS Runtime SDKs, was packaged



↓ This image shows the hurricane data in World Geodetic System (WGS) 1984 before being dynamically reprojected.

as a WebAssembly (WASM), included with the API, and enables fast client-side projection for feature layers and CSV layers.

API tools and widgets already part of the API and those that will be available in upcoming releases take advantage of these client-side capabilities to provide an interactive user experience.

Seeing the Power of Client-Side Processing

A web app, showcased during the 2018 Esri Developer Summit and available online at esriurl.com/hurricanes, demonstrates the client-side processing capabilities of the ArcGIS API for JavaScript. It is based on an Esri Story Maps app called Eyes of the Hurricanes that was featured on the Maps We Love website. This app visualizes hurricane data obtained from the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information. More than 130,000 features are added by simply dropping the CSV file on the app's map. For each hurricane, the CSV file contains each hurricane track location in latitude-longitude, its maximum wind speed, and its Saffir-Simpson hurricane category.

Instead of using the World Geodetic System (WGS) 1984, the standard coordinate system used by GPS, the data is reprojected into the South Pole Stereographic coordinate system. This not only matches the basemap but also showcases the circuitous path of hurricanes. The reprojected data is visualized with a unique value renderer using firefly image symbology based on the hurricane category on the

↖ In the hurricane app, the data was reprojected from latitude-longitude coordinates into the South Pole Stereographic coordinate system to showcase the circuitous path of hurricanes.

↙ Individual hurricane tracts can be interrogated interactively to learn the hurricane's path and characteristics.

firefly basemap, which is available from the ArcGIS Living Atlas of the World.

When rotating the view from the South Pole to the North Pole, the animation is smooth. Individual hurricane tracts can be interrogated interactively on the client at the cursor's location to see the hurricane's track, the year it occurred, and its maximum wind speed. As the user moves the cursor, a spatial query is performed to identify the hurricane within the search area that has the maximum wind speed. To highlight the hurricane track, the dataset is queried to find all the points that are part of the path.

The 4.8 release of the ArcGIS API for JavaScript includes additional enhancements to labeling, drawing improvements, the ability to create heat maps, enhancements to underground navigation, and many other capabilities. Read the release notes on the ArcGIS for Developers site at developers.arcgis.com/javascript/latest/guide/release-notes/index.html.

About the Author

Julie Powell is a technical product manager. Her primary focus is the ArcGIS API for JavaScript. She has more than 17 years of experience working with software development, delivering solutions for both enterprise and consumer markets. Powell has worked on a wide range of projects and consulting endeavors, including serving as a technical lead for web mapping solutions for strategic customers. She interfaces with a wide user community to maintain awareness and insight into GIS community needs, meanwhile contributing feedback to development teams to help ensure users can be successful in building state-of-the-art, purposeful solutions using ArcGIS software.

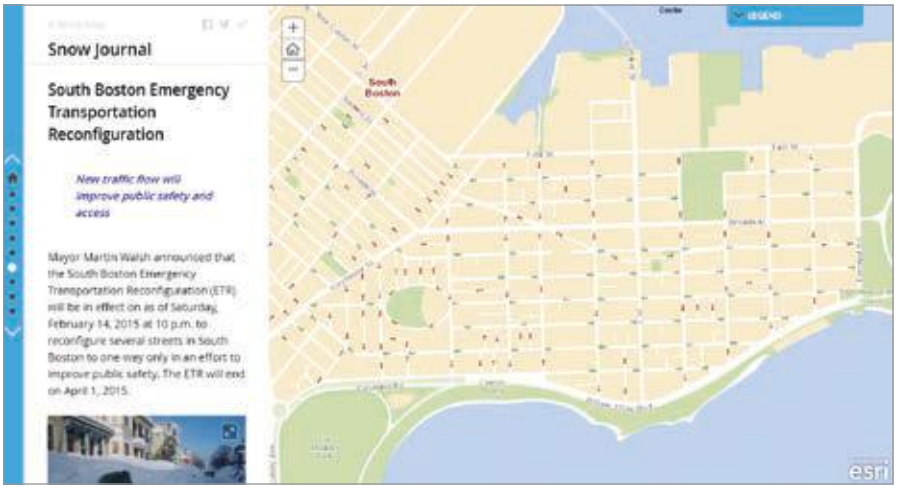
Why Governments Need to Embrace the Lost Art of Storytelling

By Christopher Thomas,
Esri Director of Government Markets

In simpler times, people knew their community and its story.

↓ Greenville, South Carolina, uses an Esri Story Maps app to attract visitors.

↓↓ The City of Boston, Massachusetts, shows citizens the intricate process of removing snow from streets.



Now we lead busy lives that strain our bonds with neighbors and community. Through social media, we have become more connected to dispersed and distant groups while we have become much less connected to the people who live next door.

Every year, my city puts on a play called the Ramona Pageant. It celebrates the history of the region. Once the community pulled together to put on this event. Generations of families participated in the play. There were parades and banners in the town promoting the pageant. Restaurants and local businesses posted its fliers. The Chamber of Commerce used it to promote tourism and investment in the community.

The play is still performed, but that sense of community is gone. An event that once represented community pride is now held together by a handful of people.

Why are we increasingly drawn away from our community? Why aren't more people engaged in their communities? Technology sometimes gets blamed. We used to shop on Main Street; now we shop online. Neighborhood watch groups and phone trees have been replaced by apps like Nextdoor and Ring.

Perhaps technology—the very thing that may have enabled disengagement—can be used to tell people the stories that will draw

them back into the community. Storytelling reintroduces the narrative that gives people a sense of place and connects them to others in their community.

Visit the website of your local government. Do you get a sense of community, or do you just get a list of departments and maybe a form for reporting a complaint? The closest you will likely get to an understanding of your community might be a short version of the city's history and a list of facts about it. Does that draw you in?

A successful local government website draws in visitors. Hundreds of communities, such as Greenville, South Carolina, and Eugene, Oregon, have embraced Esri Story Maps apps to encourage people to reengage with the communities in which they live and attract visitors.

Community stories have become a lost art but not a lost cause. You can use story maps to strengthen your community's identity and improve its sense of community. Powerful storytelling informs the public, promotes buy-in and feedback, builds community pride, and promotes your city as a tourist destination.

Informing the Public

State and local governments often try to keep the public informed about important topics and local issues that can range from drug addiction to crime rates to how tax dollars are spent. The City of Boston, Massachusetts, educates the public. It uses a story map to show the intricate process needed to efficiently remove snow from city streets. Pinellas County, Florida, uses storytelling to communicate how, where, and why taxpayer dollars are being spent. By putting issues into context, people view problems as a community, and that encourages citizens to tackle them together.

Encouraging Buy-In and Feedback

Public participation was the earliest form of civic engagement, designed to gain buy-in for government decisions while presenting opportunities for citizen feedback. In Long Beach, California, the city is seeking to create noise ordinances based on public input through a crowdsourcing story map.

Building Community Pride

When people feel they are connected to the unique culture, history, and social activities of a place, community pride grows. Story maps on government websites can share the social life of a community and highlight individuals. The City of Moreno Valley, California, shows the community's pride in and support of local men and women who are serving in the military.

Promoting Your Community as a Destination

Governments need to show people both inside and outside the community those "don't miss" places and events. What is going on that people should know and care about? Perhaps it's a craft brewery or a farmers market? Use story maps to promote the things you want your community to be known for.

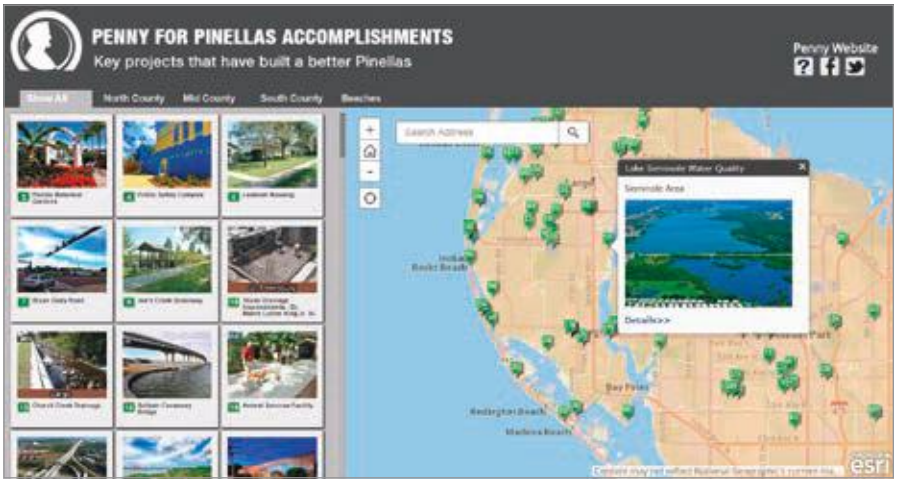
Storytelling using Esri Story Maps apps is simpler than you think. Go to esri.com/storymaps to try it for yourself.

About the Author

Chris Thomas is the director of government markets at Esri and a founding team member of the Industry Marketing Department. Prior to joining Esri in 1997, he was the first GIS coordinator for the City of Ontario, California. Thomas frequently writes articles on the use of GIS by government. Follow him on Twitter @GIS_Advocate.

↓ Pinellas County, Florida, uses storytelling to communicate how, where, and why taxpayer dollars are being spent.

↓↓ Eugene, Oregon, promotes itself as a tourist destination with a story map.



A More Informed View of City Business

By Carla Wheeler, *ArcWatch* Editor

This is the story of how the manager of a small city in West Virginia came up with a big idea: convert the city council agenda from a drab document to a lively account of municipal business using an Esri Story Maps app.

The agenda is a tried and true document that guides city council meetings. It lists items up for discussion or vote. Typically written in a bureaucratic style and void of visuals, the agenda is often posted as a PDF on a city government's website.

That's no longer true in Oak Hill, West Virginia, where the city council replaced a static agenda with an animated story map to guide its monthly meetings. Using the Esri Story Map Series app, the city's lone GIS employee Marvin Davis creates an itemized, interactive agenda describing each item and providing maps, photographs, and links to documents such as reports, legal notices, and correspondence.

Oak Hill is a city of 8,500 people that lies just west of the New River Gorge National River, a 70,000-acre national park. Earlier this year, Esri account manager Daniel Peters showed city manager Bill Hannabass an Esri story map and he immediately thought, "Gosh, I could use that for the council presentation. It's visual."

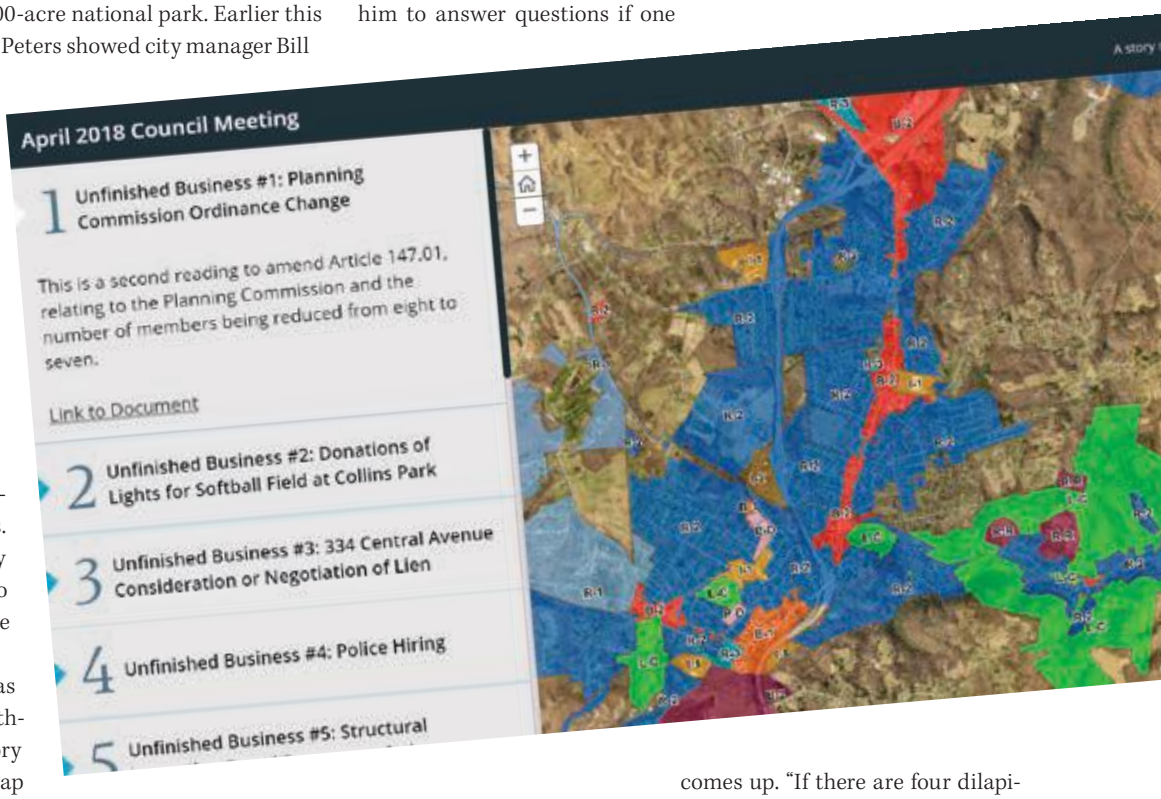
Hannabass used maps to view assets when he served in the US Army. "I lived and died by maps," as he remembers it. He was naturally drawn to the ability of maps to tell a story visually and tell it quickly. He was also impressed that the cloud-based interactive maps from the city's ArcGIS Online organization account could be used in story maps. Esri Story Maps apps are currently available at no additional cost to ArcGIS Online account holders like the City of Oak Hill.

Davis, the GIS coordinator, was given the task of turning the monthly city council agenda into a story map. Davis selected the Story Map Series app with the side accordion layout. Because that layout automatically builds a numbered list of items that run down the left side of the story map, Davis just writes a short header and one line of text that describes each agenda item; adds a related map or a photo; and then creates links to any other images, legal documents, notices, or correspondence.

One agenda item Davis worked on for the April city council meeting dealt with structural inspection board recommendations on several buildings around town that needed to be repaired or demolished. Davis mapped the buildings' locations in the story map and added links to images of those structures and related documents such as demolition orders and bids. "It makes *[the agenda]* informative," Davis said. He said the story map format gives those looking at the agenda the geographic context of the issue, and all the information on it is at their fingertips.

Oak Hill City Council members and local media outlets receive story map agendas in a ShareFile packet that Hannabass sends in an email prior to meetings. During the city council meetings, Hannabass also goes through each numbered item on the story map agenda, which is displayed on two screens in City Hall.

Agenda items often have geographic reference points, so Hannabass said using a story map as an agenda makes it easy for him to answer questions if one comes up. "If there are four dilapidated structures that I have to tear down and someone asks *[about a particular building]*, 'What street is that one on?', I can pull up a map," Hannabass said.



Because photos and legal or other types of documents can be linked in the story map, those are easy to access and view, too, if necessary. No longer does Hannabass need to display the agenda as

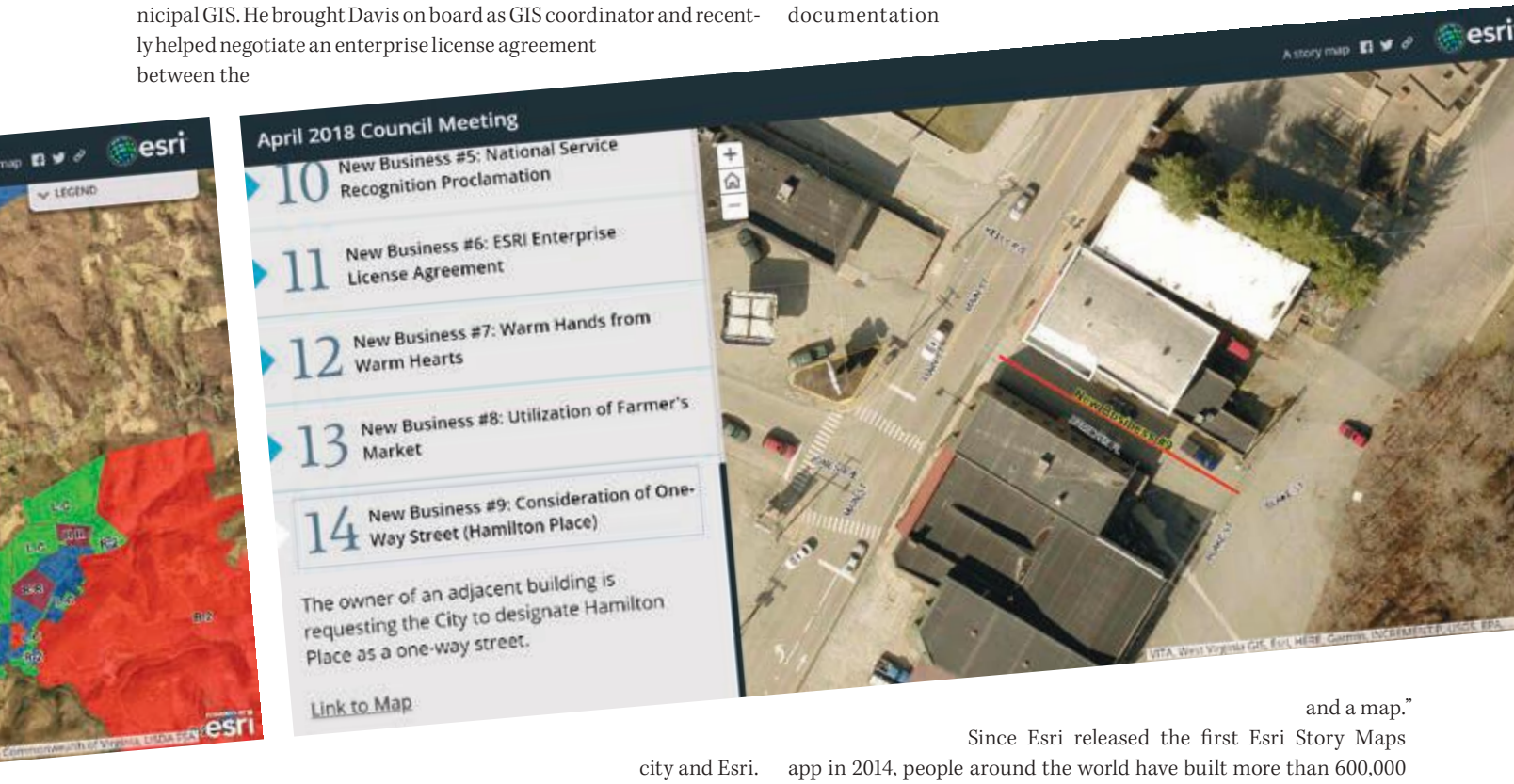
↙ GIS coordinator Marvin Davis turns the monthly city council agenda into a story map. For each item, he adds a related map or a photo and creates links to any related images or documents.

↘ Davis says the story map format gives those looking at the agenda the geographic context of the issue and all the related information.

a Microsoft Word document or PowerPoint presentation. Gone are the PDFs or scanned images of maps. If anyone asks him a question, Hannabass has "a ton of information" to dig into. "You don't have a ton of boring PDFs to flip through."

Hannabass said online story maps are an excellent medium for sharing information to a city council, board of directors, or other group—public or private. People are often overwhelmed by reams of paper they receive before a meeting. "Our council packets were three to five inches thick," Hannabass said. "It is crazy to have that much paperwork."

He put an end to paper-based agendas in Oak Hill some time ago. According to Davis, Hannabass has been a strong advocate for a municipal GIS. He brought Davis on board as GIS coordinator and recently helped negotiate an enterprise license agreement between the city and Esri.



That agreement, scheduled to begin in July 2018, will increase the number of city employees with access to GIS and beef up capabilities to do analysis. "Hannabass has been my biggest champion here," Davis said.

The city also plans to share the city council story map agendas online with the public soon, making it easier for Oak Hill residents to stay informed about what's happening in their community. Right now, city council members and the media can study the city council agenda plus all the related documents in one online app before meetings begin.

"That is transparency that is beyond what is typical," Hannabass said. "It *[will]* be more transparent on the website."

Davis said that there's often a geographic component to city business, which is why sharing information via a story map agenda makes perfect sense. If viewers want to take a closer look, for example, at zoning designations or a proposed new one-way street on a story map, they can just pan around and zoom in on the geographic locations. A PDF or a scanned image of a map restricts their view.

"I am biased," said Davis, referring to his interest in geography and his job in GIS. "But I think *[the story map agenda]* offers a more informed view. You are able to look at pertinent documentation and a map."

Since Esri released the first Esri Story Maps app in 2014, people around the world have built more than 600,000 story maps. Oak Hill's story map designed specifically for city council agendas seems to be a first. The city's adoption of the Story Map Series app to produce the agendas impressed Allen Carroll, who leads the Esri Story Maps team and is program manager of storytelling.

"We're always thrilled to see fresh and unexpected new uses of Esri Story Maps," Carroll said. "Oak Hill's use of our Story Map Series app to present its council agenda is a delightful example of the versatility and power of map-based storytelling."

Curators at the Library of Congress Embrace Story Maps

By Cooper Thomas, Esri Story Maps Product Engineer

The largest library in the world, the Library of Congress (LOC), found a new and innovative way to share its massive collection using Esri Story Maps apps.

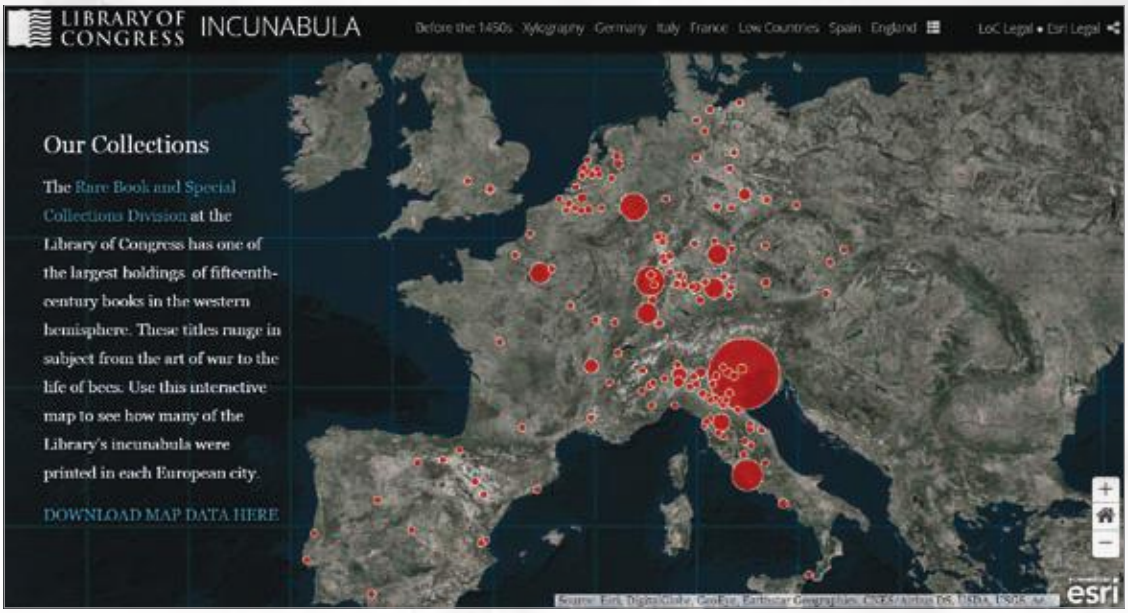
← LOC houses the Carnegie Survey of the Architecture of the South (CSAS), a collection of more than 7,100 images created by noted architectural photographer Frances Benjamin Johnston. Her systematic record of early American buildings and gardens in the South is the subject of the story map by Kristi Finefield of the Prints and Photographs Division, LOC.

Located in Washington, DC, LOC serves Congress, the federal government, and the people. The library's collection now boasts more than 167 million individual items. The staggering 838 miles of bookshelves contain books, printed materials, recordings, photographs, maps, sheet music, and manuscripts. With 12,000 new items added daily, many of these national treasures will never be part of a physical exhibit.

As the library embraces the twenty-first century, its leaders have adopted a strategic plan for 2016 through 2020 that will share more of its collections using new technologies, systems, and online tools. Physical exhibits cost money, take time, and are available only to those who can physically visit the library. The library has empowered curators with digital tools to reach an increasingly connected global audience beyond the library's walls.

Library leaders initiated a 10- to 12-week pilot program to test Esri Story Maps apps as a new method for curating collections. Story maps let users combine text, images, and multimedia content in an interactive application that tells stories through the power of geography using GIS. During the trial program, 10 employees from six library divisions used the online platform to create presentations that illuminate previously unseen collections. The curators chose compelling materials that had never been exhibited and readied their story maps for presentation during LOC's GIS Day celebration on November 15, 2017.

The exercise shined a light on collections that otherwise might never have been seen. Story maps provided new ways for the 10 curators to explore and share their collections. They used existing location data in their subject matter to better understand each collection, tease out



→ LOC has one of the largest holdings of fifteenth-century books in the western hemisphere. The *Incunabula* story map by Stephanie Stillo of the Rare Book and Special Collections Division organizes these extensive holdings geographically.

new insights, and foster connections between different divisions at LOC as curators collaborated to enrich each other's projects. Perhaps most important, they created a means of sharing collections with anyone in the world who has an Internet connection.

"I was able to give a voice to a collection and make it my own," said Francisco Macias of the Law Library of Congress. "I think many of us who work in the library oftentimes think, 'Why don't they do an exhibition on this?' This provides an opportunity to bring collections to life."

The cloud-based Esri Story Maps platform will be available to all library staff. Pilot project participants are looking forward to creating more digital exhibits using story maps. Three story maps have been published on the Library of Congress website (www.loc.gov), and the library has plans to share more story maps on the website.

"I find story maps to be a twenty-first-century tool for a twenty-first-century library," said Stephanie Stillo of the Rare Book and Special Collections Division. "Story maps give us this fun and user-friendly way to mine deeper into our collections through mapping our data and through creative visualization. More and more people are reaching out to the library through our website, and I think it's important that we're reaching back to them with information that's interactive, that's engaging, and that has that stamp of authority from the Library of Congress."

About the Author

Cooper Thomas is a cartographer and product engineer on the Esri Story Maps team. He is a displaced Oregonian, a forager of cultural sustenance, and a fair-weather motorcyclist.

← Japanese-Americans who were interned in assembly and relocation centers during World War II produced newspapers that chronicled their experiences. *Behind Barbed Wire*, by Chris Ehrman and Heather Thomas of the Serial and Government Publications Division, highlights some of LOC's collection of more than 4,600 English and Japanese language issues published in 13 camps.

Make Your Story Map Successful

By Hannah Wilbur,
Esri Story Maps Team

Following these tips will help you wow readers of your Esri Story Maps apps every time.

1 Connect with Your Audience

Who are your readers? Before you build your story map, think about who will be seeing it. Craft your text, maps, and other content to suit your audience. Avoid jargon. Use accessible language. It's not about dumbing down; it's about striving for clarity and simplicity.

2 Lure People In

Start your story map with a bang. For your cover image, choose one that's exciting and attractive. Make sure your title is active and descriptive. While a title like *A Walking Tour of Springfield* is okay, *Discover the Hidden Treasures of Springfield* is better, but don't be ambiguous about the location. Make it clear that you are talking about Springfield, Illinois, not Springfield, Massachusetts.

After you lure them in, keep people reading your map. Put the map's core concepts at the beginning rather than the end. Don't include outbound hyperlinks in your introduction. They could distract readers and dissuade them from navigating through your story. Put those links at the end of the map.

3 Choose the Best User Experience

There are many styles of Esri Story Maps apps templates. Go to the Story Maps Gallery (https://bit.ly/1T0WbU4) to see examples of creative approaches to storytelling as well as general best practices.

Choose one with a user experience appropriate for your story. Story Map Tour is great if you have lots of places with photos and short captions. If you have more text, the Story Map Journal might be better. If you want your audience to be able to compare different maps, Story Map Series makes the most sense. For a long, less structured narrative that people read like a web page, use Story Map Cascade.

Browse all Esri's templates to decide which one makes the most sense for your map. Each template has a tutorial page that guides you through the authoring process. Once you have picked a template, take the template tutorial.

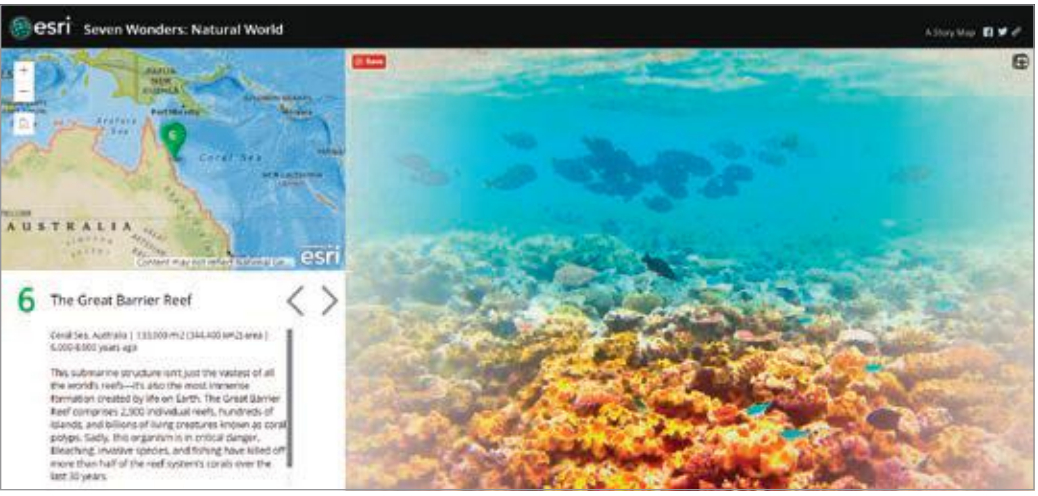
4 Make Easy-to-Read Maps

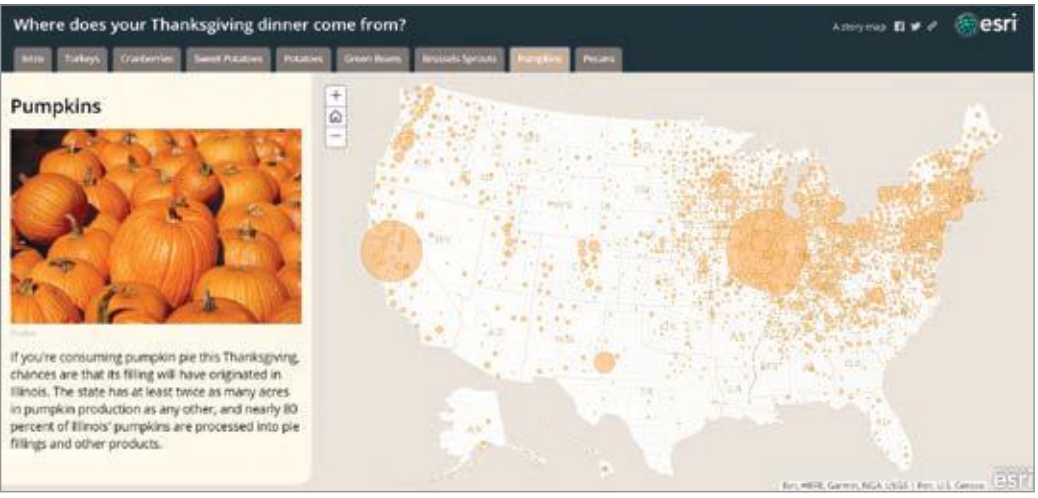
You can create your web maps in ArcGIS Online first and reference them when building your story map. Some templates also let you create and edit maps within their interactive builders. No matter which approach you use, make sure your maps are as simple, clear, and user-friendly as possible.

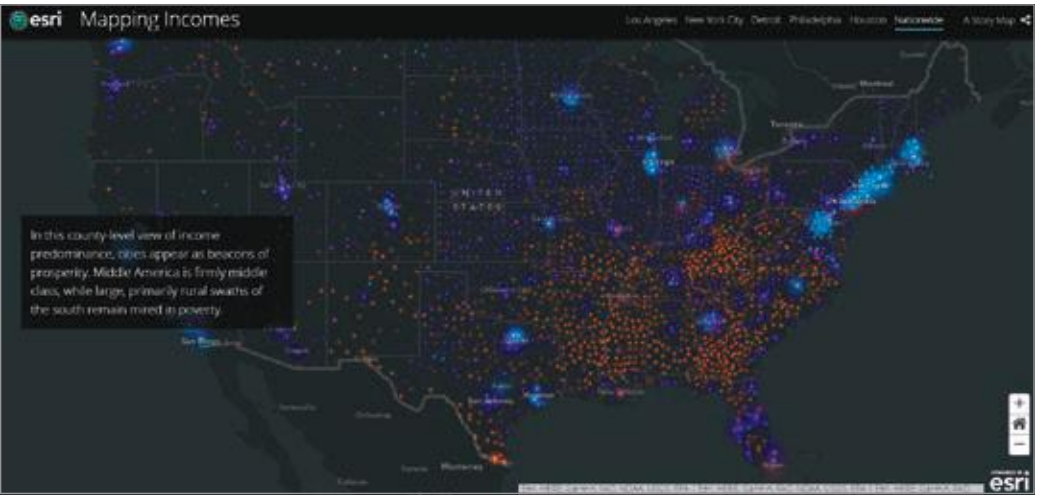
You can add your data to ArcGIS Online web maps in many formats, including tabular data from spreadsheets. Combine your data with the authoritative data published by Esri and other leading agencies. Choose an appropriate basemap. In many cases, a simple gray basemap may be better than satellite imagery.

Incorporate cartography that matches your project. Edit your map to eliminate unnecessary detail. Think about what custom pop-ups, legends, and symbology you want to provide to deliver your map's message.

← Start your story with a bang by choosing a cover image that's exciting and attractive.







↖ Choose the story map template that will help you tell your story.

← Make maps that are easy to read, and eliminate anything that detracts from your map's message.

↙ Strive for simplicity in individual maps and the story map overall.

6 Reach Your Audience

Now that you've finished your story map, make sure it gets in front of its target audience. You can share your work publicly or restrict it so it can only be accessed by people in your organization. Promote your published story map by linking to it, embedding it in your website, writing a blog post about it, sharing it on social media, or including it in your newsletter.

About the Author

Hannah Wilbur is a transplant from upstate New York. She works as a content creator on the Esri Story Maps team. She is fascinated by how storytelling affects the human brain, and she loves conservation.

5 Strive for Simplicity

Stories are distillations. The more you remove nonessential elements, the more effectively you can communicate. Remember that attention spans are short in the digital age, so shorten your text and simplify your maps—and then go back and do it again. A person should not have to get to the fifth or sixth section of your story map to understand its underlying concepts and mission.

Mapping and Modeling Lidar Data with ArcGIS Pro

By Mike Price, Entrada/San Juan, Inc.

What you will need

- An ArcGIS Pro license
- ArcGIS Spatial Analyst or ArcGIS 3D Analyst extension license
- Sample dataset downloaded from the *ArcUser* website

Calculating the difference between bare earth and first return lidar rasters provides information such as forest canopy height and character, building heights and orientation, aboveground utility alignment, a count of cars on the road, and even estimates of large livestock in a field.

This tutorial teaches how to use bare earth and first return lidar rasters to compare natural and cultural features in ArcGIS Pro. It uses data from previous *ArcUser* tutorials that was collected in 2017 during a public safety event sponsored jointly by agencies in the United States and Canada called the fifth Canada-United States Enhanced Resiliency Experiment (CAUSE V) exercise. For more information on this exercise, see "Testing Cross-Border Disaster Response Coordination" in the fall 2017 issue of *ArcUser*.

A tutorial in the fall 2017 issue of *ArcUser*, "Modeling Volcanic Mudflow Travel Time with ArcGIS Pro and ArcGIS Network Analyst," used CAUSE V data to model volcanic mud and debris flows (lahars), riverine flooding, landslides, and other natural phenomena caused by the hypothetical crater collapse of nearby Mount Baker.

The rasters enabled CAUSE V geoscientists and emergency managers to accurately predict lahar behavior and identify values at risk along its travel path. They were collected by WSI (Watershed Sciences, Inc.). The company was contracted by the Nooksack Indian Tribe and the Puget Sound LIDAR Consortium (PSLC) to collect lidar data along the Nooksack River Basin, which was flown in 2013. This exercise makes further use of that lidar data.

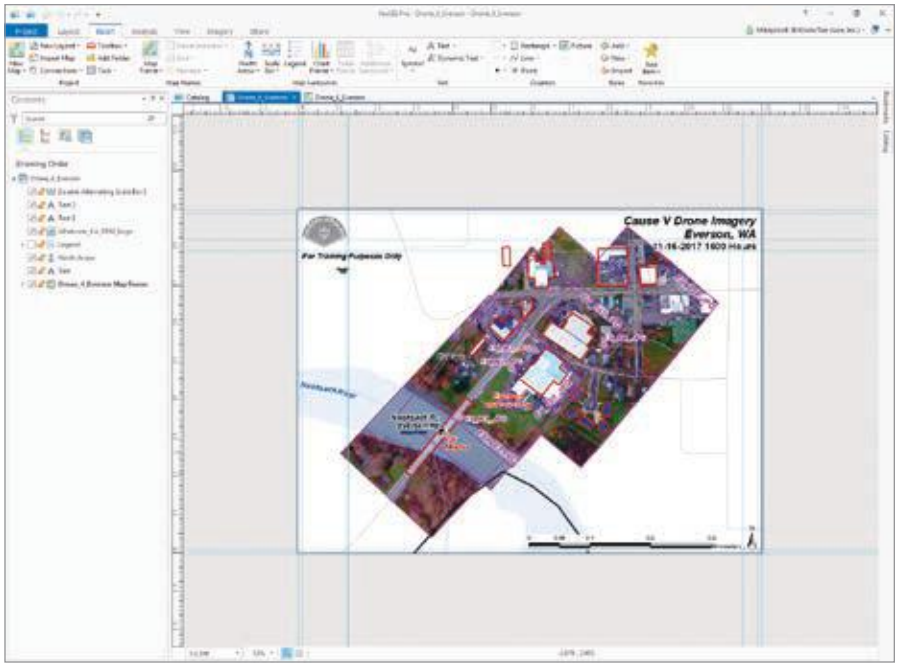
Getting Started

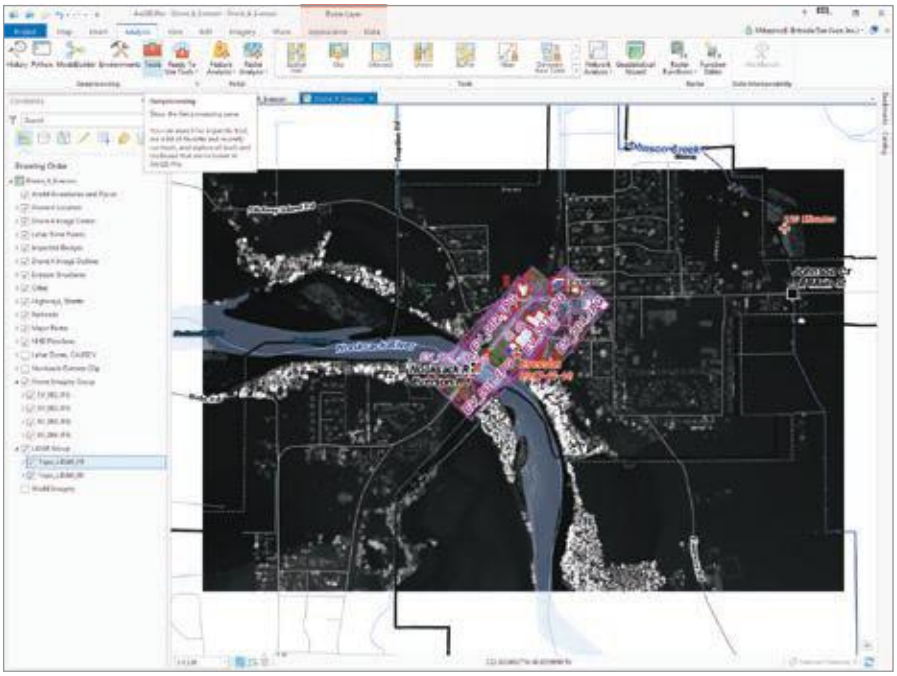
Download the sample dataset from the *ArcUser* website and unzip it on a local machine. The archive includes a new prebuilt ArcGIS Pro project, two lidar surfaces, and four georeferenced drone images. In this exercise, make sure to follow the naming conventions specified.

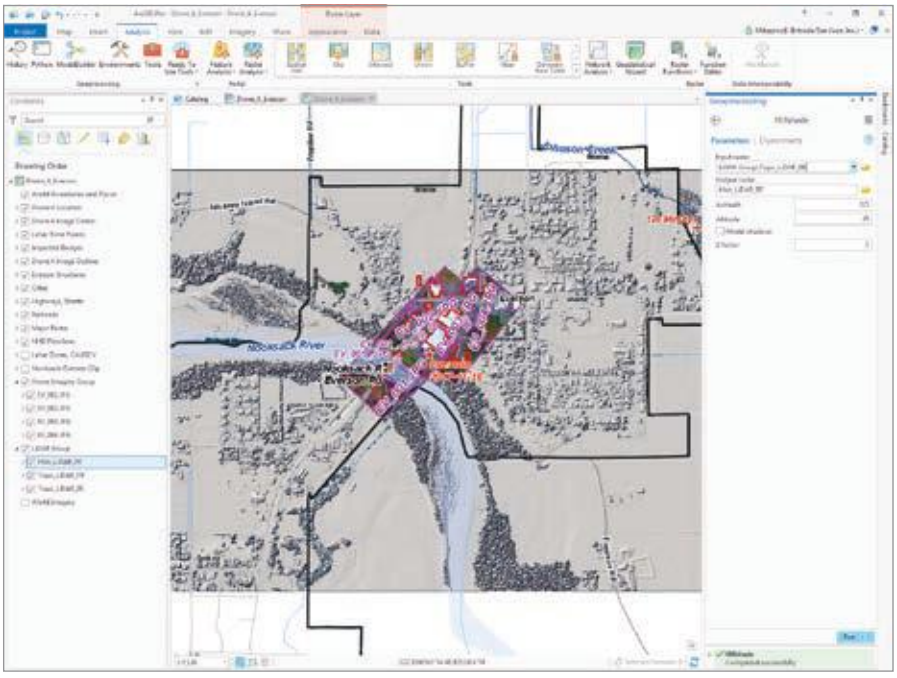
Start ArcGIS Pro and open Drone_4_Everson.arpx, located in CAUSE_V_Drone_4\Drone_4_Everson. The project displays the four georeferenced drone images. Inspect the layout and notice how the georeferenced images closely match the river corridor and building footprints. How would you confirm the location and position of natural and cultural features on these images? This exercise uses bare earth and first return lidar rasters to do that.

Switch from the Drone_4_Everson layout to the Drone_4_Everson map, and inspect the feature layers in the Contents pane. The coordinate system is universal transverse Mercator (UTM) North American Datum 1983 (NAD83) Zone 10 N. All horizontal and

↓ The project opens in layout view with four drone images.







↖ In the ArcGIS Pro ribbon, click the Analysis tab. Select Tools to display the Geoprocessing pane, and locate the Hillshade tool.

↙ Move Hlsh_LiDAR_FR to a position just above Topo_LiDAR_FR.

vertical units are in meters. Turn individual images on and off and zoom in to check the georeferencing accuracy. Turn on the Esri *World Imagery* basemap and compare it to the drone imagery.

On the ribbon, click Project and select Options. In the Options window, open the Map and Scene window and make sure the scene type is set to Local.

Global scenes display 2D and 3D data using the World Geodetic System 1984 (WGS 84) Web Mercator (Auxiliary Sphere) coordinate system. Local scenes display data that has a spatial reference in a local projected coordinate system with terrain and layers projected on a planar surface. Local scenes support display and analysis of data at a large scale and within a fixed extent.

ArcGIS Pro will retain this local scene selection, so be sure to switch back to a global scene if you model small-scale data subsequently, especially if data is referenced in a geographic coordinate system (GCS) rather than supported in a local scene. Click the back arrow located in the upper-left corner and save the project.

Adding Lidar Rasters

In the ArcGIS Pro map, click the Add Data button, navigate to \CAUSE_V_Drone\GDB_Files\UTM83Z10, and open Topo_LiDAR.gdb. Hold down the Shift key and select Topo_LiDAR_BE (the bare earth raster) and Topo_LiDAR_FR (the first return raster). Click OK to add them to your map.

After the lidar rasters load, select both, right-click either layer, and choose Group. Rename the new group LiDAR Group and place Topo_LiDAR_FR above Topo_LiDAR_BE.

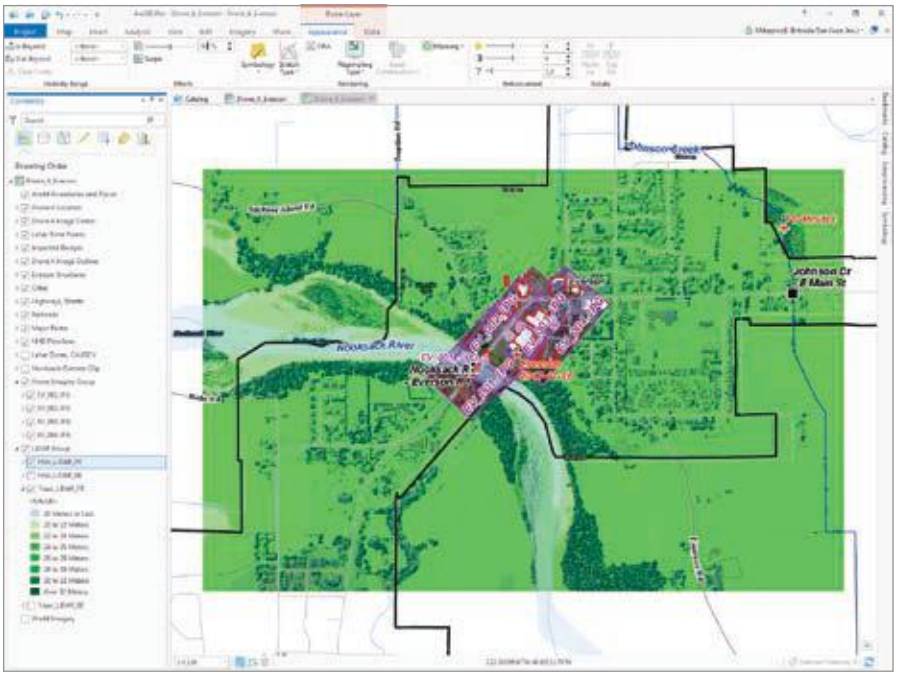
First return points are typically positioned above the bare earth. Check the elevation range for each raster. Each raster has 1-meter resolution and contains considerable detail. Move Lidar Group below Drone Imagery Group and save the project.

Modeling Lidar Hillshade

Hillshades show the high level of detail in both rasters and visually demonstrate the difference between first returns and bare earth. Create hillshade rasters for both lidar surfaces. In the ArcGIS Pro ribbon, click the Analysis tab, and select Tools to display the Geoprocessing pane. In the Contents pane, highlight Topo_LiDAR_FR and type hillshade in the Geoprocessing pane's Search window to locate the Hillshade tools for Spatial Analyst and/or 3D Analyst. Although there are several ways to display a hillshade in ArcGIS Pro, you need either the Spatial Analyst extension or 3D Analyst extension to perform other tasks in this workflow.

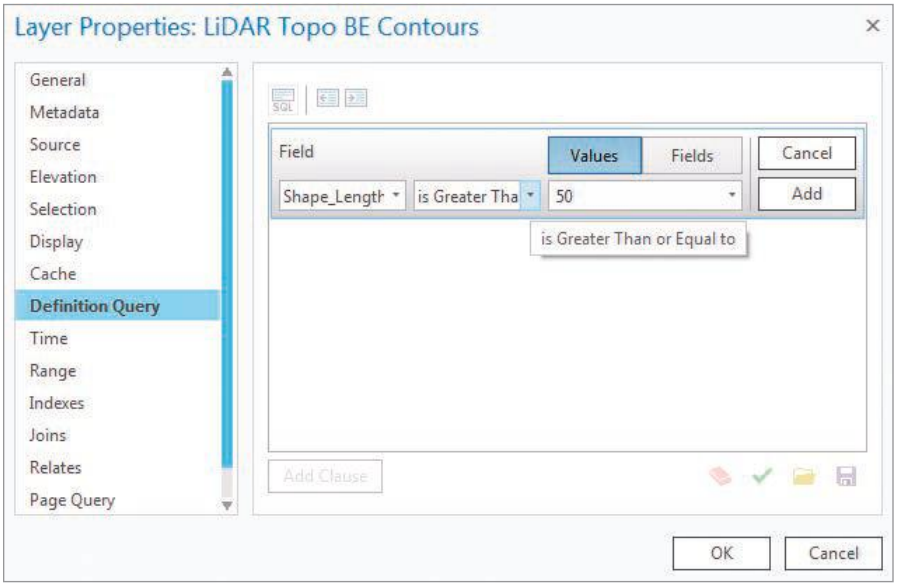
In the Geoprocessing Hillshade pane, set the Input Raster to Topo_LiDAR_FR and specify the Output raster Hlsh_LiDAR_FR. Make sure you save it in Topo_LiDAR.gdb. Leave other parameters unchanged and click Run.

After the first return hillshade is added to the Contents pane, move it just above Topo_



↖ Select Hlsh_LiDAR_FR. On the Raster Layer tab, click the Appearance tab and in the Effects area, set the transparency to 50 percent.

↙ Create a definition query on the LiDAR Topo BE Contours layer to thin the visible contours.



LiDAR_FR and inspect it briefly. Return to the Geoprocessing Hillshade pane and create a hillshade for Topo_LiDAR_BE and name it Hlsh_LiDAR_BE. (Hint: Simply change FR to BE in both raster windows.) In the Lidar Group, place Hlsh_LiDAR_BE immediately below Hlsh_LiDAR_FR and save the project.

Enhancing Lidar Symbology

Since the bare earth and first return rasters contain reasonably similar elevation ranges, the same classified symbology can be applied to both using a layer file. In the Contents pane, make only Topo_ LiDAR_FR visible, and right-click this raster and select Symbology to open its pane. In the Symbology pane, click the menu bar in the upper-right corner (which is three horizontal bars).

Click Import, navigate to \CAUSE_V_Drone\GDB_Files\UTM83Z10, and select Lidar Topo Symbology.lyr. Click OK to apply, and repeat the process for Topo_LiDAR_BE.

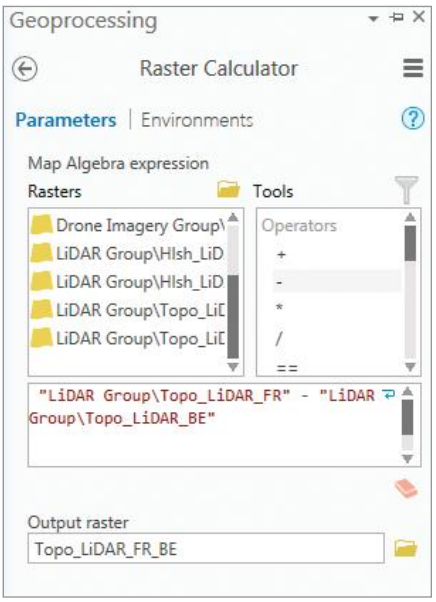
Turn off Topo_Lidar_BE. Turn on Hlsh_LiDAR_FR and select it. On the Raster Layer tab, click the Appearance tab and in the Effects area, set the transparency to 50 percent. Turn on Hlsh_LiDAR_FR and Topo_LiDAR_FR. Inspect the visual enhancement provided by the partially transparent hillshade. Also set the transparency of Hlsh_LiDAR_BE to 50 percent in the same manner. Turn on Hlsh_LiDAR_BE and Topo_LiDAR_BE. Save the project.

Creating and Enhancing Contours with Barriers

Now, let's create bare earth contours. The Contour with Barriers tool provides a highly functional way to create index and intermediate contours, even if you do not assign barriers. Reopen the Geoprocessing pane, type contour in the Search window, and select Contour with Barriers from either the Spatial or 3D toolset. Select Topo_LiDAR_BE (not Hlsh_LiDAR_BE) as the Input Raster, skip Input Barrier Features, and name the Output Contour Features Con_Topo_LiDAR_BE. Set the Base Contour to 0, the Contour Interval to 1, and the Index Contour Interval to 5. Click Run to create the contours.

In this project, I have provided a Contour Line template, stored as a layer file. Once the contours build and display, click the Add Data button, navigate to \CAUSE_V_Drone\

↓ In the Raster Calculator window, create an expression that subtracts Topo_LiDAR_BE from Topo_LiDAR_FR.



GDB_Files\UTM83Z10, and add LiDAR Topo BE Contours.lyr. If you have followed the naming and storing conventions exactly, the contour lines should reload with appropriate symbology and labels. If the layer has a red exclamation point next to it, indicating a broken data source, right-click it, choose Properties > Source and click Set Data Source. Navigate to the location where you saved Con_Topo_LiDAR_BE and set the data source to that location. If it still does not load properly, start troubleshooting by verifying that files have been named correctly.

Remove Con_Topo_LiDAR_BE from the Contents pane, relocate LiDAR Topo BE Contours below NDH Flowlines, and save the project again.

Notice that there are many small closed contours, even in the relatively simple bare earth set. To remove the smallest contours, create a definition query to display contours that have a length of 50 meters or more.

In the Contents pane, right-click LiDAR Topo BE Contours, select Properties, and open Definition Query. Click Add Clause and create a query where Shape_Length is Greater than or Equal to 50. Click OK, and the smallest contours should disappear. Notice how contour lines often match the bare earth raster's unique values thematic symbology. This is certainly reassuring. Save the project again.

As a challenge exercise, you could contour and symbolize the first return raster. Expect that it will be very noisy.

Calculating the Difference between First Returns and Bare Earth

One of my favorite lidar tasks is calculating the difference between the first return and bare earth rasters because it yields information that is useful in the real world.

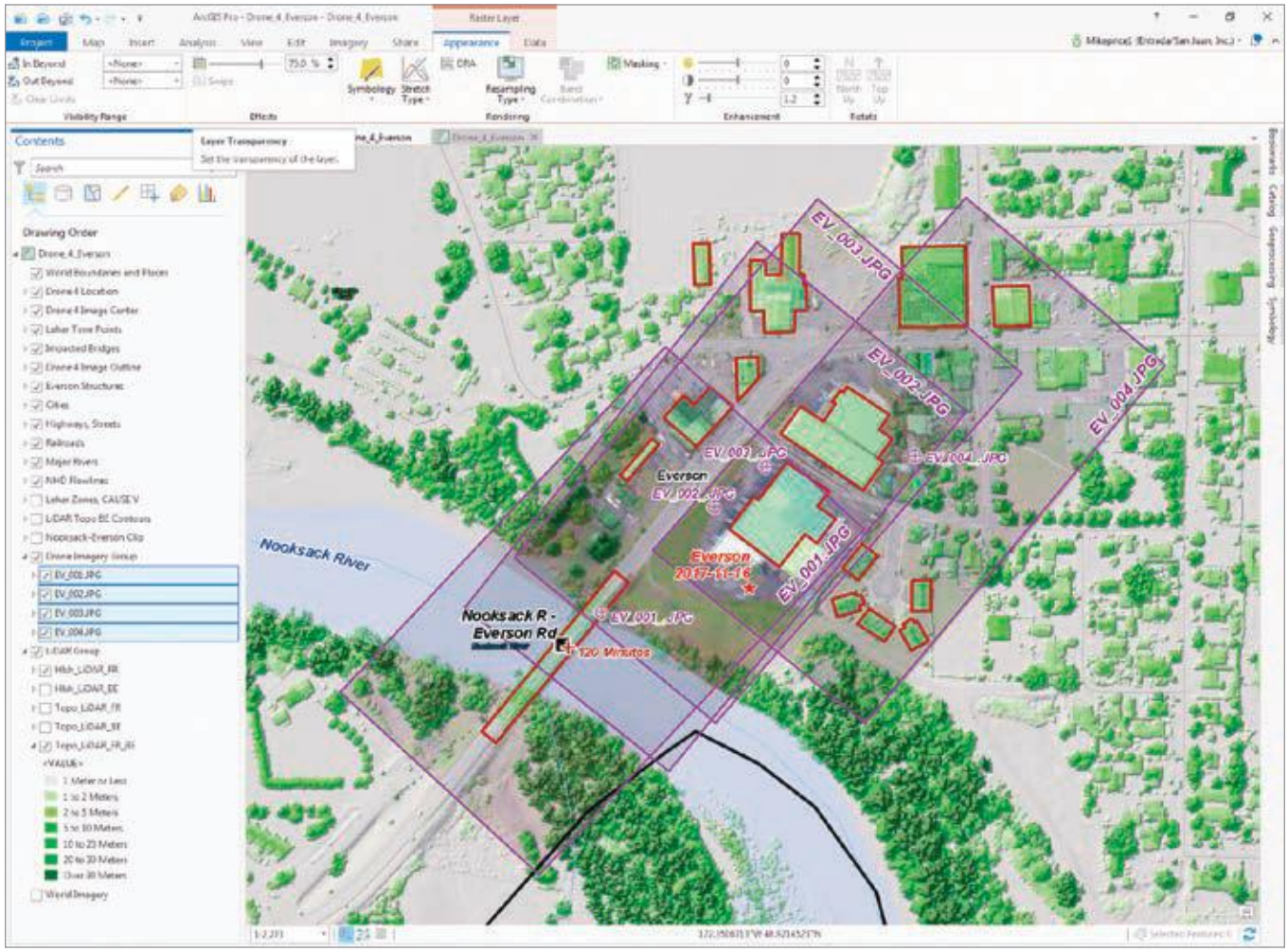
Return to Geoprocessing tools and type raster calculator in the Search window. Select Raster Calculator (the raster calculator from either the Spatial Analyst or 3D Analyst extension toolsets will work).

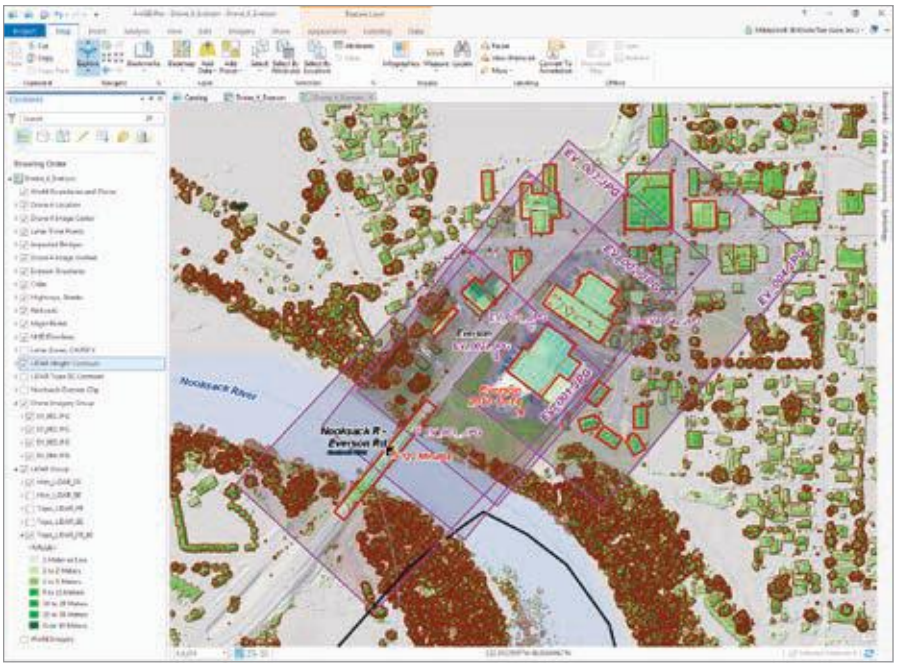
In the Raster Calculator window, create an expression that subtracts Topo_LiDAR_BE from Topo_LiDAR_FR. The expression order is critical. Make sure that you use the minus sign operator. Store the Output raster in Topo_LiDAR.gdb and name it Topo_LiDAR_FR_BE. Click Run to model the difference in the two rasters.

After Topo_LiDAR_FR_BE loads in the Contents pane, change its symbology by applying the layer file LiDAR Feature Height FR-BE.lyr. Move it to the bottom of the LiDAR Group.

In the next step, create one more contour set that will emphasize the differences between first returns and the bare earth. Before creating detailed contours, turn off LiDAR Topo BE Contours and use

↓ Select all four images in the Drone Imagery Group, and set their transparency to 75 percent.





↑ Add a layer file, LiDAR Height Contours.lyr, to apply symbology to Con_Topo_LiDAR_FR_BE and place it above LiDAR Topo BE Contours.

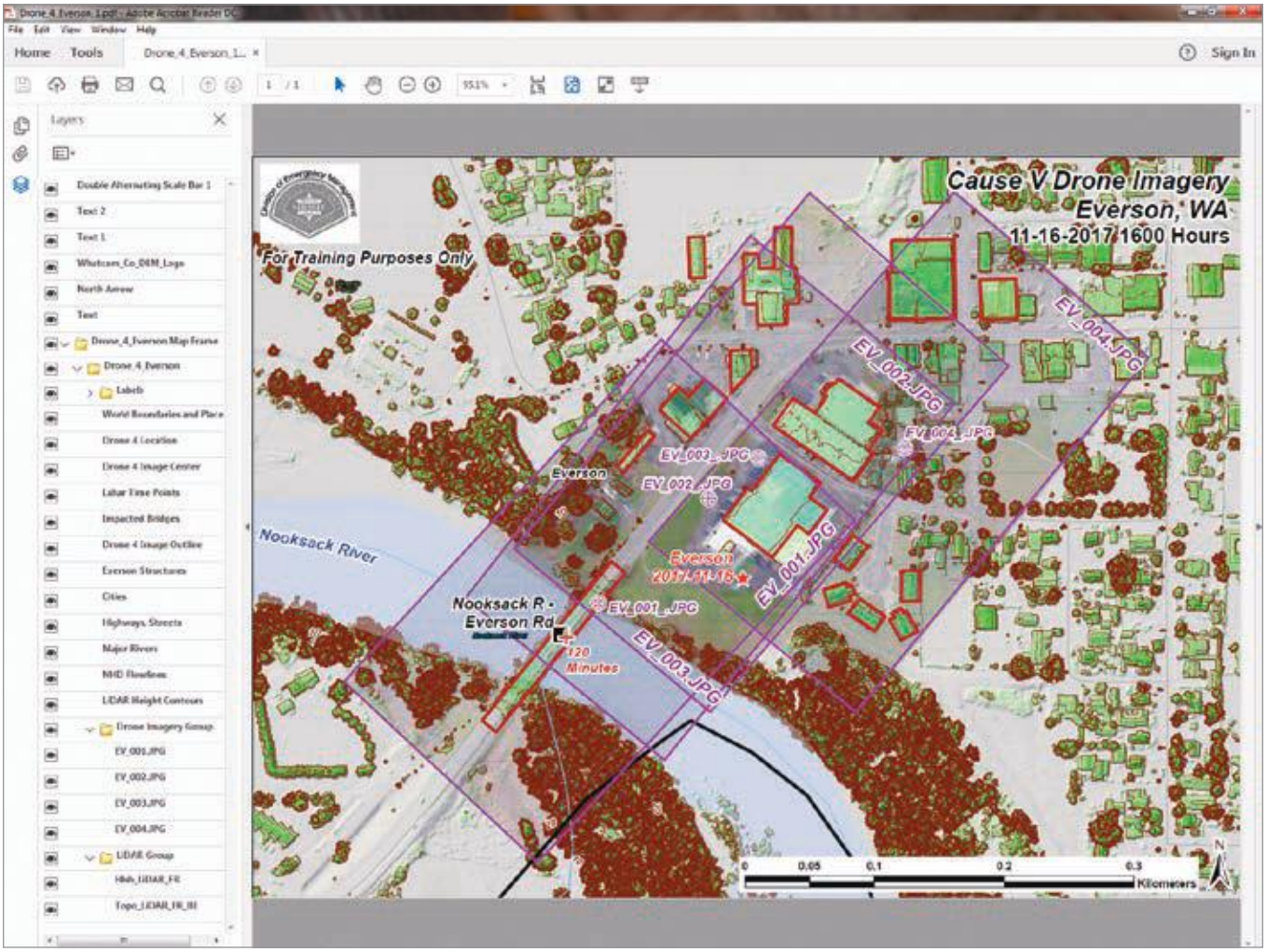
Bookmarks to zoom in to Everson 1:2,500.

Once zoomed in, turn on the Drone Imagery Group and select all four images. On the Raster Layer tab, click the Appearance tab, and in the Effects area, set the transparency for all drone images to 75 percent.

Return to the Geoprocessing Contour with Barriers tool and create another contour set by setting Input Raster to Topo_LiDAR_FR_BE, Output Contour Features to Con_Topo_LiDAR_FR_BE, Base Contour to 0, Contour Interval to 2, and Index Contour Interval to 10. Click Run to create contours.

To symbolize and label contours, load another layer file template. Navigate to \CAUSE_V_Drone\GDB_Files\UTM83Z10 and load LiDAR Height Contours.lyr. Place the new layer above LiDAR Topo BE Contours and remove Con_Topo_LiDAR_FR_BE. Notice how height contours define riparian woodlands, building footprints, the Highway 544 bridge, cars on roadways, logs

↓ Export the layout as a PDF file. Explore the layers available in this PDF.



An Introduction to Lidar Data

Light detection and ranging, or lidar, is a remote-sensing technology that uses pulsed laser energy (light) to measure ranges (distance). Engineers and earth scientists use lidar to accurately and precisely map and measure natural and constructed features on the earth's surface, within buildings, underground, and in shallow water. It has broad applications in many industries such as engineering and public safety.

Often deployed in down-looking systems in the air or oblique geometries in ground systems, a lidar system includes a laser source, a scanner, and a GPS receiver. During a lidar survey, an active optical sensor transmits laser beams toward a target while moving along or rotating across defined survey routes or fixed objects.

The laser energy is reflected by the target and is detected and analyzed by receivers in the lidar sensor. The receiver records the precise time from when the laser pulse left the system to when it is returned to the sensor. Using precise pulse time, the range distance between the sensor and the target may be calculated.

When combined with the positional information from GPS or an inertial navigation system (INS), these distance measurements are transformed into measurements of three-dimensional points that define the reflective target in 3D space. Lidar point data—including laser time range, laser scan angle, GPS position, and INS information—is postprocessed. It is then compiled into highly accurate georeferenced x,y,z coordinates by analyzing the laser time range, laser scan angle, GPS position, and INS information.

Laser pulses return to the sensor from different reflective surfaces located above and on the ground. A single emitted pulse may return as one or more reflections. The first returned pulse is very important, as it marks the highest or tallest reflective surface. First returns can include treetops, building roofs, and vehicle tops. If no other reflective surfaces are encountered, a single first return may represent the earth's surface.

A cloud of multiple intermediate returns allows modeling of forest canopy, ground cover, and some constructed features. The lowest elevation return may reflect from earth materials and support modeling of a single bare earth surface.

For additional information about lidar and its application in ArcGIS Pro, read the ArcGIS Pro topic, "What is lidar data?"

in the river, and maybe even a cow or two. Save once more.

Exporting and Reviewing a Lidar Map

To export the map, click the Everson_4_Layout tab and inspect your layout. Open the Catalog pane and expand Layouts. Right-click Drone_4_Everson and select Export to File. Save the export file as a PDF with a resolution of 300 dpi. Place it in \CAUSE_V_Drone\Graphics and name it Drone_4_Everson_1.pdf. Because the map has a lot of detail, it may take some time to generate the PDF.

Open a file manager such as Windows Explorer and browse to \CAUSE_V_Drone\Graphics. Open Drone_4_Everson_1.pdf. Click the Layers icon and use the visibility selection (eye symbol) to turn individual layers off and on. Investigate how the ArcGIS Pro PDF export function manages labels, images, analytical rasters, and transparency. Compare the lidar height contours to Everson structures and the georeferenced images. They should match pretty closely thanks to the 1-meter resolution of the rasters. Continue to explore the PDF export, and consider how you might use the workflow presented in this article.

If you were wondering why the cars in the lidar rasters aren't in the drone imagery, remember that the lidar was acquired in 2013, while the drone imagery was flown in 2017. Any cars or cows shown in the 2013 lidar rasters were long gone when the drone imagery was captured.

Summary

This is certainly one of my favorite *ArcUser* exercises. I took traditional ArcMap workflow tasks and updated them directly in ArcGIS Pro. I am especially thankful for the robust online help included with ArcGIS Pro. I encourage you to use it whenever you need extra assistance.

Acknowledgments

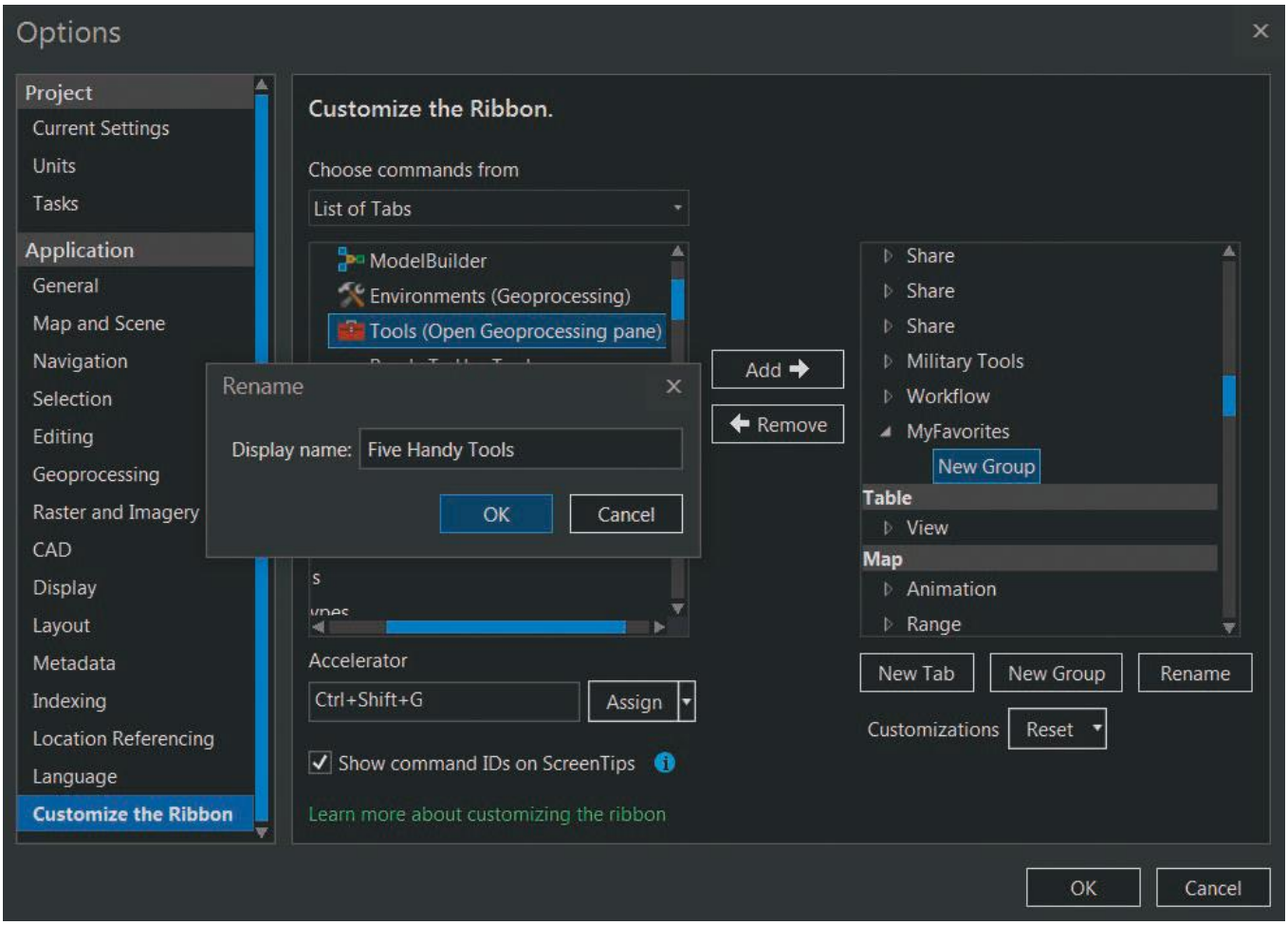
Thanks again go to the CAUSE V team members for all their support and encouragement. Thanks also to WSI (Watershed Sciences, Inc.), the Nooksack Nation, and the Puget Sound LIDAR Consortium for acquiring and hosting the great lidar dataset that supports this exercise.

ArcGIS Pro Customizations in No Time with No Code

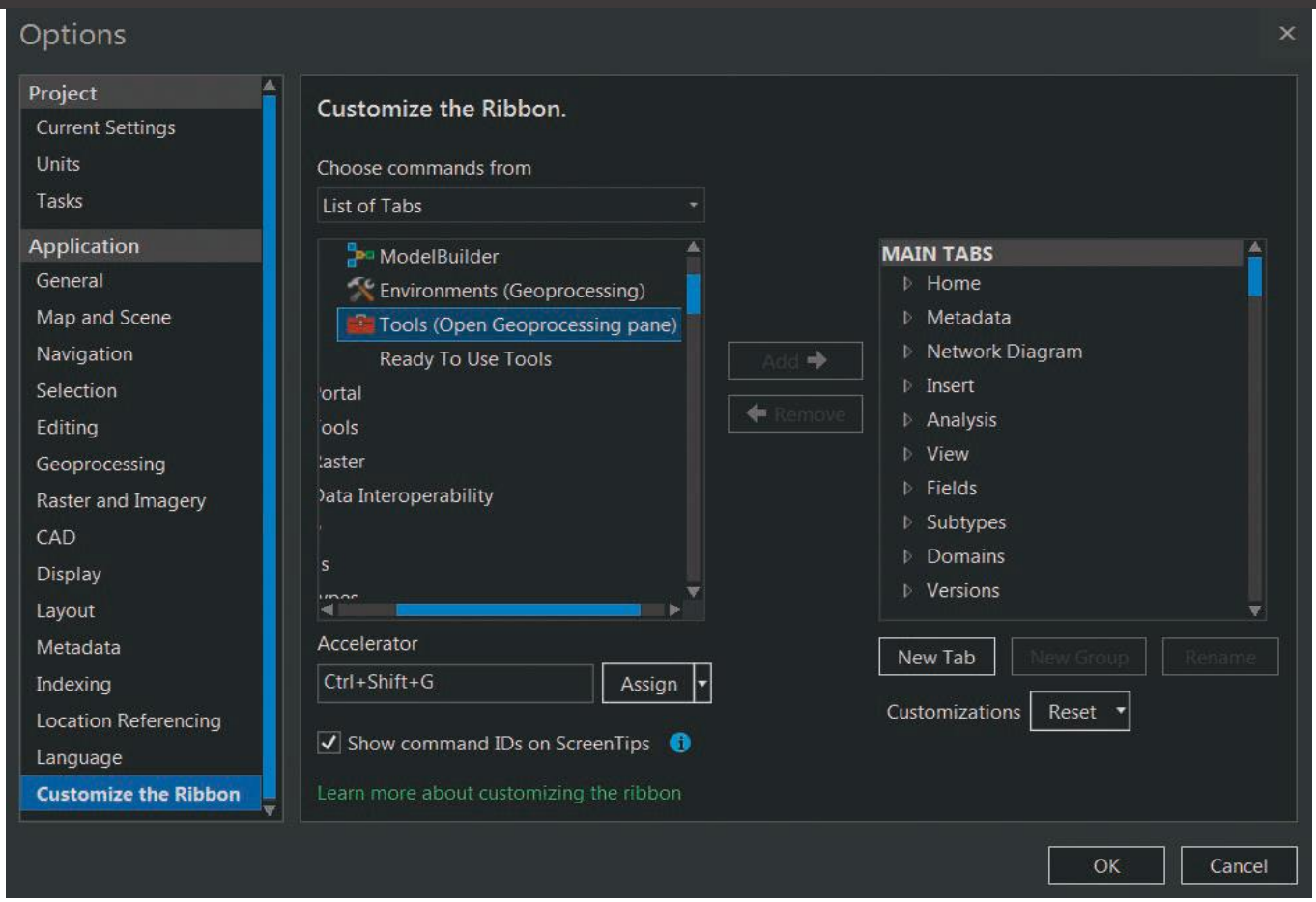
By Monica Pratt, *ArcUser* Editor

You can customize the ArcGIS Pro interface as much or as little as you want to help you work more efficiently. You can make lots of modifications without coding—and without much time or effort.

Although you can make extensive changes to the functionality of ArcGIS Pro using the ArcGIS Pro SDK for the Microsoft .NET Framework, this article gives you a couple of non-coding options for quickly and easily tailoring ArcGIS Pro to streamline what you do and how you do it. You have lots of choices. These range from simply rearranging the location and placement of windows, panes, and tools to making a custom toolbar that keeps the tools you use most often where you can quickly find them with a minimum number of clicks.



↓ Click Project > Options and click Customize the Ribbon to use the panes to move and remove tools and make new tabs and new groups.



You can minimize the screen real estate consumed by the two panes you probably use all the time, the Contents and Catalog panes. Drag one pane over the other so that the tabs for each appear at the bottom of both panes. Switch from one pane to the other using these tabs. Save even more space by clicking the drop-down on both panes and choosing Dock and then Auto-Hide. Both these frequently used panes will now be nicely tucked away until you need them.

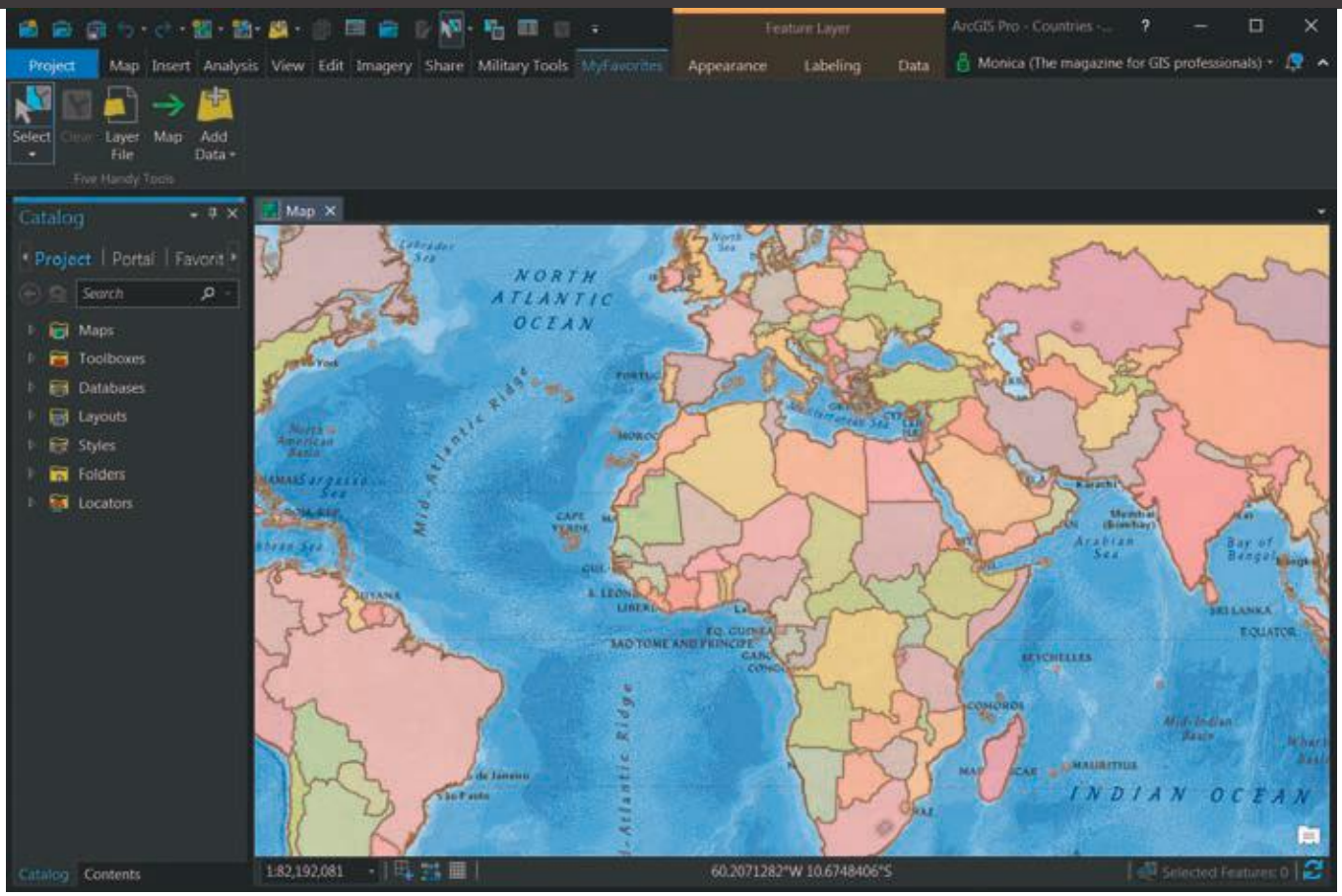
How about moving (or removing) tools from the Ribbon tab? Just click Project > Options and then click Customize the Ribbon. Use the two panes in this window to shuffle commands, adding and removing tabs at will. You can also use this same window to create new tabs and groups, add tools to those tabs and groups, and rename them if you like.

But don't close the Options window yet. If you are a person who loves keyboard shortcuts, this window is also where you can set your own keyboard shortcuts to instantly access tools you need frequently. Locate the desired command from the left-hand pane, select it, and give the focus to the Accelerator text box below the left-hand pane. Press the key combination you want to use as a shortcut for that command to assign it.

You can get even fancier by customizing the two tool galleries on the Analysis and Edit tabs. Click the drop-down arrow on the lower right side of either tool gallery to invoke the customization panel. Use the arrows to reorder tools, add or delete tools in a group, add a new group, or rename a group.

Decide you don't like the changes you made after all? Buttons on customization panes let you revert to the default settings with just one click, so nothing should stop you from

↑ Use the same pane to make your own keyboard shortcuts.



↑ Use the ArcGIS Pro Quick Access Toolbar (QAT) to put all your frequently used tools in one place. By default, it is on top of the ArcGIS Pro ribbon.

experimenting with the display or placement of tabs, groups, and tools anywhere in the ArcGIS Pro interface.

If you really want to simplify things, you can use the ArcGIS Pro Quick Access Toolbar (QAT) to put all your frequently used tools in one place. By default, QAT is always shown on top of the ArcGIS Pro ribbon and already contains the New Project, Open Project, Save Project, Undo, and Redo tools. To add more tools to QAT, right-click any tool on the ribbon and click Add to Quick Access Toolbar. You can move QAT below the ribbon or delete any tool from QAT using the same context menu. Reorder the tools on your QAT using the Customize window. One small caveat: your QAT will not persist when you upgrade ArcGIS Pro.

That's it. What could be simpler?

One last modification you might like if your eyes get fatigued. You can change the interface theme from the default light setting to the dark theme. Choose Project > Options, click General, and scroll down to the Personalize section. In the Theme drop-down, choose Dark. You will need to restart ArcGIS Pro for the theme change to take effect.

For more productivity tips and the latest news about ArcGIS Pro and the rest of the ArcGIS platform from Esri software teams, make sure to read the *ArcGIS Blog* at esri.com/arcgis-blog.

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GIS Applications & Data Services Unit Manager
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ModelBuilder 101

For ArcGIS Pro users who want to automate workflows

By Suzanne Boden, Esri Training Services

ModelBuilder provides a visual canvas to create geoprocessing models that automate GIS workflows. Included with ArcGIS Pro, ModelBuilder has been called a visual programming language. You can think of ModelBuilder as a tool to map a geoprocessing workflow.

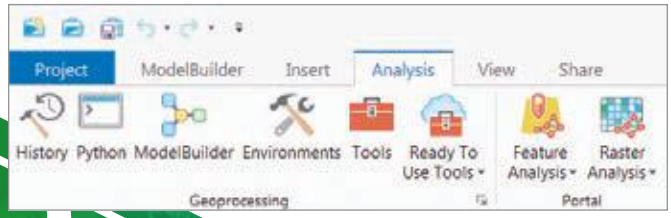
A model is a workflow map. Like maps, models you create in ModelBuiler can be navigated because they have built-in directionality. Shape, color, text, and symbols are used in models to communicate information about processes and status. Models are invaluable for conducting sophisticated spatial analyses and can reveal data relationships that spark ideas and collaboration. Models are workhorses: If built with reuse in mind, they can be your go-to shortcuts for getting lots of geoprocessing tasks done with less work.

If you've never worked with ModelBuilder, here is a simple five- (or six-) step approach to get you started.

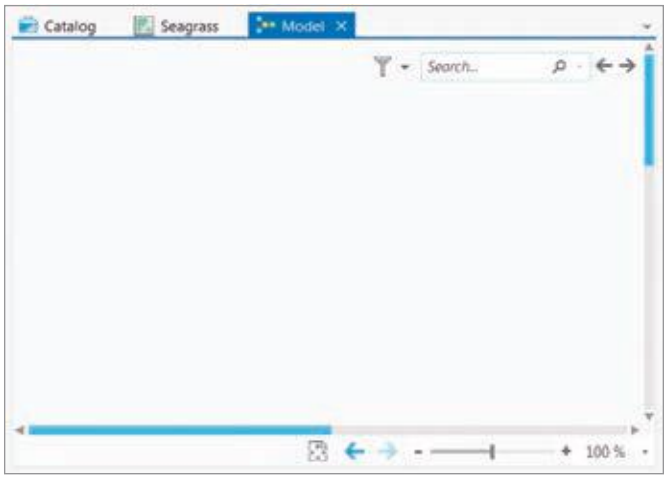
1 Plan the Workflow

Before creating a model, know what you want it to do. List the data input, identify the required geoprocessing tools, and describe the desired output. If the workflow is simple, just think it through in your head. For more complicated workflows, you may want to sketch everything on paper or a whiteboard. If you're not sure which tool to use or what a tool's required inputs are, check the online ArcGIS Pro tool reference.

1



↑ Click ModelBuilder on the Analysis tab.



2

↑ A blank canvas for building your model opens.

2 Create the Model Shell

In ArcGIS, a model must be stored inside a toolbox. In ArcGIS Pro, when you create a new project, a toolbox with the same name as the project is automatically created.

On the Analysis tab, click ModelBuilder. An empty model window opens.

Tip: You can also open a new model by right-clicking the toolbox folder in the Catalog pane and choosing New > Model.

Now set the model properties by clicking Properties on the ModelBuilder tab.

In the General tab, the option to Store tool with relative path should be selected, because using relative paths prevents headaches down the road if your data is moved.

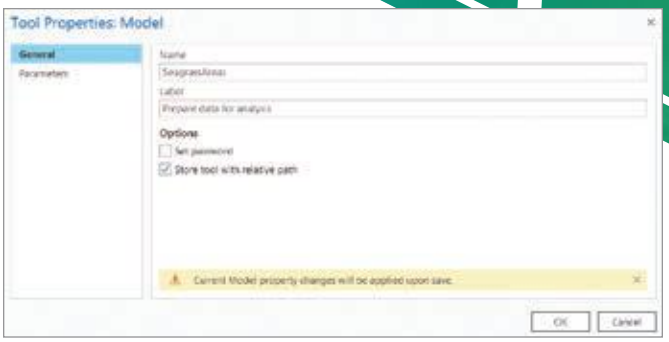
Set these properties:

Name—Type the file name with no spaces.

Label—Provide a plain name that can include spaces.

Click OK.

3



↑ Make sure you check the box for relative paths when filling in the model properties.

3 Add Tools and Set Parameters

With the basic setup done, now comes the fun part. You can't beat ModelBuilder for easy drag-and-drop building and tinkering. But first, you will need to understand some ModelBuilder vocabulary. A model consists of one or more processes. A process consists of three elements: input data, a tool, and the tool's output. Each output can become input for the next process.

When you add a tool to a model by dragging it from the Catalog or Geoprocessing pane, its output element is also added, and both elements are light gray. In model parlance, gray means *not ready to run.*

Double-click each tool and set its parameters. A red asterisk next to an item in a tool dialog box means the parameter is required. Set tool parameters and pay attention to red asterisks.

Tip: If your input data has selected features or records, models like individual ArcGIS geoprocessing tools will process only the selection.

Once you click OK to set the tool parameters, the input element displays and the process colorizes.

As you add processes, the model window may fill up. Use the Auto Layout and Fit to Window buttons to see the big-picture view and zoom in and out as needed.

Be sure to save periodically as you build the model by clicking Save on the ModelBuilder tab.

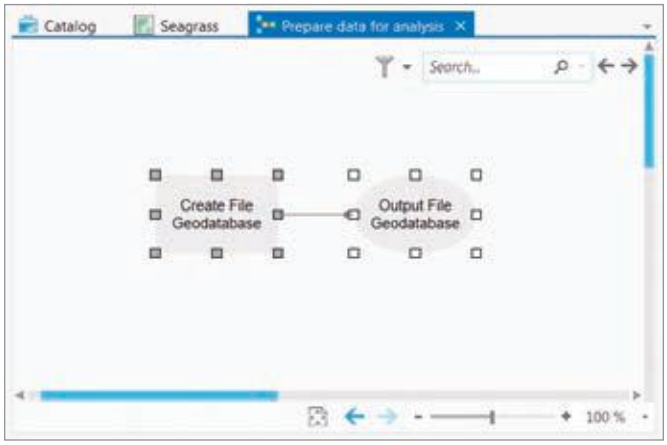
If you want to visualize the model's final output on a map, right-click its model element and choose Add To Display. Otherwise, you'll have to manually add the output as a layer to the map.

4 Validate the Model

After you've added all the tools and set their parameters, it's time to ensure the model will run properly by validating it. Validation is easy—just click the Validate button with the green check mark on the ModelBuilder tab. During validation, if there's an error, processing will cease at the process with the problem.

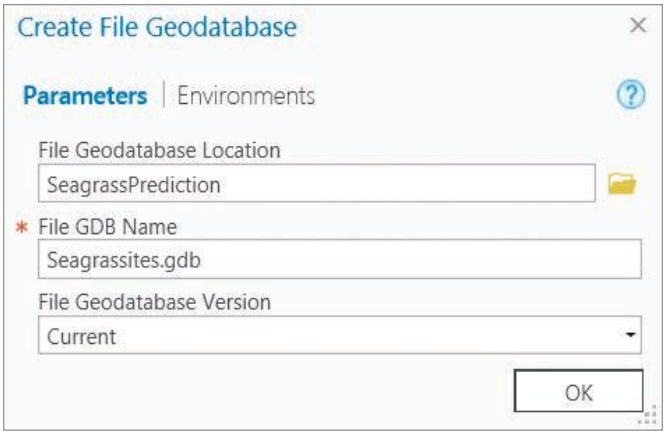
Figure out what's wrong, make the fix, then validate again. One the model is validated, save it and the ArcGIS Pro project.

4



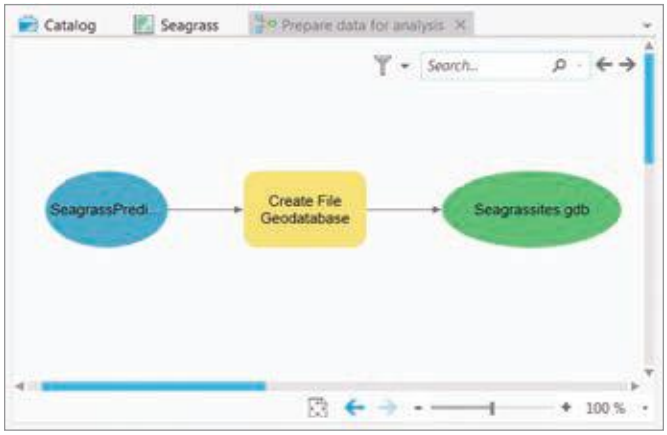
↑ When you add a tool to a model by dragging it from the Catalog or Geoprocessing pane, its output element is also added and both elements are displayed in light gray.

5



↑ All fields with red asterisks are required.

6



↑ When all the required parameters for a tool are set, it colorizes and is ready to be run.

5 Run the Model

You have two options for running a model: inside or outside ModelBuilder. Run a model inside ModelBuilder by clicking the Run button. As the model progresses, each process turns red and then gets a drop shadow. The drop shadow indicates the process has completed correctly. If a process turns gray, that means something needs to be fixed and the model stops running. If you've validated, this shouldn't happen.

You can also run outside of ModelBuilder by running the model as a tool or service. Running a model as a tool or service has advantages for collaboration and sharing.

6 Run It Again (Optional)

A model's final output may raise a question. For example, suppose a model process created a 50-meter buffer around a map feature. After examining the model output layer on the map, you wonder what the impact would be if you used a 100-meter buffer instead. To find out, you would simply open the Buffer tool, enter the new distance value, and run the model again starting at the buffer process (right-click the Buffer tool and choose Run). Because you're not altering preceding processes, you don't need to rerun the entire model. This is the beauty of a model.

Built for reuse, models are a perfect way to explore and test what-if scenarios. Like scripts, models are encapsulated workflows. Once created, they can be used over and over as a fast alternative to manually performing all the individual steps in a workflow. You can build a model to automate any geoprocessing workflow, whether it's complex or simple and straightforward.

Now that you've learned the steps to create a simple model, get going and try it for yourself.

esri.com/training

Want to Learn More?

If you're interested in a deeper dive into geoprocessing models or ArcGIS Pro, check out these online and instructor-led courses from Esri Training (esri.com/training):

- ArcGIS Pro: Essential Workflows
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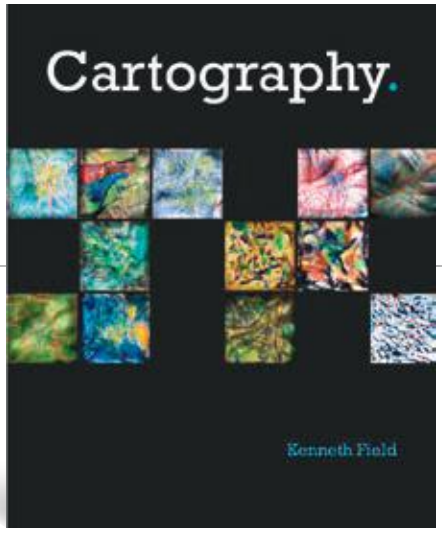
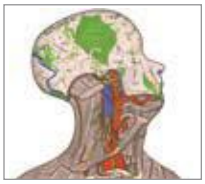
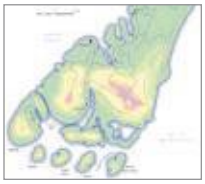
LASER TECHNOLOGY

The Art and Science of Cartography.







A comprehensive compendium of what constitutes good map design, *Cartography.* is a new book from Esri Press written by award-winning cartographer Kenneth Field.

Why the period in the title? Well, this period—or as Field would say, full stop—signifies that this is a one-stop guide for cartography. It's a guide for aspiring mapmakers that will ground them in the ideas that are foundational for better mapping. It's a handy reference for more experienced mapmakers. It's the definitive text for the modern mapmaker.

It was written for people without an academic background in cartography who make maps as part of their jobs. This audience includes GIS professionals and those who use the technology daily. The book's goal is to impart the principles, processes, techniques, and best practices of cartography that will help them author maps that communicate information clearly, scientifically, and artfully.

As Field notes in the preface, "This book is about encouraging thought." He acknowledges that cartography does have "plenty of what might be called rules, but these are just guidelines for cartography developed from decades of practice and people working out what works and why. Maps should be objective and have scientific rigor, but there's plenty of scope for creativity."

This beautifully illustrated reference guide to map design is not a how-to tutorial on mapmaking or a deep-dive discourse on underlying theory. Instead, the book explains both the science and art of cartography. More than 250 separate topics cover the full range of cartographic concepts and practice beginning with traditional topographic and thematic cartography and continuing through the profound changes brought about by modern digital mapping environments and including developments such as democratized mapping, new mediums, and ephemeral and fantasy mapping.

The book features original maps, technical illustrations, and exemplary map design from both historic and contemporary sources. In addition to Field's own work, the book has maps and illustrations by Esri colleagues Wesley Jones and John Nelson as well as contributions from dozens of academics and cartographers.

The cover art is a collection of maps painted by artist Angela Andorrer onto the palms of the hands of attendees at a previous International Cartographic Conference. It reflects Field's purpose in writing the book: to communicate the knowledge acquired from peers, teachers, and students during more than 30 years of research and work inside and outside academia.

Field holds a doctorate in GIS and a bachelor's degree in cartography and geography. Before joining Esri seven years ago as a senior cartographic product engineer, he was director of GIS courses at Kingston University and the University of Northampton in the United Kingdom. This blend of academic and commercial experience gives Field a unique perspective on modern cartography—what works, what doesn't work, and what can be shared to support everyone's need for making great maps that inspire and—crucially—communicate.

Cartography. is educational and aspirational. Roger Anson, Field's mentor and the former head of cartography at Oxford Brookes University in the United Kingdom, provided the book's foreword. He believes the book should be required reading for cartography students and anyone who needs to make a map. "It's not a traditional textbook. It's a wonderful collection of all that Ken has learnt and the thinking he's developed along his cartographic journey so far."

Esri Press, 2018, 576 pp., softcover (ISBN: 9781589484399) and hardcover (ISBN: 9781589485020, 576 pages)

← Kenneth Field shows a map painted on his palm by Angela Andorrer.
Photograph © Angela Andorrer, used with permission. www.andorrer.de

↓ This book contains delightful examples of fine cartography including this digitally remastered version of Heinrich Berann's poster of Yellowstone National Park.

INSPIRING WHAT'S NEXT

"WHAT IS GIS TODAY?"

Esri president Jack Dangermond put this simple question to the Plenary Session audience at the start of this year's Esri User Conference (Esri UC). In answering this question, he delved into the profound and exciting changes in applying GIS to the world's problems.

More than 18,000 users of Esri technology from 130 countries met in San Diego July 9–13, 2018. The purpose of the conference has remained the same over the event's 38-year history: learn about the latest developments in GIS from Esri and from each other, share work, celebrate achievements, and grow the community of GIS users.

In discussing the conference theme, "GIS—Inspiring What's Next," Dangermond noted that for many years GIS has been a system for managing and analyzing geographic information and solving problems holistically so that organizations can work more effectively.

What's next is the new generation of GIS that is "based on sharing and collaboration and leveraging the technologies of web services to distribute knowledge and interconnect our knowledge and engage everyone." This is Web GIS.

It extends the three conceptual components of GIS—integration, analytics, and mapping—to improve understanding. By taking advantage of faster computers utilizing distributed computing and machine learning, it more effectively harnesses the power of computational geography. Innovations in ArcGIS continually enhance mapping and communication.

"This technology *[Web GIS]* is literally driving major aspects of digital transformation in organizations," because it takes sequential workflows that have been automated and interconnects them so different aspects of an organization can share information and workflows simultaneously, which will change the way organizations, as a whole, do their work.

EASY, OPEN, AND ACCESSIBLE TO EVERYONE

This pattern is compelling because it brings together lots of other technologies—such as web maps, web apps, hubs, location analytics, and visualizations—and fuels them with sensor and other data being captured at a rate that is growing exponentially and makes it available through web services. Web maps are becoming a kind of language supporting new kinds of problem solving. Intelligence tools, like Insights for ArcGIS, bring understanding and spatial analytics to a large swath of people, not just GIS professionals.

Through Web GIS, "GIS is becoming easier and more open and more accessible to everyone."

→ Tom Crowther described how Crowther Lab is gaining a deeper understanding of how the loss of ecosystems negatively impacts the earth's ability to regulate carbon dioxide.

WHAT'S NEXT FOR OUR PLANET?

Dangermond challenged the audience to think about what the future will be like. In this complex and interconnected world, "the pace of change is accelerating almost exponentially, threatening our natural world and our future as humans."

Web GIS makes it possible to apply more widely the power of digital geography to problems and challenges such as climate change, loss of biodiversity, overpopulation, threatened water supply, and urbanization. For example, earth observations combined with GIS and artificial intelligence (AI) provide real-time global intelligence that can lead to better decisions at many scales. Web GIS plays a fundamental role in organizing content on the way to creating the pervasive geographic understanding needed to deal with these challenges. This process will "integrate geography and the work of GIS professionals into virtually everything everyone does."

BUILT ON THE SCIENCE OF WHERE

Dangermond noted that, "The Science of Where is the foundation for GIS and the new and expanding world of mapping and location intelligence." The GIS community needs to drive this process in an accelerated way starting with embracing a geoscience-based foundation for envisioning a better future for the planet that Dangermond calls societal GIS. After years of thought on this topic, he believes that this is not just possible, but it is essential and in some ways inevitable.

ACTION WITH UNDERSTANDING

During the Plenary Session, several speakers described how their work, using GIS, is helping make a better future. One of the first speakers, Tom Crowther, a professor of global ecosystem ecology at ETH Zürich, described how the Crowther Lab is gaining a deeper understanding of how the loss of ecosystems negatively impacts the earth's ability to regulate carbon dioxide in the atmosphere.

"Most of us now recognize the threat that climate change poses to us and to future generations, but it seems so hard to take action because it seems like such a huge and complex topic," said Crowther. "Our research aims to simplify this topic by generating a more spatial and holistic perspective."

Although global ecological restoration is one of the most effective weapons in the fight against climate change and the biodiversity loss it causes, successful restoration requires intricate knowledge—down to plot-level information, but on a global scale. Trees that have been restored in the wrong ecosystems have destroyed natural biodiversity or failed to thrive.

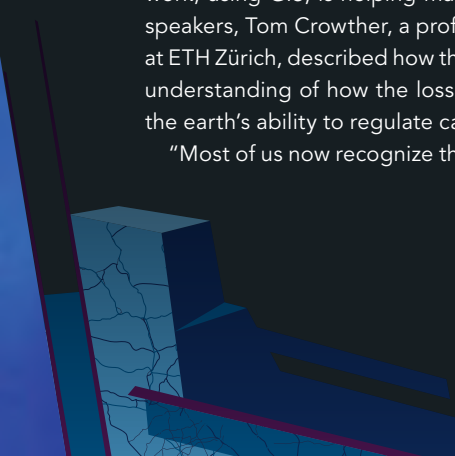
ONE PERSON CAN MAKE A DIFFERENCE

Plenary Session speaker Felix Finkbeiner encouraged attendees to participate in the Trillion Trees Campaign sponsored by the Plant-for-the-Planet organization he started in 2007 when he was just nine years old. He was inspired to plant one million trees in every country on earth by the late Nobel Peace Prize Laureate Wangari Maathai, founder of the Green Belt Movement and Esri User Conference keynote speaker in 2007.

Through the work of Plant-for-the-Planet over the past decade, children and organizations across the globe have planted more than 15 billion trees in 190 countries under the guidance of the United Nations Environment Programme (UNEP). The restoration of this tree cover will have social, economic, and environmental benefits.

This year, the now twenty-year-old Finkbeiner and his organization set their sights higher. The goal is to add a trillion trees to the world's existing inventory to help end deforestation. Supporters can plant trees or give donations to have trees planted. The Trillion Tree Campaign based this goal on work by the Crowther Lab, which is studying the number and species distribution of trees on a global level.

To support this effort, Esri is donating 60,000 trees to offset the carbon caused by everyone who traveled to the Esri UC this year.



→ Esri president Jack Dangermond noted that GIS is becoming more accessible to everyone.

END-TO-END BENEFITS

Jason Killam and Heather Morrison of J.D. Irving, Limited (JDI), explained how this 136-year-old company uses GIS to connect and optimize its vertically integrated network of 50 businesses in Canada and the United States. JDI adopted GIS in 1984, and its use of GIS underpins its resource management practices, which have garnered the company international awards for sustainability. JDI embraced digital transformation and GIS to make data-driven decisions that have benefited the supply chain for its forestry unit. From using lidar to assess the health of its forests to tracking the shipment of its forest products by truck and train, JDI uses location intelligence to automate decisions so things are done at the right time and place.

UNDERSTANDING DEVELOPMENT IN CONTEXT

The Boston Planning & Development Agency (BPDA) and Esri are leading a new revolution in urban planning that promotes collaboration and engagement between real estate developers, city planners, and citizens. Using ArcGIS Urban, not only can they see what proposed projects will look like, they also have a standard process for evaluating the impacts of these projects environmentally, economically, and aesthetically. Proposed zoning code changes can be applied virtually to not only see possible problems but also opportunities.

TOOLS FOR PROBLEM SOLVERS

Cobb County, located near Atlanta, Georgia, has a robust enterprise GIS. Its current mission is to extend the benefits throughout the organization, transforming its non-GIS staff into problem solvers who use location intelligence and the new analytical capabilties in ArcGIS. Felicia Alingu, a specialist with Cobb Senior Services, uses Insights for ArcGIS to probe data—nonspatial as well as spatial—to visualize interactions between the program's clients and its centers to determine which programs are successful and anticipate the county's future needs.

FEEDING THE NEED FOR SPATIAL EXPERTISE

Thousands of researchers and students have joined U-Spatial, a nationally recognized program at the University of Minnesota that builds the expertise in GIS, remote sensing, and spatial computing needed for tomorrow's workforce. Nearly every discipline on campus uses GIS for research, teaching, and outreach. GIS is also an intregal part of campus management. Just one of the research projects highlighting the university's innovative use of GIS was presented by Kevin Ehrman-Solberg. A founding member of the Mapping Prejudice Project, Ehrman-Solberg and others involved in the project are using GIS and other technologies to uncover how racism was embedded in the built environment through the inclusion of racial convenants in property deeds.

WHAT'S NEXT IS UP TO YOU

In closing his Keynote Address, Dangermond challenged the audience of GIS professionals to accelerate their efforts. "Keep moving, keep learning, keep understanding and leverage our best technology and science, best geographic information, and holistic design thinking to turn this around to create both a sustainable and a better world."

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Esri Training has teams of instructors, education specialists, designers, systems support specialists, training consultants, and certification experts who are dedicated to helping you knowledgeably apply ArcGIS capabilities so you can make a difference in your organization and the world.

The design of Esri Academy is premised on the belief that learning should be easy, timely, and fun. The site's resources encompass both the training you need to learn workflows and accomplish specific tasks and the underlying concepts and geographic approach needed to intelligently apply GIS to your work.

You can go to a class, watch a video, join a live seminar, take an e-Learning course, interact with thousands of other learners around the world in a massive open online course (MOOC), or download a white paper on the latest ArcGIS capabilities. You control what, when, and how you learn, based on your learning goals. If your organization has a qualifying Esri product and is current on maintenance, you have unlimited access to e-Learning. Esri Academy is the place to grow professionally through learning plans that lead to mastery of a topic or support you on your way to become certified through the Esri Technical Certification Program.

The dashboard at the site helps you track your learning activity by showing completed and current classes and seminars, letting you schedule classes, and walking you through the process of creating learning plans.

If you are a GIS manager or educator, the site provides tools that help you compare training options and create and assign learning plans that will help develop workforce capabilities, manage change, and support specific missions and workflows. Esri Academy centralizes access to tools such as training for organizations to ramp up workforce skills for upcoming projects or meet strategic goals through ArcGIS-enabled workflows. It also organizes coursework by industry. These coursework pathways for the defense and intelligence, public safety, and health and human services industries teach recommended workflows and use industry examples and data.

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GIS and BIM Provide Life Cycle Support for University's Assets

By Jim Baumann, Esri Writer

In 2009, Ohio State University (OSU) announced the Buckeye Building Information Modeling Initiative to improve decision-making and management of the hundreds of facilities on its campuses.

OSU was originally founded in 1870 as the Ohio Agricultural and Mechanical College. The university's name was changed eight years later when it graduated its first class of six students.

Today, OSU's original Columbus campus enrolls nearly 60,000 students. In addition, OSU has six regional campuses throughout the state, where more than 6,000 students study. OSU's multicampus facilities encompass 1,283 buildings that occupy about 16,000 acres (or 65 square kilometers) with infrastructure that rivals that of a small city.

OSU's Facilities Information and Technology Services (FITS) department is a longtime user of AutoCAD and has implemented EvolveFM for space management and Revit for its building data. In 2013, the department decided to standardize on the ArcGIS platform for all its geospatial data.

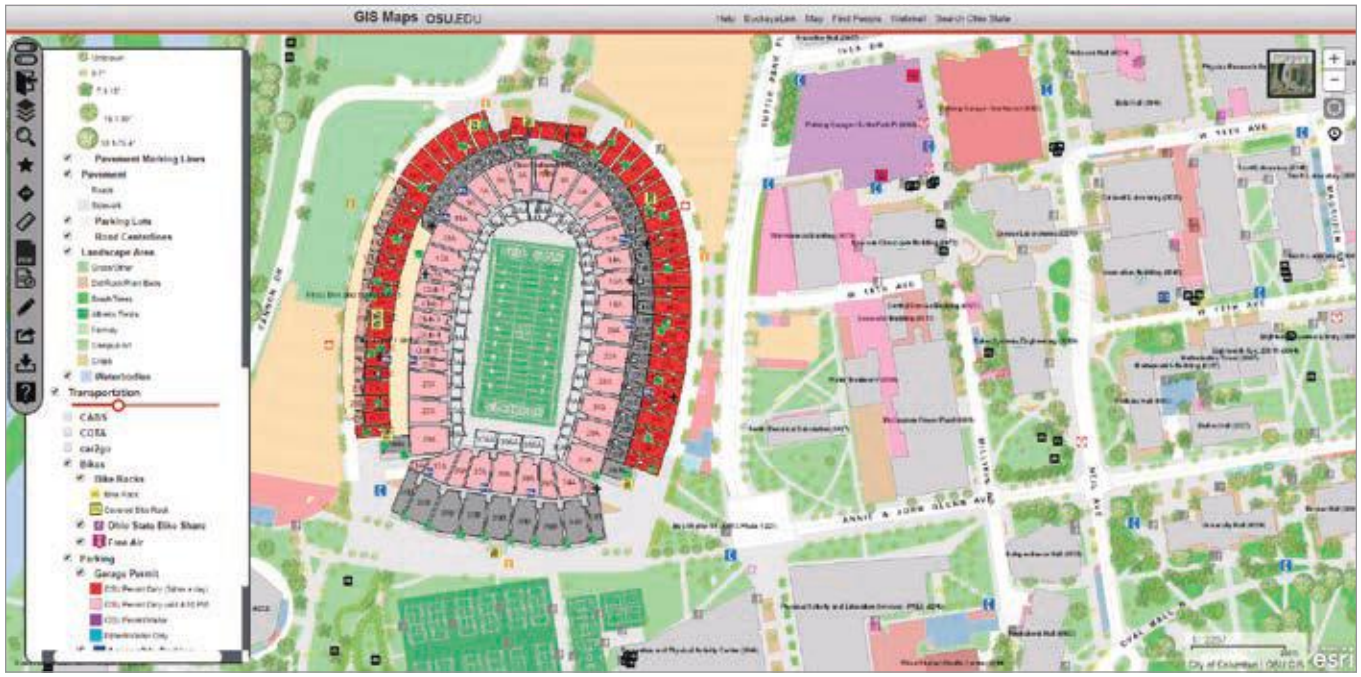
"We took this step because we wanted to implement a platform that could integrate our existing systems within a geographical context," said Larisa Kruger, OSU GIS manager. "Our AutoCAD system was primarily used for utilities, construction, and some basemapping, but it provided little data attribution and had no accessibility outside of our department."

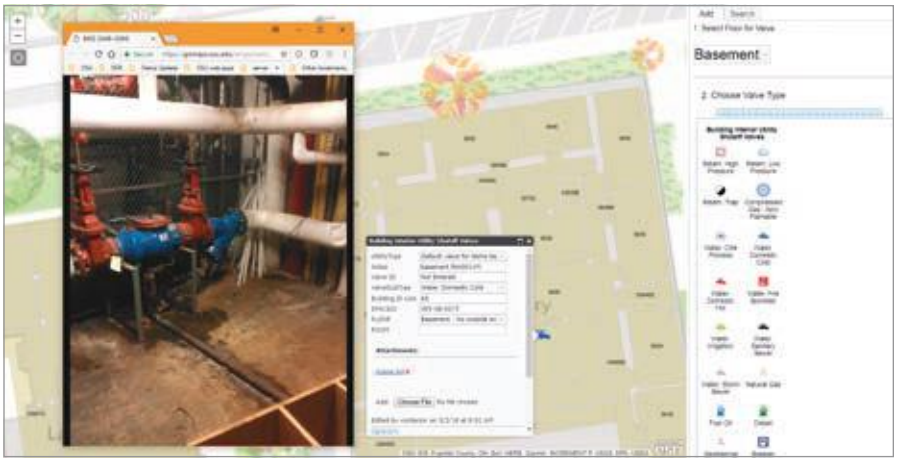
Campus-Wide Access to GIS

FITS originally set up a GIS advisory council to help define the university's GIS needs and create a wish list of geospatial datasets and necessary field data collection. "We wanted to serve the entire campus and prevent isolated or redundant implementations," said Kruger. "So it was decided to implement an ArcGIS site license to allow access to the platform throughout the entire campus network."

The university's software stack includes ArcGIS Enterprise, ArcGIS Pro, Esri CityEngine, ArcGIS Online, ArcGIS Hub, and ArcMap,. AutoCAD and Revit from AutoDesk are used to create 2D

↓ The primary application is GIS Maps, which provides answers to questions about buildings and available transportation options.





→ Asset management apps include the Shut Off Valve application, which collects and updates the location of shutoff valves both inside and outside many OSU buildings and includes pictures of the valves to assist in locating them.

drawings and 3D models. FME from Safe Software is used for data conversion. EvolveFM from CAFM Resources is used to extract floor plans from the AutoCAD or Revit 2D DWF files, which are georeferenced for use in ArcGIS.

The ArcGIS platform not only provides integration and standardization of the data from FITS as well as other systems across the campus, including the Space Information Management System from EvolveFM and the facility condition index, but also allows the data to be widely distributed throughout the university for many administrative, management, and service-related functions. FITS uses the ArcGIS platform as an asset management system for data/asset collection, management, and analyses; planning; design; and construction.

FITS has developed several GIS applications that deal with asset management and maintenance issues. The primary application is GIS Maps, which provides answers to general queries about buildings and available transportation options. Related information includes each asset's location, condition, and general specifications, such as its square footage and the materials used in its construction. Links to leases, CAD drawings, and other documents are also available.

The application also dynamically symbolizes and filters campus buildings by various criteria including use, condition, and amenities. The app provides a choice of basemaps and shows campus roads, parking lots, and landscape information. Restricted information, such as public safety data related to blue light emergency phone locations and numbers, patrol zones, and surveillance camera locations, can be accessed with appropriate credentials. Extensive utilities data showing line, valve, and meter locations for the entire campus can also be accessed.

The university's Design and Construction and real estate departments make extensive use of GIS Maps. The real estate department tracks all university parcels, easements, and leases. Non-GIS staff develop map documents for real estate transactions. To support planning efforts, the GIS analyst creates hard-copy maps for meetings of the board of trustees,

Design Review Board and Student Life

GIS Maps is interactive. Crowdsourced data can be incorporated using a redlining tool available to logged in users who can mark up the map to indicate features that are incorrect or need updating.

Other asset management apps include the Shut Off Valve application, which collects and updates the location of shutoff valves both inside and outside many OSU buildings. The app includes pictures of the valves to assist in locating them. Collector for Trees records and tracks tree maintenance activities such as the removal of dead trees and the planting of new ones. The Collector for Street Furniture app records updated information about the location of campus benches, tables, trash containers, and other outdoor assets. Other applications have been developed related to space planning, emergency phone locations, energy consumption monitoring, and crime mapping.

GIS is also expected to play a major role in the redevelopment master plan for the OSU Columbus campus. Work on the plan, known as Framework, began in 2010. It includes new facilities, roadway realignment, restoration of a local lake, the creation of a protective flood barrier, and other major infrastructure projects. The first phase of construction began in fall 2017 with the realignment of Cannon Drive, a major thoroughfare for OSU.

FITS also shares its data with outside agencies. The department updates address points on campus and shares the data with the Mid-Ohio Regional Planning Commission (MORPC) and the City of Columbus.

Developing OSU's Digital Twin

OSU has used AutoCAD to record and store data about the geometry of its facilities for many years. Its extensive database of detailed AutoCAD files includes information such as floor measurements and the location and size of windows, doors, and stairwells. In a major initiative to expand the use of these 2D drawings, the university began converting the AutoCAD floor plans into 3D models using Revit, a related Autodesk software product.

Revit is software designed for building information modeling (BIM). It provides the compilation, connectivity, and digital construction for an accurate 3D model of a building by assembling the multiple 2D plan drawings used in its construction or documentation with the vertical measurements and connectivity between the floors.

Revit supports BIM workflows, and Revit files are exported to an Industry Foundation Classes (IFC) data model that can include both the geometry and nongeometric design and the construction information required by BIM. This model is then exported to FME for integration into the ArcGIS Enterprise geodatabase.

The Buckeye Building Information Modeling Initiative has two sections: one for existing buildings and one for proposed buildings. For existing buildings, FIT is converting existing 2D AutoCAD-based floor plans to 3D Revit-based building models. "There are more than 500 existing buildings that we are converting to as-built architectural models," said Kruger.

For the second section of the BIM initiative, BIM for Design, Construction, and Operations, FIT has developed a BIM project delivery standard for all projects over $4 million that mandate the use of BIM and a Revit deliverable.

"We are currently determining how to use the data and geometry from this process in the best way for operations. The models we receive from projects that utilize the BIM project delivery standard will contain a significant amount of asset and construction data," said Kruger. "Although we have chosen to use the architectural engineering *[AE]* models which do not have as much data as those needed for construction, the information in them is sufficient—for now—for operational purposes."

This process is more about the data than the geometry, and once the data has been incorporated into the university's operational systems, such as AssetWorks AiM facilities management software, it will be maintained in those systems rather than the AE models, although AE models will be as up-to-date as possible to ensure that they reflect each building's current state.

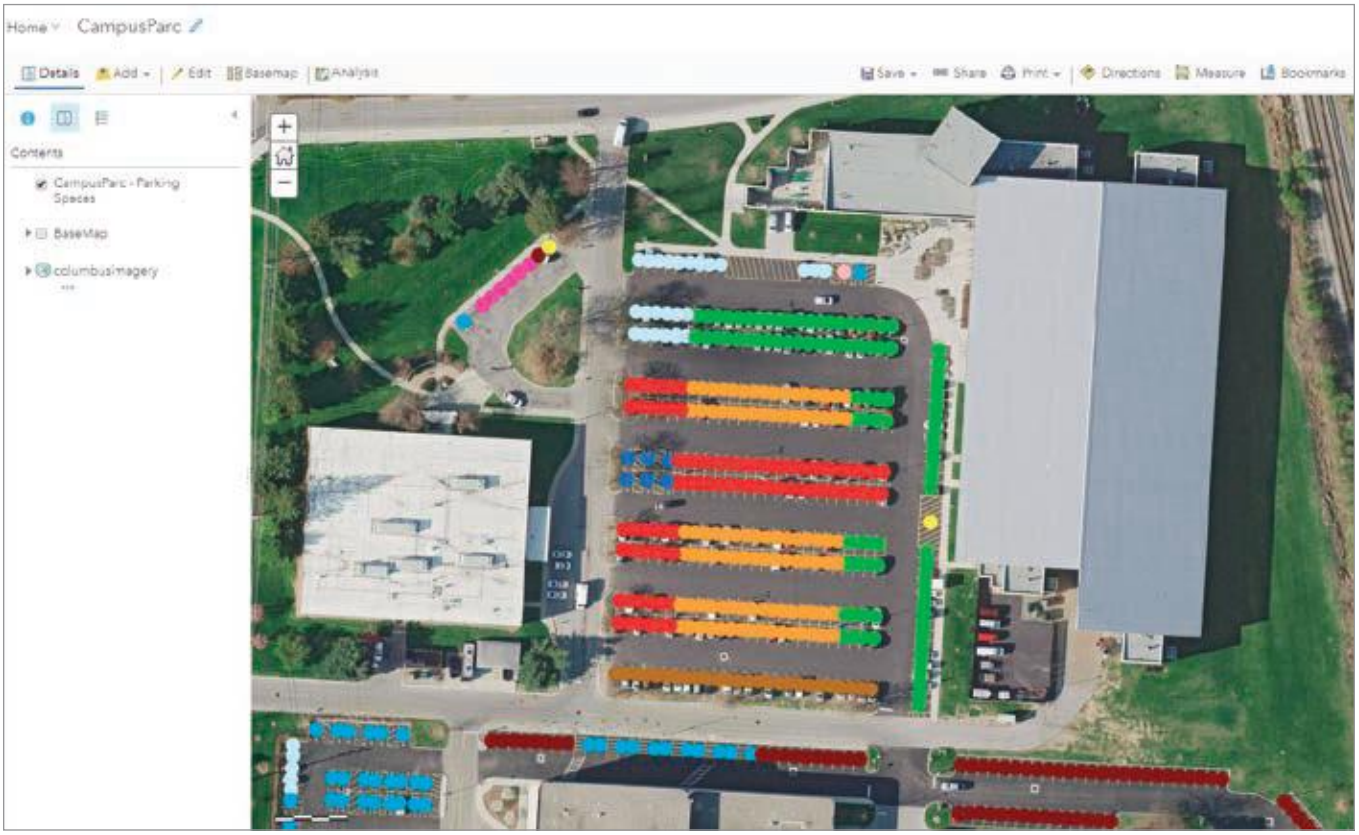
Though OSU has created representational models of existing buildings in BIM that serve as architectural rather than construction models, BIM can include extensive smart facilities data. This data can be used for architectural design and engineering; mechanical, electrical, and plumbing (MEP) applications; and structural engineering and building construction. With the inclusion of sensing devices with related monitoring software, like OSU's Shut Off Valve application, it can ultimately be used to create an intelligent 3D model or digital twin of the existing facility, which greatly enhances the support for facilities management, maintenance, and safety.

Better Infrastructure Planning and Operations

Previously, data was either uncollected or siloed away from those who need it. Using ArcGIS and other systems to collect and house data presents opportunities that will enhance the way OSU plans and operates its physical infrastructure. A system that gives operations staff members access to all the data they need from one source to do their jobs can potentially bring great efficiencies to their work.

"Our goal is to make these robust facilities data available across our entire campus through user-friendly systems," concluded Kruger. "Our team exists to support decision-making across the life cycle of our building and infrastructure assets. We will do this by ensuring all decision-makers have access to the data they need, when they need it, and in an easy-to-use format. Having access to more data from the construction process aids in our ability to maintain our facilities long term."

↓ GIS Maps shows campus roads, parking lots, and landscape information.



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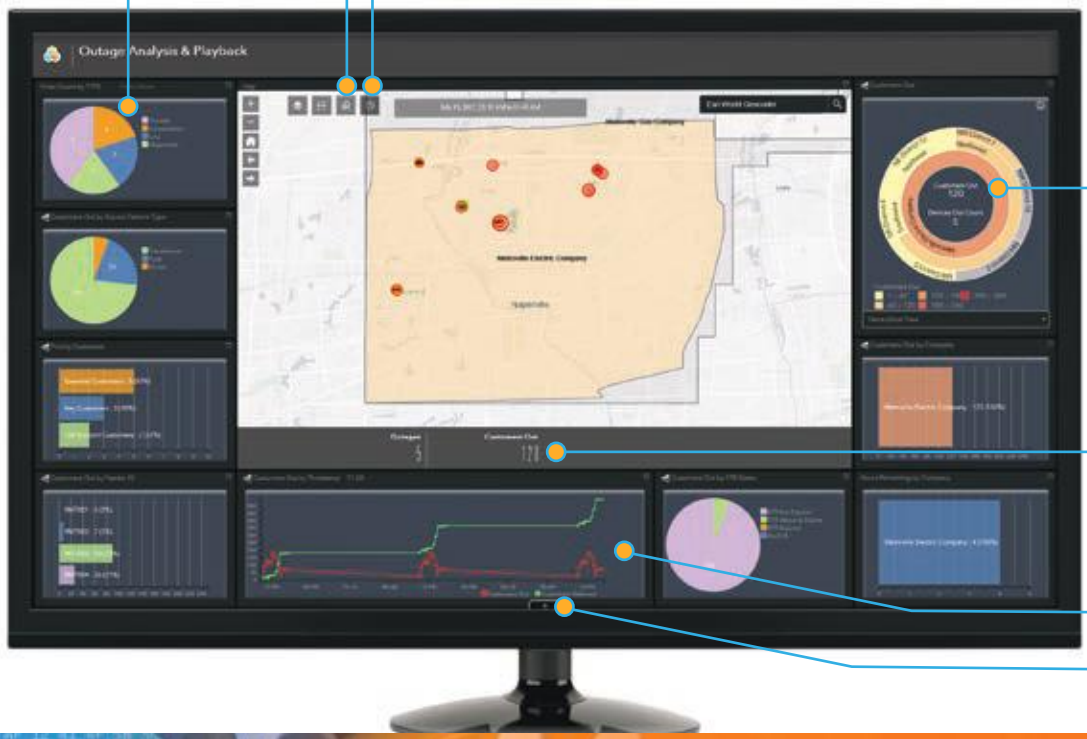

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Empowering Women's Voices at Esri and Beyond

By Citabria Stevens, *ArcNews* Editor

Being bold, seizing opportunities, building a community, and elevating women were some of the key messages of the WeCan Empower Your Voice panel, held July 11, at the 2018 Esri User Conference (Esri UC).

The panel was put on by the Women's Empowerment and Career Advancement Network (WeCan). An internal, grassroots organization at Esri, WeCan seeks to give women resources that they can use to make headway in their careers. WeCan invited four extraordinary women—Dr. Paulette Brown-Hinds, Dr. Karen Kemp, Alison Rose, and Lilian Coral—to participate in the well-attended panel discussion.

"Figure out what's important to you," urged Brown-Hinds, founding partner of Voice Media Ventures, a multimedia company that emphasizes community engagement and outreach throughout California. "That's the kind of life you want to build."

"*[Take]* the opportunities that are handed to you—sometimes not knowing at all that they're important," advised Kemp, professor of the practice of spatial sciences at the University of Southern California's (USC) Spatial Sciences Institute.

"Raise *[your voice]* in an effectual way," stressed Rose, who recently became Esri's global national government marketing director after spending the majority of her

→ Lilian Coral is the director of national strategy and technology innovation at the John S. and James L. Knight Foundation. She is shown speaking at the 2016 Esri User Conference when she was chief data officer for the City of Los Angeles.

career in the Australian Department of Defence.

"You have to have courage and just step into it," said Coral, who, after an effective stint as the chief data officer for the City of Los Angeles, is now the director of national strategy and technology innovation at the John S. and James L. Knight Foundation. "Make moves. It forces you to be comfortable with change and adaptation."

Although women have certainly made progress in the workplace over the last few decades, there are still important disparities to overcome. In the United States, women accounted for almost 60 percent of bachelor's and master's degrees and 52 percent of doctoral degrees earned in 2014–2015, according to the National Center for Education Statistics. Yet they make up only 26 percent of senior-level managers and executives—and just 5 percent of CEOs—at S&P 500 companies, reports the nonprofit Catalyst.

In the US tech industry, they fare even worse, consisting of only 20 percent of executives, senior officers, and managers, according to the US Equal Employment Opportunity Commission. And in 2016, 43 percent of the top tech companies in Silicon Valley still lacked female executive officers, reports Fenwick & West LLP, a technology and life sciences law firm.

To women working in these industries, those aren't just statistics. They have real and lasting effects on how women do their jobs and how far women can get in their careers. That is why this past November, a group of women at Esri founded WeCan. Meetings every other week vary in content from tutorials on how to write more authoritative emails to hearing Esri's female leaders speak about their professional experiences. The group has attracted about 280 participants in nine short months.

To solidify its place in the Esri ecosystem, the organization partnered with Esri's Young Professionals Network (YPN) to put on the WeCan panel at this year's user conference. "At Esri, nothing's really official until it happens at the user conference," observed Julia Lenhardt, imagery product engineer and WeCan admin.

"We have this platform—this group, this network, these resources, the infrastructure—to put on a really meaningful event for women not only at Esri but at the user

"Figure out what's important to you, that's the kind of life you want to build."

← Dr. Paulette Brown-Hinds, founding partner of Voice Media Ventures

"*[Take]* the opportunities that are handed to you—sometimes not knowing at all that they're important."

← Dr. Karen Kemp, professor of the practice of spatial sciences at the University of Southern California's Spatial Sciences Institute

"Raise *[your voice]* in an effectual way."

← Alison Rose, global national government marketing director at Esri

← This year's Women in GIS events marked the first women-specific events sponsored directly by Esri.

"That was the moment I really realized how powerful my voice was."

conference as well," said Margot Manasevit, an account manager on Esri's global business development team and one of the leaders of WeCan. "There are amazing women in attendance, so we want to showcase the great resources that we have here for women."

"For me, being young and new to the professional world, it's just great to see women in higher positions in tech, or just in general, talking about women and diversity," said Josie Imrie, a recent graduate of the University of Oregon who interned at Esri and is now job searching. "It gives me people to look up to and *[shows me]* that there are so many different paths you can take with GIS."

"Being able to see the four women discuss their experiences felt empowering because they all come from such diverse backgrounds," said Christina Boggs-Chavira, an engineering geologist who co-founded Women in GIS. "It really let each person who attended the panel get something different out of it."

Some attendees also enjoyed the camaraderie they found with other women—a sentiment echoed by the WeCan organizers.

"I work with a lot of men, and everyone is super great and supportive, but it's really difficult for me to find other women in the company to be friends with and get career inspiration from," said Jillian Foster, a product engineer on the ArcGIS Pro graphics team who also manages the WeCan listserve. "I hope that attendees were able to see themselves in the women who were up there and are inspired to continue pursuing their dreams."

This appeared to be the case, with attendees reflecting afterward how motivated they felt to take chances and chart their own careers the way all four panelists have.

"My first plan was to be an academic," said Brown-Hinds, thinking she wanted to focus on scholarly writing, which garners a relatively small audience. But then she took over her family's newspaper, *Black Voice News*, and found herself putting out powerful editorials that gave a voice to people who don't have one.

"I wrote a piece, and within 10 minutes of sending it out, our chief of police called me. He had just read it, and he had concerns about it," she recalled. "That was the moment I really realized how powerful my voice was."

Not only did Brown-Hinds's writing begin to effect change in the community, but it also led people to become much more

interested in her as a civic leader. Now, she sits on the board of The James Irvine Foundation, which provided more than $90 million in grants in 2017 to individuals and organizations throughout California.

"I'm able to make an impact in a way that I never imagined when I was writing for our little newspaper there in Riverside, California," she said.

Kemp mapped out a career of her own liking within academia. She was 34 when she entered the PhD program in geography at the University of California, Santa Barbara, and was told she'd have to toil for years as an assistant professor and then an associate professor before becoming a full professor. But that wasn't the kind of lifestyle she wanted. Instead, she took on directorial roles at various universities before being lured to the University of Redlands as an associate professor to create and lead the master's in GIS program. After several successful but intense years, she left for a simpler life in Hawaii. USC soon hired her as a lecturer (the lowest rank, usually reserved for new professors). Within a couple years, she was a full professor again.

"You don't have to do what the world says is the path," she told the audience.

This is something Rose understands, having moved from the world of geospatial intelligence to private sector GIS. In her new role, she hopes to hone a legacy that inspires and motivates others to love their jobs as much as she does, as well as cultivate a supported and happy family.

"That is ultimately my priority," she said.

But nobody can attain their career goals unaided—especially women who still have such high hurdles to clear.

"I've always had this sense that you don't just succeed because you're brilliant," concluded Coral. "You really do rely on a network of people."

Attendees of the WeCan panel were excited about this emerging Esri community and expressed interest in sustaining these types of official gatherings. WeCan is aiming to be that network of people for women at Esri, while also continuing to engage with women in the larger GIS community. "If we can use our platform to empower other women outside Esri, we want to do everything we can to do that," said Manasevit.

Other meetings and activities geared toward women have been held at previous Esri User Conferences. These events were led primarily by a group called Women in GIS, which held a special interest group meeting and a social this year. Both groups supported all three events.

This year marked the first time that a women-specific event came directly from Esri. This is important, said the WeCan organizers, not only because Esri is a leader in the GIS industry but also because it's something that potential hires are seeking.

"We go to women-specific events for recruiting, and a lot of young women have started asking what resources Esri has available for women," explained Lenhardt. "Two years ago, I couldn't really say anything. But now, we have something that's organized and that people here care deeply about. And it's not going anywhere."

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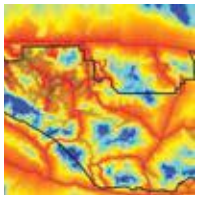

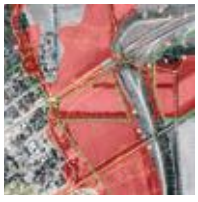

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