ArcNews

Briefly Noted

Maps and Imagery Data from China Now Available
The National Geomatics Center of China (NGCC) is partnering with Esri to make the country's authoritative cartographic and imagery data available to ArcGIS Online platform users outside China. This data has been made part of the platform, and users now have complete access at no additional cost.

Esri Cited As Authoritative Standard for GIS
Esri was among six companies that market research company Forrester invited to participate in its evaluation for The Forrester Wave: Geospatial Analytics Tools and Platforms, Q3 2016. Forrester conducted interviews with 23 organizations and selected Esri as one of the top six software providers to evaluate in the report. Forrester notes, "Esri is an authoritative standard for GIS and continues to innovate."

Esri Helping Explore How to Keep Low-Risk, Nondangerous Offenders out of the Criminal Justice System
Esri is working with law enforcement, public health, and elected officials from more than 60 US communities. The company also pledged $500,000 to the White House Data-Driven Justice Initiative and demonstrated how using ArcGIS in the Amazon Web Services (AWS) cloud could help law enforcement and parole and probation officials use predictive analytics to better manage at-risk offender populations.

ArcGIS Is a Complete Platform for Open Data
Esri Users Take on Responsibility for Open Data Sharing in Their Agencies

Agencies and organizations at all levels of government are increasingly conscious that being transparent and open will make them more effective and efficient. To expand the number of smart communities in the United States and around the world, the White House and other national governments are calling for government agencies to share more information. Open data fosters trust by promoting constituent engagement and provides validation that equitable and appropriate development is being done.

As agencies start down the path of creating an open data strategy, they typically realize that the GIS department is the most mature, experienced, and prepared team to build powerful information services and make data accessible to different communities. Tens of thousands of government-based GIS teams use ArcGIS as their system of record, so the platform is already integrated with agencies' enterprise and operations systems. This is beneficial, since ArcGIS is a complete open data solution as well.

Open Data at No Extra Cost
Too often, it is assumed that making data open and available to the public is expensive, complicated, and not very advantageous. Executives deem that forming and executing an open data strategy involves a long process of acquisition, installation, and operational work that burdens already busy IT groups that are just striving to get through their day-to-day work and respond rapidly to unexpected occurrences.

However, many organizations are realizing that ArcGIS is an exhaustive solution for open data. When combined with the rest of Esri's mapping platform, it can be used to support business development, collaborate with other governments, and tell stories that really engage citizens. The data services already available in ArcGIS can be reused to share integrated, sustainable, and effective data with the public.

↑ Andrew Turner, director and chief technology officer of the Esri R&D Center in Washington, DC.

Smart GIS Enabling a Smarter World
Los Angeles, New Orleans, Other Cities Around the World Highlighted

GIS is enabling a smarter world to take shape. While advances in technology are certainly facilitating this evolution, it is the people who use GIS who are responsible for making this change take hold.

"Your work is so innovative at demonstrating the power of smart GIS," said Esri president Jack Dangermond.

He told an audience of 16,000 people during the Plenary Session at the 2016 Esri User Conference, "You are working on virtually all the significant challenges and issues on the planet, from climate change to food production to humanitarian relief to making cities better."

Dangermond spotlighted scores of maps generated by users all over the world that address issues ranging from environmental monitoring, energy development, and transportation planning to building management, disaster response, health, and education.

GIS Provides a Framework and Process for Creating a Smarter World

Data Integration and Management
Visualization and Mapping
Informing
Analysis and Modeling
Understanding
Planning and Design
Action
Decision-Making
Collaborating

↑ Lilian P. Coral, the chief data officer for the City of Los Angeles, showed the audience the Los Angeles GeoHub.

ArcNews

Esri | Fall 2016 | Vol. 38, No. 4

In preparation for hosting next year's US presidential inauguration, the Washington, DC, District Department of Transportation is using high-resolution aerial imagery and the ArcGIS platform to reduce the time it spends on field inspections.

14

8

11

18

32

Table of Contents

A Green Infrastructure Approach to Development

Help Your Community and Region Preserve Their Natural Landscapes

↑ Anyone can assess the current state of green infrastructure in a community by using a simple online tool at esri.com/greeninfrastructure.

Creating a truly sustainable future for the United States means not only identifying the interconnected natural landscapes that remain but also actively preserving them. This irreplaceable green infrastructure promotes healthier living by ensuring clean water and air and providing access to the natural world while enhancing economic growth across communities. To this end, Esri has launched the Green Infrastructure Initiative to help plan a better future for the United States using GIS.

There is a pressing need to ensure that the nation's valuable landscapes are not sacrificed as a result of haphazard or poorly conceived development. Unlike the gray infrastructure of bridges, roads, and dams, this green infrastructure is precious and cannot be rebuilt once it is lost.

This also means addressing green infrastructure proactively at the beginning of the planning process, rather than reactively at the end. A green infrastructure approach to development identifies critical landscapes of ecological, scenic, and cultural value and preserves them. Ecologically valuable landscapes contain features—such as watersheds, surface water, wildlife habitats, and coastal areas—that benefit all living organisms in an area, not just people. Scenic and culturally valuable landscapes are characterized by recreational areas, viewsheds, and similar features that increase property values and promote tourism.

The objective of the Green Infrastructure Initiative is to create a systematic, information-based method for transforming communities in the United States into sustainable centers by identifying and preserving an interconnected system of landscapes at regional, local, and urban scales. Maintaining the connectivity of open spaces, habitats, and parks is important at each of these scales because connectivity lends the components of these landscapes the resilience they need to survive challenges, such as climate change, better than isolated areas can.

Previously, environmental concerns were set aside in favor of what was perceived as economic necessity based on the belief that these were competing rather than complementary aspects of a truly sustainable future. But green infrastructure makes solid economic contributions. For example, preserving watersheds protects water supplies and safeguards the health of human populations, wildlife, and vegetation that depend on that water. Keeping coastal areas intact mitigates the effects of storm events and limits damage to buildings and other structures. And unmarred scenic views enhance property values.

Currently, the majority of local government entities that regulate the use of the land base in the United States do so in isolation from each other and often without tools to effectively collaborate, assess existing conditions, or model the effects of proposed policy changes. GIS makes planning with accountability and metrics possible by providing the tools needed to integrate, analyze, visualize, collaborate, and communicate this new vision for the nation.

Green infrastructure planning is fundamentally a spatial problem. Data about the natural world and built environments—from many sources in a variety of formats and at a range of scales—can be combined and modeled to uncover patterns and perceive relationships.

To enable people to use GIS for protecting green infrastructure, Esri compiled the first national *Green Infrastructure* map depicting every intact natural area larger than 100 acres in the United States—regardless of ownership or preservation status. This map shows areas of ecological, cultural, and scenic importance. Local and regional data can be combined with the *National Map* to evaluate the current state of an area and its probable future, given specific planning policies to determine what actions are required to preserve these valuable landscapes.

The suite of green infrastructure planning tools is available across the ArcGIS platform as online tools and desktop toolsets for use with the data behind the *Green Infrastructure* map. A simple online tool that lets anyone assess the current state of green infrastructure in their area is available at esri.com/greeninfrastructure on the Current tab. At the same site, on the Future tab, users can filter and weight the national green infrastructure data to model scenarios and generate layers that reflect community values. These layers can be viewed or used with GeoPlanner for ArcGIS, a web application for planning professionals.

A premium app offered in ArcGIS Marketplace, GeoPlanner for ArcGIS is integrated with ArcGIS Online and runs in desktop and tablet web browser environments. It contains tools that support every step in a geoenabled planning and design workflow. Esri also provides toolsets for ArcGIS for Desktop and ArcGIS Pro that are available at no charge via ArcGIS Online.

Using these tools, planners, elected officials, researchers, businesses, and the public can find out the status of green infrastructure in a community now and extrapolate the effects of current planning on the landscape.

Applying a green infrastructure approach encompasses these four steps:

1. Critically evaluating community policies on land development
2. Benchmarking the area against other communities
3. Including a green infrastructure element in the community's comprehensive land-use plan
4. Using GIS analysis and tools to ensure that the community stays on track to preserve its green infrastructure

To take the first step toward a more sustainable future, find out your community's green infrastructure score. Visit esri.com/greeninfrastructure, enter your location, and see how your region is doing.

ArcGIS 10.5 Is a Major Advancement in the Server Platform

Full Web GIS in Your Own Infrastructure

This is an exciting time to be a GIS professional. Every day, thousands of GIS organizations around the world are compiling and building geographic data layers about topics that are critical to their work. In many cases, these layers are being openly shared, providing others with the opportunity to leverage their efforts. The scope this information covers is almost everything—rooms in a building, parcels of land, neighborhoods, local communities, regions, states, nations, and the planet as a whole.

With web services and cloud computing, GIS promises to become embedded in almost everything we do. Organizations from myriad industries are picking up this new GIS pattern and deploying it in entirely new ways. GIS continues to be a platform technology for maintaining systems of record and making basic maps. The emerging Web GIS pattern has expanded it to also be a system of engagement that can reach everyone with mapping and the power of spatial analysis.

The Web GIS pattern is fundamentally enabling this transformation. Web GIS is also making it easier to connect to and integrate many types of distributed data.

Esri users have already been incrementally deploying enhanced technologies available in the Web GIS pattern using ArcGIS Online and Portal for ArcGIS. However, with the 10.5 release of ArcGIS, users will be able to deploy a complete Web GIS (similar to ArcGIS Online) in their own infrastructure.

Significant distributed computing enhancements have been made to the ArcGIS for Server technology, and its name has been changed to ArcGIS Enterprise. ArcGIS Enterprise includes everything an organization needs to launch a dedicated Web GIS in its own infrastructure. The software efficiently delivers secure, scalable, data-driven mapping and GIS throughout an organization.

ArcGIS Enterprise is much simpler to set up and administer. It furnishes portal-to-portal collaboration, which further enhances information sharing and makes it easy to access authoritative content across departments and agencies. ArcGIS Enterprise is designed for both local infrastructure and native cloud deployments (in Amazon Web Services, Microsoft Azure, and others), giving organizations flexible options to meet their infrastructure needs.

Web GIS Enables Collaboration Across Entire Organizations

Transformational Technology

The portal collaboration capability in ArcGIS 10.5 enables organizations to easily configure an enterprise system that spans multiple Web GIS implementations. This is done through portal-to-portal and portal-to-ArcGIS Online replication services.

Distributed Web GIS helps users organize and share content across departments, organizations, and geographic areas. With portal collaboration, content and items can be shared beyond a single Web GIS implementation. This facilitates enterprise GIS collaboration within a trusted network of participants, as well as beyond the organization with GIS Hub implementations.

ArcGIS Enterprise significantly enhances analytical and problem-solving capabilities, using Web GIS to create and share authoritative content and information products. Users now have the ability to expand ArcGIS with the following premium capabilities that offer even more ways to work with data:

ArcGIS Portal Replication
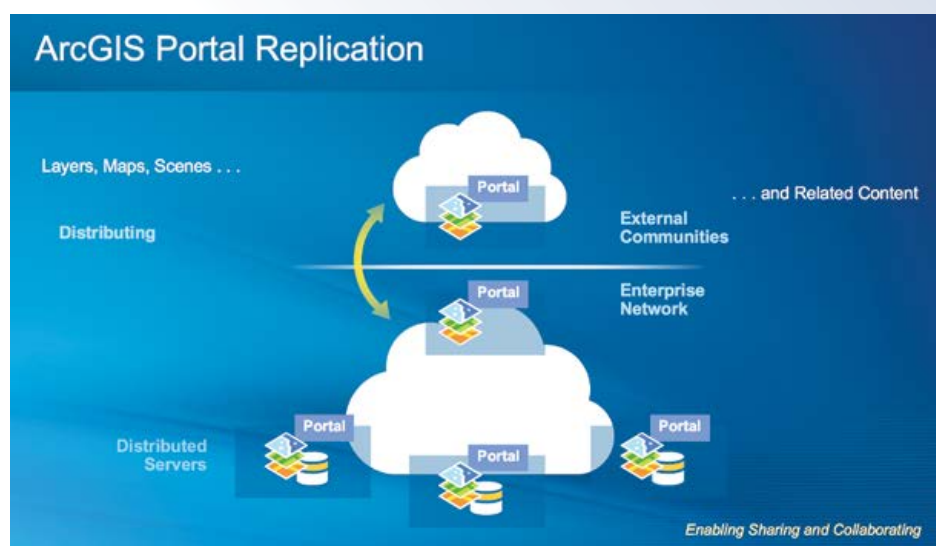
Insights for ArcGIS

Insights for ArcGIS is a new web app that works with ArcGIS Enterprise and supports exploration and analysis of spatial data using maps and charts. Data from almost any source is organized in workbooks and cards, where it can be visualized and interacted with to gain better spatial understanding.

ArcGIS GeoAnalytics Server—Big Data

ArcGIS GeoAnalytics Server makes space and time analysis considerably faster through the power of distributed computing. This includes harnessing the computing power of multiple servers and nodes rather than relying on a single machine. Now, users can analyze and make sense of billions of data points in minutes or hours instead of days.

ArcGIS Image Server—Large Raster Data Analytics

At 10.5, users can employ ArcGIS Image Server to build their own big data raster processing and analytical workflows. ArcGIS Pro is used as a client to manage this work and generate analytic results.

ArcGIS GeoEvent Server for Real-Time Events

ArcGIS GeoEvent Server gives users the ability to connect to and use streaming data from sensors and devices, as well as social media feeds. With GeoEvent Server, organizations can track their most valuable assets on a map in real time. They can monitor assets that constantly change location, such as vehicles, aircraft, or vessels. They can also track stationary resources that collect a variety of constantly changing attributes, such as weather and environmental monitoring stations or utility network sensors.

ArcGIS Pro 1.4

ArcGIS Pro 1.4, which will release around the same time as ArcGIS Enterprise, will complete most of the functionality of ArcMap. This includes geoanalytics and raster analytics tools in the standard interface. These new tools will work like any other geoprocessing tools. With a Web GIS implementation, ArcGIS servers can have their raster analysis and processing powers scaled up so users can create persisted results faster and share them within the organization. In addition, users can share and publish scene layers to an ArcGIS Enterprise portal.

Web GIS Is More Agile and Integrable with Other IT

Shifting to a Web GIS pattern is enabling users to better connect to the world of information both within their enterprise and outside of it. This is best represented by the ability to integrate real-time information streams from the Internet of Things (IoT). With Web GIS, geospatial information becomes dynamic instead of remaining static. This allows organizations to be more agile, moving from custom application development and configurable templates to using web app builders. Most importantly, Web GIS promotes open data and expands shared services that engage and empower everyone.

Web GIS is much more than a trend; it's the new paradigm for implementing a modern GIS. It is fundamentally changing how we think about GIS and the role of GIS professionals, as well as how they do their work.

Capturing Survey-Quality Data with UAVs

Drone2Map for ArcGIS Is Producing Highly Accurate Results Everywhere

Agencies that work in public safety; agriculture; utilities; natural resources; and architecture, engineering, and construction (AEC) are expressing increased interest in GIS apps that use data from unmanned aerial vehicles (UAVs). A key requirement for those apps is being able to generate a high level of accuracy so that the data collected from drones can be seamlessly integrated into existing workflows.

Esri's recently released Drone2Map for ArcGIS takes the high-resolution still photographs captured by UAVs and, with integrated Pix4D photogrammetric image processing capabilities, returns 2D image mosaics, 3D elevation products, and oblique images that are ready to be analyzed in the ArcGIS platform, including in ArcGIS Online. The app's preprocessing capability allows users to review the collected imagery while still in the field so they can immediately determine if the desired data has been captured. This helps cut down on the need to redo flights, which can be costly.

Drone2Map has basemaps built into it so users can see reference points. Additionally, the images contain metadata—including the coordinate system that was used to capture the images, a link to the GPS file, and other orientation information—that can be saved so the image is automatically placed in the correct location in Drone2Map. The app also ingests information about the camera being used to collect the data, such as its focal length and pixel information, so the images can be accurately processed.

When Drone2Map was in beta, it underwent a series of tests by select Esri partners to determine its capabilities, accuracy, and market acceptance.

One of those partners, leading geomatics and planning firm McKim & Creed, Inc., thoroughly tested the product when it surveyed a landfill.

"An interesting aspect of this project is that a landfill is a microgeography that is constantly changing," said Kurt Schwoppe, business development lead for imagery at Esri. "It's the ideal environment to test this technology."

McKim & Creed obtained exceptional results.

Evaluating a Landfill for Expansion

A landfill operator in North Carolina wanted to determine the expansion potential of its 61-acre site. To do this, the state first required the operator to survey its existing facility so that volumetric calculations could be done to design and potentially implement an expansion.

Jason Nyberg, senior project manager at McKim & Creed, proposed that the operator use a UAV to conduct the survey. Nyberg explained that using a UAV would expedite the process and subsequently reduce costs.

"While there were initial questions about the degree of accuracy using a UAV rather than traditional survey methods, we assured our client that we would meet their accuracy specification, which was 5 cm RMSEz and 9.8 cm at 95 percent," said Nyberg, indicating that 95 percent of the vertical measurement values in the dataset needed to have an RMS error (which measures the difference between known locations and interpolated or digitized locations) that was equal to or less than the reported accuracy value.

"This level of accuracy is high," he continued. "But with Drone2Map, we achieved 2.25 cm RMSEz and 4.45 cm at 95 percent, which really exceeded their requirements."

Executing a Survey with a UAV

To conduct the survey, McKim & Creed flew a 3D Robotics Solo drone 400 feet above ground level. The UAV was equipped with a Sony QX1 camera.

The ground sampling distance was approximately 3.5 centimeters. At the site, McKim & Creed placed five control targets on the ground that could be seen in the photos. These targets were surveyed using conventional survey methods. An additional four photo-identifiable targets were surveyed but withheld from the bundle adjustment to verify the results.

"We were able to capture 216 photos in less than an hour and verify the accuracy of the collected data on-site within two hours," said Nyberg.

"We then processed the imagery and produced a calibrated point cloud in less than 24 hours."

From the point cloud, McKim & Creed produced a digital terrain model and a textured mesh for a realistic 3D image of the area. Within a week, the company gave the client planimetric mapping, digital terrain models, contours, orthophotography, and Laser Data Exchange format files.

"Using a UAV for the survey of landfills is an accurate and economical method," said Nyberg. "We believe that it is approximately 10–20 percent cheaper than a conventional ground survey, 30–40 percent cheaper than aerial photogrammetry, and 40–50 percent cheaper than lidar."

He likes Drone2Map too, which Esri fully released at the end of June.

"Drone2Map provides efficient, cost-effective survey and mapping tools that complement our existing data collection workflows," said Nyberg. "The materials produced with this procedure are identical to those created with other methods, providing our customers with products that are consistent with their own design processes."

For more information about Drone2Map, visit esri.com/products/drone2map.

↑ It only took McKim & Creed a week to provide the landfill operator with planimetric mapping, digital terrain models, contours, orthophotography, and Laser Data Exchange format files.

Smart GIS Enabling a Smarter World

continued from cover

"GIS and maps are the common language that brings us together: they help us communicate, they help us understand, and they will help us act," he said. "You are addressing so many of our planet's increasing challenges," from loss of nature and lacking biodiversity to ongoing social conflict.

"GIS—your profession, your technology—provides the framework and the process for creating...a smarter world," asserted Dangermond.

With its ability to integrate and manage data, GIS transforms abstract information into visual models—maps, charts, and 3D representations—that are increasingly informing people and organizations all over the world. The technology integrates content and provides the context for understanding why things are the way they are, allowing anyone who uses GIS to analyze the interrelationships among various phenomena. By using this technology to connect and collaborate, people and organizations can gain a better understanding of the forces that shape the world we live in today, with the goal of discovering and designing better paths toward a more sustainable future.

GIS is undergoing a transformation as well. With the Internet of Things (IoT) promising to measure in real time virtually everything that changes or moves, a massive digital transformation is under way. Enormous amounts of data are now becoming more widely available, and maps have the ability to not only visualize this information but also integrate data from many sources and communicate this information to people and organizations.

Bringing Together Disconnected Data

"Smart GIS...is about integrating everything—connecting people and processes and things and all the data about them," noted Dangermond. "Smart GIS, for me, also means being able to engage communities."

This, in fact, is what the City of Los Angeles, California, is doing with its Los Angeles GeoHub, which brings together disparate data that, until now, has been stored in different city departments. The online public platform encourages residents to use this data and the ready-to-use apps available at the GeoHub to improve their city.

"The citizens of Los Angeles and the employees are basically weaving together pockets of our GIS data and technology that have been hidden in the halls of our city," said Lilian P. Coral, chief data officer for the Office of Mayor Eric Garcetti in the City of Los Angeles. "What this has meant is that we've been developing applications that matter and we're putting data to work."

For example, GeoHub is being used to inform initiatives such as Vision Zero, which aims to lower the number of deaths and serious injuries caused by traffic collisions. And the city's Street Wize app uses Web GIS to pool data onto a single map so that citizens can see in-progress or upcoming construction work on their streets. Private developers can use Street Wize to examine building opportunities as well, and the city uses the app to minimize construction conflicts and encourage coordination.

"The GeoHub dynamically integrates real-time data onto this user-focused map," added Coral. "And now we can use the same data and actually feed it into other applications—say, for emergency management."

As Los Angeles mayor Eric Garcetti specified, "[The] portal enables us to reinvent the way we're delivering services and broadens our ability to engage everyday residents and businesses."

Surveying Blight in the Big Easy

The City of New Orleans, Louisiana, is conducting similarly engaging projects, though with a bit of its own flair. In an effort to be extremely thoughtful about how the water-bound city uses its land, New Orleans—together with the community—built a map that uses soil permeability, wetlands, and historical flood zones to show areas where the ground is highly absorbent and likely not ideal for development.

"Using this map, we can think in completely different ways about how we build our environment and our neighborhoods," said Lamar Gardere, the city's chief information officer.

Gardere also exhibited the city's BlightStatus crowdsourcing web app, which in addition to educating residents about the blight remediation process also enlists citizens to report blight.

After collecting street-level photos of every parcel in New Orleans, the city created a six-question survey that people can use to determine blight on individual properties. Having members of the community use the photos to report whether or not there is a structure on the property; if the lot is overgrown; and if the walls, doors, or roof appear to be damaged allows the city and citizens to get a better idea of where blight is occurring around New Orleans and what needs to be done to restore these areas.

"Running frequent surveys will give us a reliable layer of vacant lots and foundation type, giving us a sense of our housing resiliency," said Gregory Hymel, the GIS director for the City of New Orleans.

As he pointed out, having a baseline on blight before hurricane season helps New Orleans tremendously with recovery efforts.

Insuring a Smarter Future

Knowing how natural disasters could affect various areas is at the core of what companies like Guy Carpenter do. One of the world's largest reinsurance brokers, Guy Carpenter helps its customers—insurance companies—manage claims and assess risk. And it uses GIS to do so.

For example, Guy Carpenter used ArcGIS to visualize which neighborhoods were impacted by a massive wildfire in Fort McMurray, Alberta, Canada, earlier this year. The fire destroyed about 2,400 homes and buildings and forced more than 80,000 people to evacuate.

"We could...pinpoint individual homes destroyed by the fire," said Shannon Peterson, a product manager for Guy Carpenter. "With this information, insurance companies can focus in on the homes that they insure, estimate their losses, prepare for expected claims, and put the resources in place to assist their policyholders."

Guy Carpenter also provides clients with a catalog of historic, mapped data that goes back 60 years and shows the relative risk of natural disasters such as tornadoes throughout the United States.

"In states where tornadoes are prevalent, insurance companies need to balance a mix of locations [for policies] they have across these high- and lower-risk areas," said Peterson.

The company also has a web-based risk management app called GC AdvantagePoint that uses ArcGIS to tackle clusters of risk.

"Bringing together the power of GIS and our industry knowledge...we help our clients manage a concentration of risk through stunning visualization and powerful analytics," said Bryan Adams, senior GIS specialist at Guy Carpenter.

Peterson added that insurance companies also use the app to evaluate locations before underwriting new policies.

"Underwriters are able to see the concentration of other homes they already write in that area," she said. "Underwriters can also evaluate hazards around the location like terrorism targets, distance to [the] coast, distance to fault lines, and other hazards as customized by the insurance company."

Insurance companies that use GC AdvantagePoint can even get live data feeds to real-time information, such as wildfire perimeters, so they can monitor situations that might affect their policyholders.
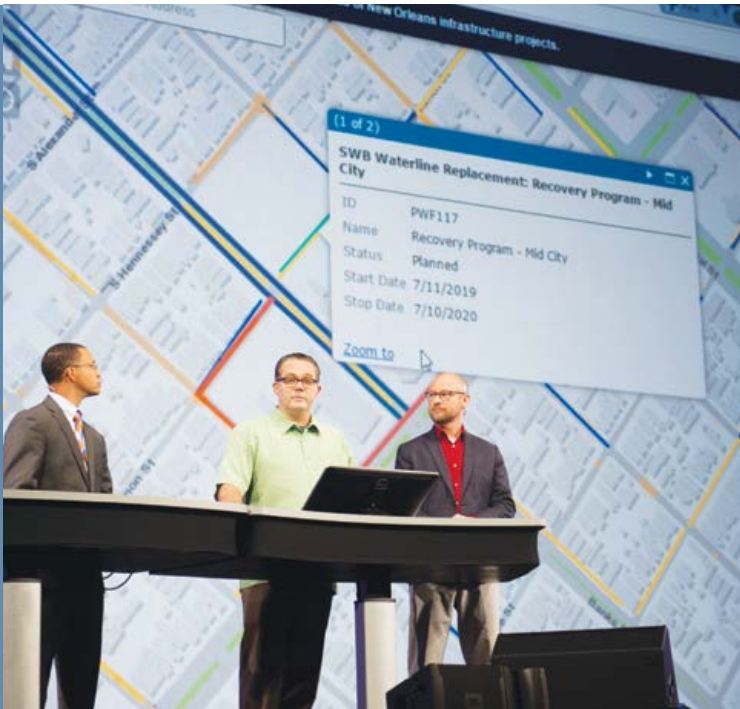
↑ From left to right, Lamar Gardere, J. B. Raasch, and Gregory Hymel demonstrated how the City of New Orleans is using GIS to engage citizens in being more thoughtful about land use.
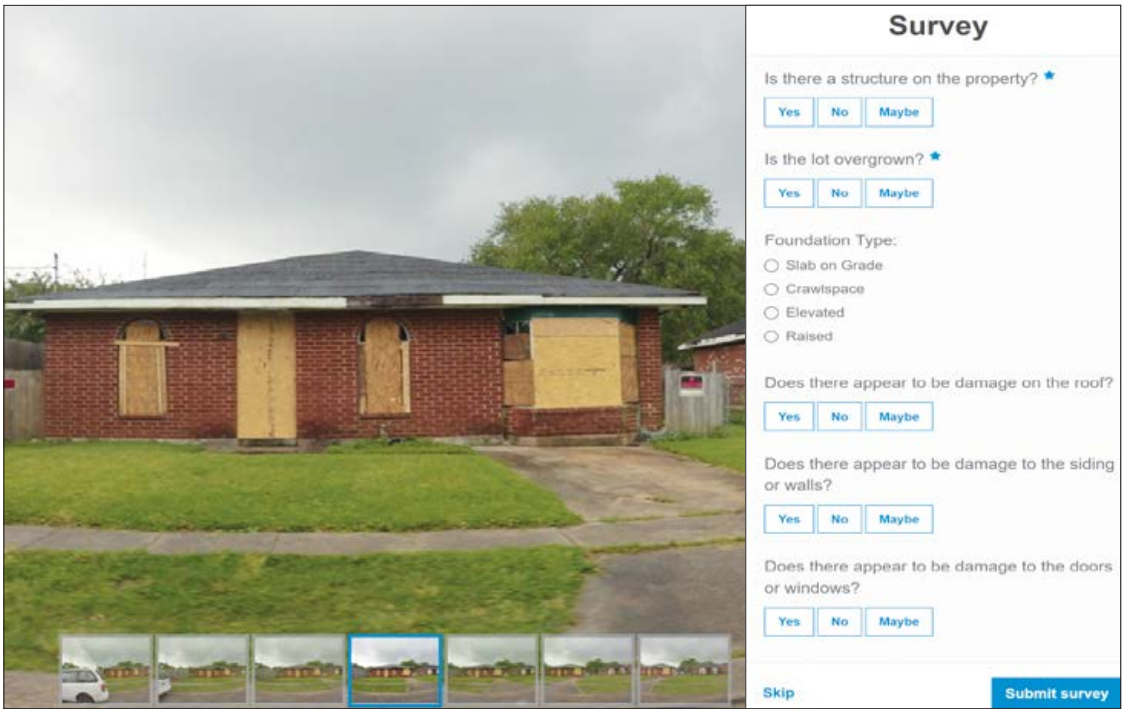
↑ The City of New Orleans' BlightStatus crowdsourcing web app enlists citizens to report blight while educating them about the blight remediation process.
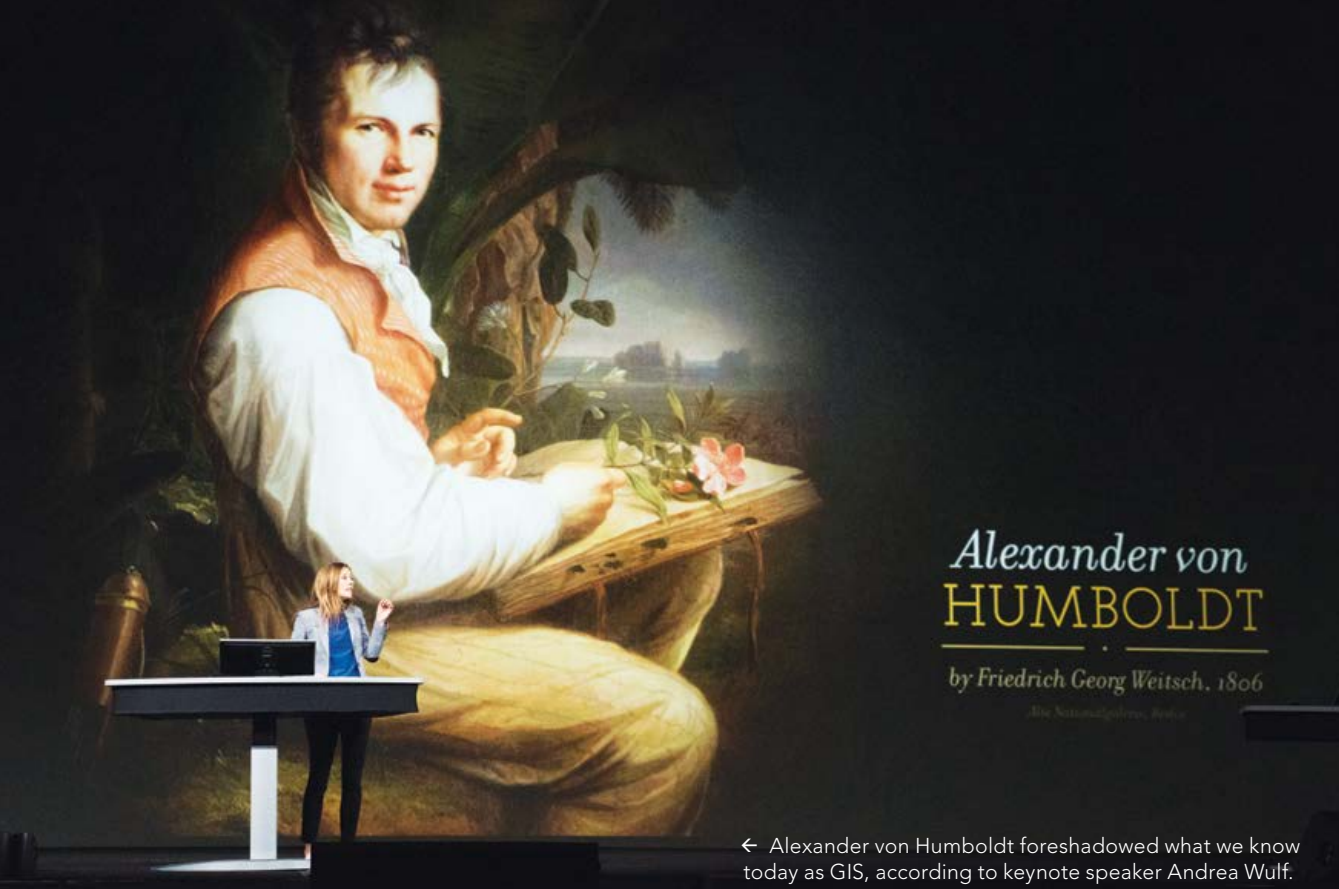
← Alexander von Humboldt foreshadowed what we know today as GIS, according to keynote speaker Andrea Wulf.
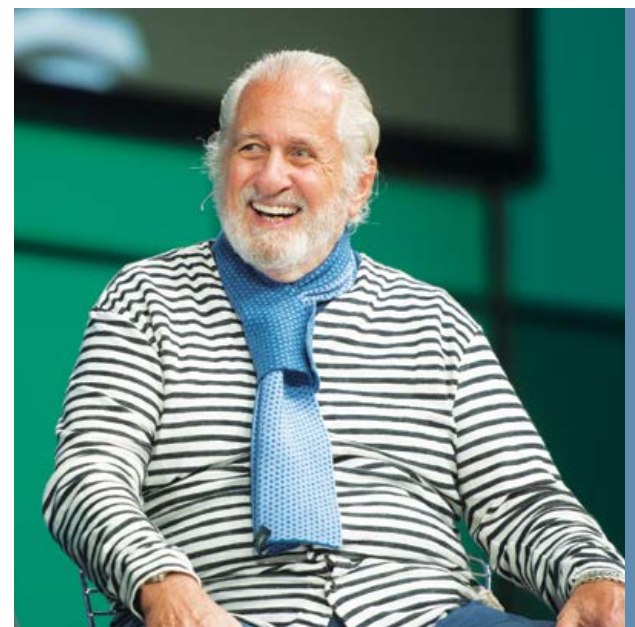
↑ According to Richard Saul Wurman, the only way humans can bring about a better world is to embrace the individual way everyone understands things and put together those idiosyncrasies, like GIS does. His new book, *Understanding Understanding,* will be published next year and feature GIS and mapping as a fundamental language for understanding.

A Hubmoldtian View of Nature

Although nature can be vexing to insurance companies, it was what motivated and inspired Alexander von Humboldt. The Prussian scientist and naturalist spent his life in the eighteenth and nineteenth centuries studying and writing about nature. He explored South America and Russia, observing a diversity of plants, animals, and geology.

Andrea Wulf's book, *The Invention of Nature: Alexander von Humboldt's New World*, explores Humboldt's views of nature "as a web of life." She said one of his goals was to excite in people a love of nature.

Humboldt's writings—including his seminal book *Cosmos: A Sketch of the Physical Description of the Universe*—greatly influenced a number of prominent naturalists, politicians, writers, and thinkers, including Charles Darwin, Henry David Thoreau, and John Muir, Wulf said. The maps and infographics in these books, which accompany essays about science and nature, were pioneering, foreshadowing what we know today as GIS.

Wulf showed examples of Humboldt's maps, including one that focused on the transportation of precious metals around the world. Another showed the location of volcanoes and earthquakes, with green circles illustrating groups of volcanoes; green and red dots showing inactive and active volcanoes, respectively; and gray shaded areas displaying where earthquakes had occurred.

"*[Humboldt]* was…the founder of what you are doing here today," Wulf said. "He said that with knowledge comes thought and with thought comes power. So his belief in the free exchange of information, in uniting scientists, in fostering communication across disciplines remains an important pillar of science and communities today. And this is exactly what you are doing here. You are sharing all your knowledge, all your data with your Web GIS."

Embracing Understanding

Just as Humboldt cultivated and shared his knowledge, so should GIS practitioners.

"Geography, mapping, *[and]* GIS have never been so important," said Dangermond. They provide "the language of understanding of our world and…a platform for creating a better future."

With GIS continually getting smarter, humans today are aware of things they couldn't have known before—things about the built environment, about nature, about the planet. That engenders a different kind of understanding about the world—and that is just what Richard Saul Wurman, founder of TED Talks, wanted the audience to contemplate at the end of the Plenary Session.

"I'd like you to think about how you personally understand things," he prompted. "Don't measure yourself by what teachers or parents or others tell you…that this is the only way you can do things."

Instead, he urged attendees to figure out how they each go about understanding things. It will be different from person to person, he said, but he gave everyone "permission…to embrace that idiosyncratic, human way each of us understands things."

Because, just as GIS cultivates new understanding, so do different ways of understanding create a better, smarter world.

With GIS, Ecuador's Indigenous Nations Preserve Amazonian Land, Culture

In 1984, Richard Resl was fresh out of high school and ready for an international adventure when he went to see a travel agent. Being from Austria, he wanted to go somewhere tropical, a place not gripped in cold weather and the Cold War. He wanted to experience a new culture and be in touch with nature. The travel agent told him about a cheap flight to Peru.

"What language do they speak there?" he asked.

"Spanish," said the travel agent. "You will pick it up."

And that is how Resl—a tall, lanky man with long blond hair and a passion for geography—began his journey to Latin America, where he eventually ended up in Ecuador, now running a nonprofit organization called AmazonGISnet. He teaches indigenous people from 11 nations how to use GIS and other geospatial technologies to protect their land and ways of life in the Amazonian rain forest.

Resl was at the 2016 Esri User Conference with indigenous leader Domingo Ankuash from the Shuar nation. Together, they accepted the Making a Difference Award from Esri for the work AmazonGISnet does to support participatory planning among the indigenous communities as they strive to preserve their culture, create sustainable economic development opportunities, and protect the fragile environment in the Amazonian lowlands of Ecuador.

That first trip to Peru (with additional stops in Bolivia, Argentina, and Brazil) set the stage for what Resl would do with the rest of his life and where he would do it.

"I fell in love with Latin America," he said in a telephone interview from his office in Cumbayá, Ecuador, just outside of Quito. "The people were so friendly."

After returning to Austria from his post-high school trip, Resl made a big decision.

"I decided I wanted to become a geographer," he said.

One day in 1988 while studying in Innsbruck in western Austria, he saw a poster on a wall for a seminar on GIS. Intrigued, he attended and was hooked.

"I thought, 'This gets into computer science,'" he said.

Resl went on to earn a master's degree in geography with a specialization in GIS from the University of Salzburg. He then attended the University of Washington in Seattle on a Fulbright scholarship to do postgraduate work toward a PhD in geography.

Then fate stepped in, precipitating a return to Latin America. Again, the young Austrian saw a note tacked up to a wall in a university building. A physician was on campus looking for researchers interested in working in Latin America. It was then 1994.

Everything had come full circle, Resl said. The doctor wanted to hire a researcher with knowledge of GIS to help him do epidemiological research in Ecuador. The work involved studying where outbreaks of malaria and other mosquito-borne diseases were occurring based on physical indicators, such as living near a pond or lake, and social parameters, such as having a home with a grass roof.

After Resl arrived in Ecuador, he soon began to branch out into other areas besides health research. He worked to create a GIS database for Quito's municipal drinking water and sewer system. He also got involved in a foundation called DIVA, sponsored by the Danish government, which studied biodiversity in relation to cultural diversity.

Though he was becoming more fluent in Spanish, another language also served him well.

"GIS was my language to get to know people," said Resl.

The Day the Shuar Came Calling

Resl still vividly recalls the day in 1996 when strangers showed up at his house in Tumbaco, a small town with views of the Ilaló volcano and, on a clear day, glacier-covered Mount Cayambe.

"They came from nowhere," Resl said of the small group of Shuar men, who stood outside and stuck a spear in the ground. "I couldn't really [figure out] what they wanted. I brought them water. Then I had them enter the house."

↑ Local leaders such as this group have
helped guide the measuring and mapping
projects in indigenous territories.
(Photo courtesy of AmazonGISnet.)

Resl did not speak Shuar, and he faced a conundrum: He needed to get work done, but the men would not leave. So he had an idea. He brought out a map and, in the language of mapping, asked, "Where are you located?" They pointed to a place on the map.

"I could see they were eloquent in using maps," Resl said.

It turned out the Shuar wanted Resl to travel to their community. Three days later, he took an eight-hour bus trip to a small airport where a charter plane (provided by a missionary church for trips the indigenous people needed to take) flew him into the Amazon. He was the only passenger on the small plane piloted by a man who said he absolutely would not stay with Resl once they arrived at their destination.

"It's quite dangerous," the pilot said.

"I have an invitation," Resl replied.

They flew over a vast expanse of impenetrable trees. It was a one-hour flight that took Resl almost to the Peruvian border.

The pilot dropped him off at a small airstrip and minutes later was gone. Resl stood alone.

"It was five in the afternoon, and I waited there for a half hour," he said. "I thought, 'I am really lost.'"

Suddenly, the Shuar appeared.

"I was so surprised," he remembered. "They were totally prepared. The whole community was there with a greeting ceremony."

As darkness fell, Resl grew uncomfortable as men with spears and painted faces approached him and told him to sit down.

"I was really frightened," he said.

A young man who spoke Spanish told him to stay awake and accept all food and drink offered.

"If they give you something to drink and eat, don't reject anything," Resl recalled the young man saying.

For 24 hours, Resl was observed and told to "defend yourself," he said. He thought he was going to be on trial. All of a sudden, however, people came up to him bearing gifts such as

jewelry and other Shuar crafts, as well as about a dozen spears.

The Shuar knew Resl was a geographer and wanted him to map their land. They wanted to create a map of their territory that they could give to the Ecuadorian government, and they wanted to develop a management plan for their community. Indigenous rights had long been an important issue in Ecuador, with the formation in 1986 of the Confederation of Indigenous Nationalities of Ecuador, a group of indigenous nations that worked toward gaining those rights.

Resl knew that with no roads and just jungle, mapping a territory of 220,000 hectares would be nearly impossible. So he told the tribe the work would cost them $20,000. He thought they would say no.

"But they said okay," he recalled.

Two years passed before the Shuar returned to Resl's home in Tumbaco.

"They said, 'We have the $20,000, and we need to go right now,'" he said.

Resl went down to the water department where he was doing consulting work and got two GPS devices and a satellite image of the area. He also recruited a friend, a German engineer, to accompany him for the first two weeks.

Working with a small team of Shuar men, they spent weeks trudging through the dense Amazonian jungles collecting waypoints on GPS devices. They lived off the land, eating small animals and fish. Back at his office, Resl used Esri technology to make the map of territorial boundaries using the 60 waypoints collected with the GPS devices, the natural boundaries from the satellite imagery, and biodiversity information he compiled during his time in the Amazon.

Resl later went on to do more mapping for the indigenous nations, and out of that grew AmazonGISnet. He is now the coordinator of this network of members from 11 indigenous nations who use GIS as a tool for land planning and management.

"We don't have cars, but now we have GIS to protect our territory," said Ankuash in Spanish while accepting the Making a Difference Award from Esri.

He told the audience that he and his people aren't poor, but that they will be if they lose their land.

"We don't live in the forest, we are part of the forest," said Ankuash. "We are willing to teach and learn while we're alive. [...] We need maps so we can be strategic and careful."

And that is what AmazonGISnet is offering. The organization trains indigenous students in GIS and other geospatial technologies. Resl said one goal is for these young people to create "life plans" for each territory that incorporate maps. The maps show how space is used within the territory, including where women grow crops, men hunt, families live, sacred and ceremonial sites sit, and environmentally sensitive land is located. The students are also embarking on a project to use Esri Story Maps to tell their stories visually and share them with the world via the Internet.

"Maps are a means to explain identity and what makes up their identity," said Resl.

"We will maintain a record for our generation and future generations of the planet," said Ankuash—all while trying to preserve the Amazon rain forest and expand green spaces around the world.

A Sustainable Way of Life

Going forward, AmazonGISnet plans to continue to support the indigenous people from the Siona, Secoya, Cofán, Waorani, Kichwa, Zapara, Shiwiar, Andoas, Achuar, and Shuar nations as they try to protect their ways of life.

Changes are coming to the Amazon, with increased government-backed mining, oil, and logging concerns reshaping the landscape and how people live. Resl hopes the maps that the indigenous nations are creating with the help of AmazonGISnet will give the indigenous nations a stronger voice at the planning table when land-use decisions are made.

The passing years have also brought changes to Resl's life. Besides holding workshops for the indigenous students through AmazonGISnet, he is an adjunct professor teaching geography and GIS at the Universidad San Francisco de Quito. He is also the program director of UNIGIS in Latin America, a distance learning program that,

in collaboration with the University of Salzburg, offers certificates and diplomas in GIS and postgraduate degrees in geographic information science and systems. Additionally, Resl devised and designed a modern urban cable car system that he hopes will go between Quito and the growing central locations of the Tumbaco Valley to help ease traffic jams on roadways, provide highquality public transportation at a low cost, and decrease pollution. According to Resl, cable car transportation would also minimize fuel consumption and, in turn, reduce the effects the oil industry has on indigenous territories.

"Domingo [Ankuash] already mentioned to the city authorities that if they don't proceed with the project soon, he would take the lead with the Austrian cable car partners to build a transport system…over the canopy in the Cordillera del Cóndor [mountain range] to connect his people and communities, avoid the construction of roads and the destruction that comes with them, and show independence from the mining companies," said Resl.

Accepted into the community two decades ago on a lonely airstrip in the Amazon, Resl stands with the Shuar.

"They feel that their whole identity is based on an intact forest, and that this forest has to be preserved for the best of the Planet Earth," he said. "They offer to be the keepers of the rain forest, as they have proved to be for the last thousands of years."
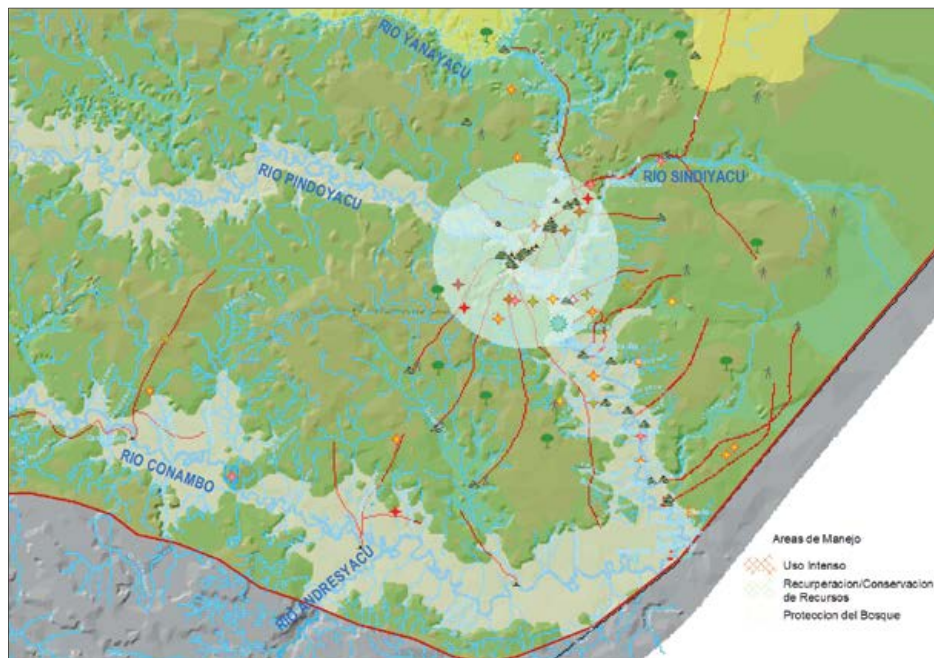
↑ With this map of Kichwa territory, users can see the land management plans for different areas in the region. (Map courtesy of AmazonGISnet/IQBSS.)
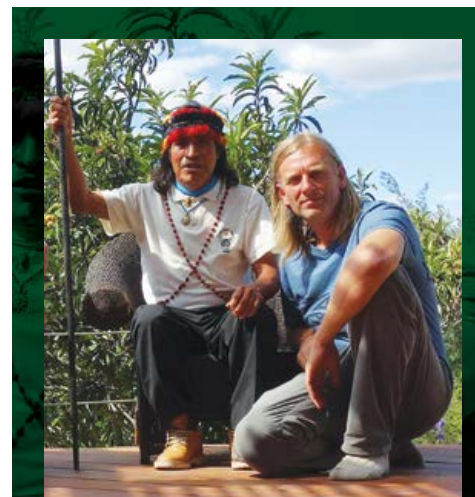
↑ Domingo Ankuash (left) and Richard Resl, who received the Making a Difference Award at the 2016 Esri User Conference, returned to Ecuador inspired to keep tackling the challenges ahead.

ArcGIS Is a Complete Platform for Open Data

continued from cover

ArcGIS Open Data is included with ArcGIS Online at no extra cost. It requires only a few minutes to enable, build, and publish an open data site. Organizations can create as many open data sites as they need, as well as configure and design them. For example, an organization can have a main ArcGIS Open Data site along with other open data sites for individual agencies, specific initiatives and events, or even local neighborhoods.

The software can be configured to use existing, on-premises layers in ArcGIS for Server. Alternatively, organizations can publish their data in cloud services. ArcGIS Open Data sites include unlimited bandwidth, and members of the public can download as much data as they want. Citizens can also create public accounts where they can save data, share it, and tell their own stories using an organization's open data. What's more, ArcGIS Open Data provides performance dashboards so that agency employees and even the public can monitor and evaluate key initiatives like affordable housing, reducing traffic congestion, and keeping pedestrians safe.

↑ It takes only a few minutes on ArcGIS Open Data to enable, build, and publish a site.

Dataset Downloads from ArcGIS Open Data Sites
Total: 15,572,393

Available to All Governments, Organizations

About 3,500 organizations all over the world already use ArcGIS Open Data. The US Department of Transportation recently launched its *National Transit Map*, which has reportedly collected 400,000 transit stops and 10,000 routes from 270 agencies and uses ArcGIS Open Data to share the information. In February, the US Department of Homeland Secur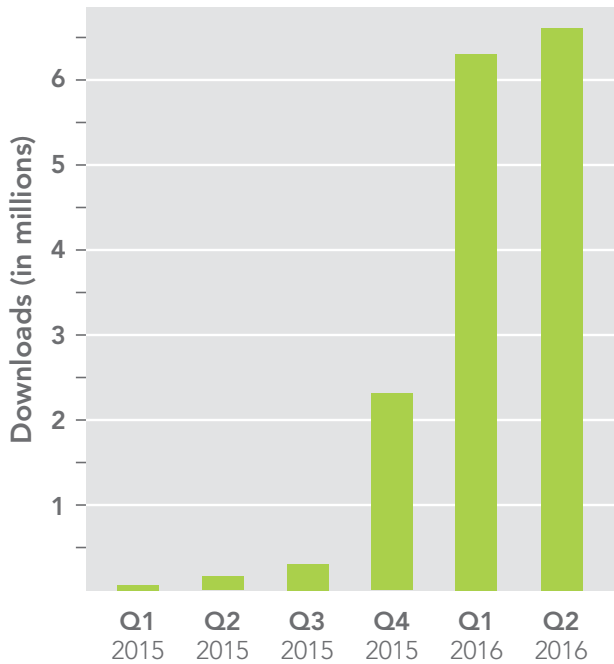ity introduced HIFLD Open from the Homeland Infrastructure Foundation—Level Data subcommittee, which makes national infrastructure data available to support community safety, disaster resilience, and economic development. The US Department of Education and the US Department of Housing and Urban Development have ArcGIS Open Data sites, as do the United Kingdom's Office for National Statistics and Australia's Commission on Safety and Quality in Health Care for its *Australian Atlas of Health Care*.

Smaller towns, nonprofits, and community groups are creating open data sites too. Washington, DC; Bexar County, Texas; Chesterfield County, Virginia; Waukesha County, Wisconsin; and Manlleu, Spain, are just a few places that use ArcGIS Open Data to make their government information a public service.

ArcGIS Open Data is translated into 26 languages, so governments and organizations around the world can build their own open data sites to serve local communities. The World Resources Institute, for example, created forest atlases for the Congo Basin and used ArcGIS Open Data to configure websites in English and French.

Foster Data-Driven Citizenship

A study from the Pew Research Center in April 2015 discovered that while 65 percent of Americans in the previous year had used the Internet to find data or information pertaining to the government, only 5 percent reported that federal and state governments were very effective in sharing data, while just 7 percent said that local governments shared data very effectively.
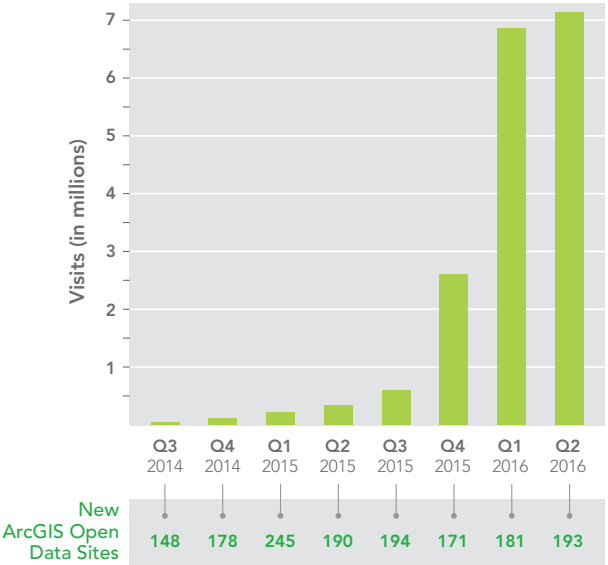
"There is a real and powerful demand for access to open information," said Andrew Turner, director and chief technology officer of the Esri R&D Center in Washington, DC. "This presents a tremendous opportunity for government agencies and organizations to meet the needs of their constituents and supporters."
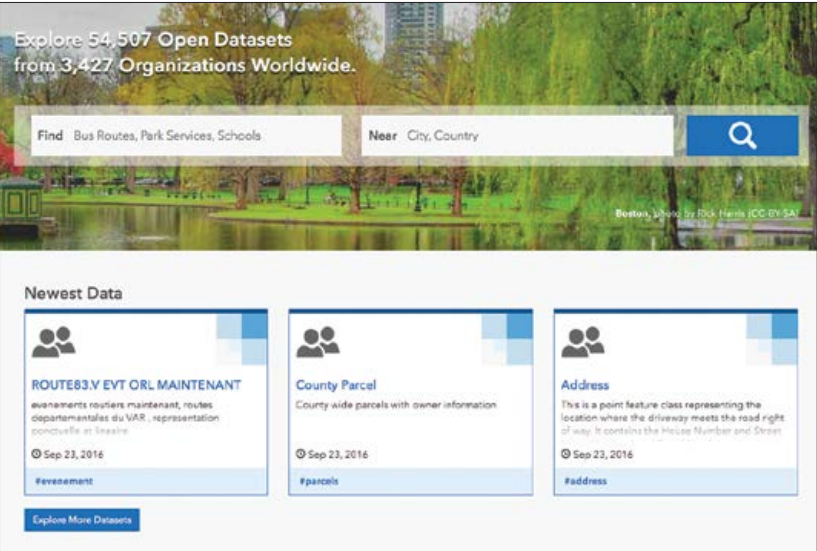
Visits to ArcGIS Open Data Sites
Total: 17,727,465

Every organization with access to ArcGIS can use ArcGIS Open Data to share information. It is integrated with a host of engagement tools, such as Esri Story Maps and Web AppBuilder for ArcGIS, as well as more than 200 open-source projects from Esri and the GIS community. Additionally, app developers can use APIs and platform libraries to build new, innovative solutions that drive economic opportunity and solve important local issues.

With ArcGIS Open Data, Esri empowers any community to have data-driven citizens.

Fayetteville Makes Police Data Public
Model for Citizen Engagement

The City of Fayetteville, North Carolina, wanted to ensure transparency and community engagement. So it built the Open Data Portal using ArcGIS Open Data.

Citizens can now visit the portal to access police data such as traffic stops, incident reports, and crime maps. They can also look at employee demographics for the police department and use-of-force statistics, as well as find out about scheduled community watch meetings.

"We want to improve understanding of policing, improve transparency, enhance community trust and confidence in police, dispel myths, and highlight realities through data," said Fayetteville's chief of police, Harold E. Medlock.

Fayetteville's Open Data Portal promotes citizen engagement with other departments as well by hosting information from the fire department, planning and zoning, transportation, finance, parks, and more.

The portal owes its success to the collaborative work of the city's IT, GIS, and police departments. Cooperation among the departments made it possible to quickly roll out the site with consistent branding, graphics, services, data preparation, and back end setup.

Three members of the Fayetteville Police Department were invited to the White House in April 2016 to discuss the city's Open Data Portal as part of the Police Data Initiative, an effort launched by president Barack Obama's Task Force on 21st Century Policing to identify the best means for effective collaboration between law enforcement and local communities. It focuses on the use of data to increase transparency, build community trust, strengthen accountability, reduce crime, and improve relationships between citizens and police. ArcGIS Open Data is the solution that helps Fayetteville and many others respond to such measures.

To turn on ArcGIS Open Data in your organization, visit esri.com/opendata.
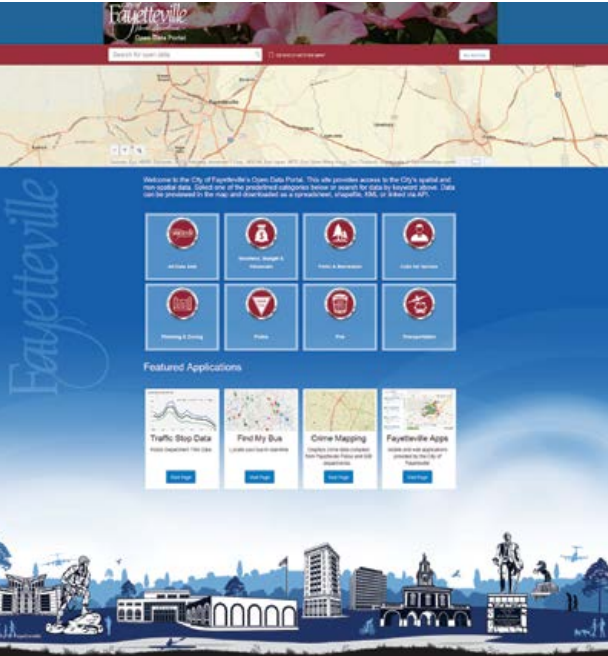
↑ Citizens can visit the City of Fayetteville's Open Data Portal to access police data, use-of-force statistics, and scheduled community watch meetings.

GIS Helps Open Up US Legislative Process

By Jonathan Marks, Quorum Analytics

On November 8, in addition to choosing a new president, Americans will elect or reelect 34 senators and all 435 representatives to Congress. They will also choose 5,920 state government officials and vote for more than 10,000 local legislators across the United States. Once in office, these lawmakers will represent the residents in their constituencies, whether at the federal, state, or local level.

Getting laws passed in any government entails working with other legislators. If, for example, a senator wants to propose a bill to help low-income families get access to better childcare, he or she needs to garner support from other members of Congress to get the measure through both the Senate and the House, to the president, and signed into law.

The most logical lawmakers to target, then, are ones who have constituents in their jurisdictions with similar needs—so, concentrations of low-income families that have at least one working adult in the household. It is also efficient to approach legislators who tend to support causes like this. But finding this information is difficult, and keeping track of it for hundreds of politicians is arduous.

Quorum Analytics, an Esri startup partner, has developed tracking software that it employs in conjunction with GIS to make gleaning political influence a lot easier. Although the company began its business using another mapping software, it switched to Esri after a year and a half to gain access to better geographic datasets, as well as a market of organizations that already store geographic data. Now, with Quorum's online and mobile apps, lawmakers (and their staffs) can seek out senators and representatives who will support their issues, cosponsor legislation, and help get bills passed. The technology also extends this ability to trade associations, government agencies, nonprofits, startups, lobby shops, and Fortune 500 companies.

Identifying Targets

Traditionally, legislative targeting has relied on advocacy professionals' intuition and experience to identify targets. Quorum's platform reinvents this process by enabling users to consider various quantitative factors such as committee and caucus membership, legislative activity, votes, mentions of key subjects in press releases and on social media, and demographics.

Through Quorum's web and mobile apps, users can track legislation and dialog in Washington, DC, and all 50 states and leverage these quantitative analytics to identify potential champions for a cause. Users get access to three main types of datasets at the federal, state, and local levels: legislative data, including bills, votes, committees, and hearing schedules; public remarks, including press releases, Tweets, Facebook posts, floor statements, and emails to constituents; and contact information for legislators, staffers, and executives.

From this constantly updating stream of information, Quorum generates sophisticated
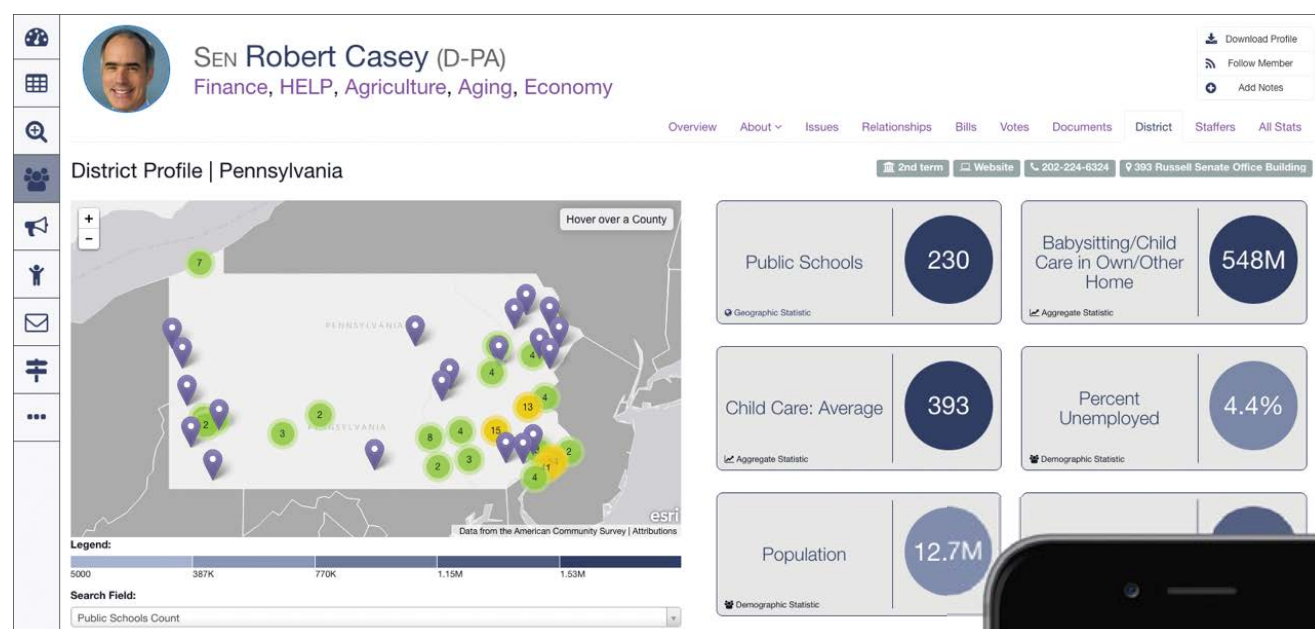
↑ Quorum makes it possible to visualize a policy's effects on various districts by layering in demographic statistics from Esri.

analytics that enable users to understand which state legislators or members of Congress are most active, influential, or effective in a given issue area and identify relationships among lawmakers to help build coalitions. The software also calls out similarities in the texts of bills from different states.

Users can then leverage their preexisting geographic datasets—along with the expansive demographic datasets hosted in ArcGIS—to view Quorum's legislative data and analytics in map form. The software employs the ArcGIS REST API for the GeoEnrichment service, which makes it easy for Quorum users to layer in extensive demographic statistics—such as age, race, industry, and consumer preferences—about each lawmaker's constituents. With this, users can visualize a proposed policy's effects on various districts and identify legislative targets.

Demonstrating Impact

Once users have identified their targets, they can use Quorum to generate comprehensive profiles that help demonstrate the value of their advocacy issues to lawmakers. Even without technical knowledge, users can directly import geographic data from ArcGIS and visualize it in Quorum's platform.

This helped a major nonprofit recently identify lawmakers whose jurisdictions would be most affected by legislation aimed at curbing child poverty. Its employees used Esri's demographic data to rank districts by different child poverty statistics—such as the percentage of people below the poverty line who are under age 18 and the percentage of households below the poverty line that have at least one child under age five—and compared that to Quorum's trove of legislative data. Using Quorum's targeting tools, it took the nonprofit hours rather than days to come up with a list of lawmakers who would most likely support a bill on the issue. From there, the nonprofit convinced several lawmakers, who previously had

been unaware of the extent of child poverty in their districts, to cosponsor a bill.

Quorum's simple interface also helped a Fortune 500 company in the retail space visualize its consumer and economic impact in various regions. After running the analytics, the company could see how many people it employed in each state and district, where each of its facilities was located, its total charitable donations, and how much the company was contributing to the economy. The company then used Quorum to distribute this information to its public relations employees and contractors in all 50 states, providing them with an unprecedented level of insight into their company's economic influence.

Communicating with Lawmakers

To see a government or public affairs project through, policy proposers need to be able to communicate directly with lawmakers, their staff, and executives.

Quorum has a full-featured customer relationship management (CRM) system to help users keep track of their relationships. It makes it easy to send personalized emails—complete with customized datasets and maps—to interested parties (even on a mass scale), right from within the software, so lawmakers can visualize the effects of suggested legislation.

This geographically driven insight is available through Quorum's mobile app as well, so users can show their data to anyone at meetings or political events. And the ability to generate professionally designed PDFs makes it easy to leave printouts with interested parties when meetings conclude.

Together with Esri, Quorum is transforming how government affairs professionals work with policy makers and how legislators work with each other.

"Quorum harnesses congressional data in the blink of an eye," said Maggie Williams, director
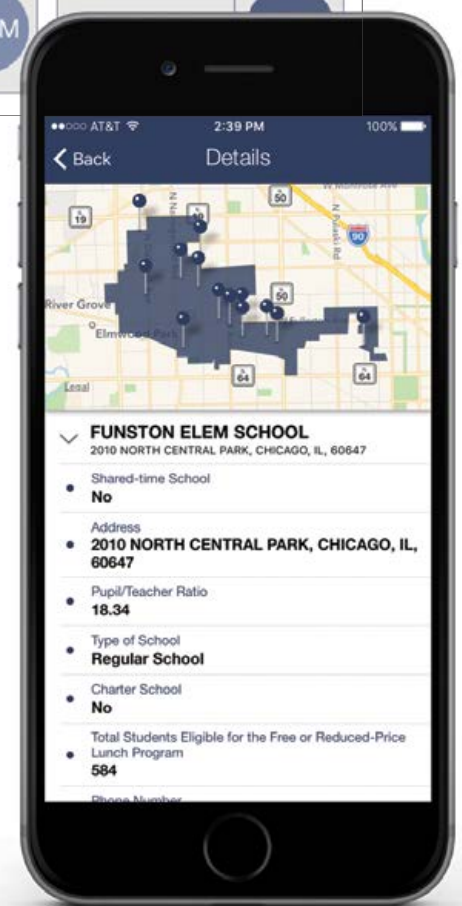
↑ Geographically driven insight is available through Quorum's mobile app, so users can show their data to anyone at meetings or political events.

of the Institute of Politics at Harvard University. "It is a window into the world of lawmaking, corralling volumes of legislative information into a readable, manageable form."

"Quorum is an amazing and powerful tool exploring the intersection of elections and policy," echoed Charlie Cook, editor and publisher of *The Cook Political Report*. "Even the smartest and most experienced lobbyists and Congress watchers will find that Quorum's fascinating data will help them understand and anticipate the behavior of members."

For more information and to sign up for free weekly email alerts to see every time your organization is mentioned by US lawmakers, visit info.quorum.us/esri.

2020 CENSUS
Embraces Digital Transformation

The census is the largest peacetime operation conducted by the US government. Article I, Section 2 of the US Constitution mandates that each person be counted every 10 years to properly allocate the number of legislators each state gets in the House of Representatives.

A lot has changed since the United States conducted its first census in 1790, when marshals traveled on horseback to administer the survey. Now, that responsibility falls to the US Census Bureau, which uses a range of methods and technologies to complete the count.

A prodigious user of GIS, the Census Bureau helped pave the way for where the technology is today. In 1967, while preparing for the 1970 Census, the bureau began developing Dual Independent Map Encoding (DIME) to more efficiently and accurately store its geographic data. DIME converted intersections, streets, and blocks into points, lines, and polygons and allowed users to edit topology (the geometric connections between vector objects). Additionally, for the 1990 Census, the Census Bureau created the Topologically Integrated Geographic Encoding and Referencing (TIGER) database, the first digital map of geographic features—such as roads, rivers, and boundaries—for the United States.

Since the last census was taken in 2010, the Census Bureau has increased its use of technology in every aspect of the undertaking. For the 2020 Census, GIS is going to be far more intertwined in the process than ever before—from figuring out where to count and encouraging people to submit their forms to enumerating everyone and sharing the results.

"We're using the technology in a much greater way than we ever have before," said Tim Trainor, the US Census Bureau's chief geospatial scientist. "There are pockets of [GIS] development going on all over that are eventually feeding into the big picture."

Slimming Down the Process

For the 2010 Census, there were more than 500 local census offices and 12 regional census centers to manage them. The bureau hired 140,000 temporary workers to walk every street in the United States and record every unit. The questionnaires were only offered on paper. To find people who didn't respond, the bureau hired an additional 600,000 temporary workers who would go back to a single unit as many as six times to get ahold of nonrespondents. The total cost came to more than $12 billion.

"When we looked at the cost of doing the 2020 Census in the same way that we did the 2010 Census, we were going from a little over $12 billion to a little over $17 billion," said Trainor.

That just wasn't an option. So the Census Bureau began innovating in four key areas: addressing, response options, the use of administrative records, and infrastructure for field operations.
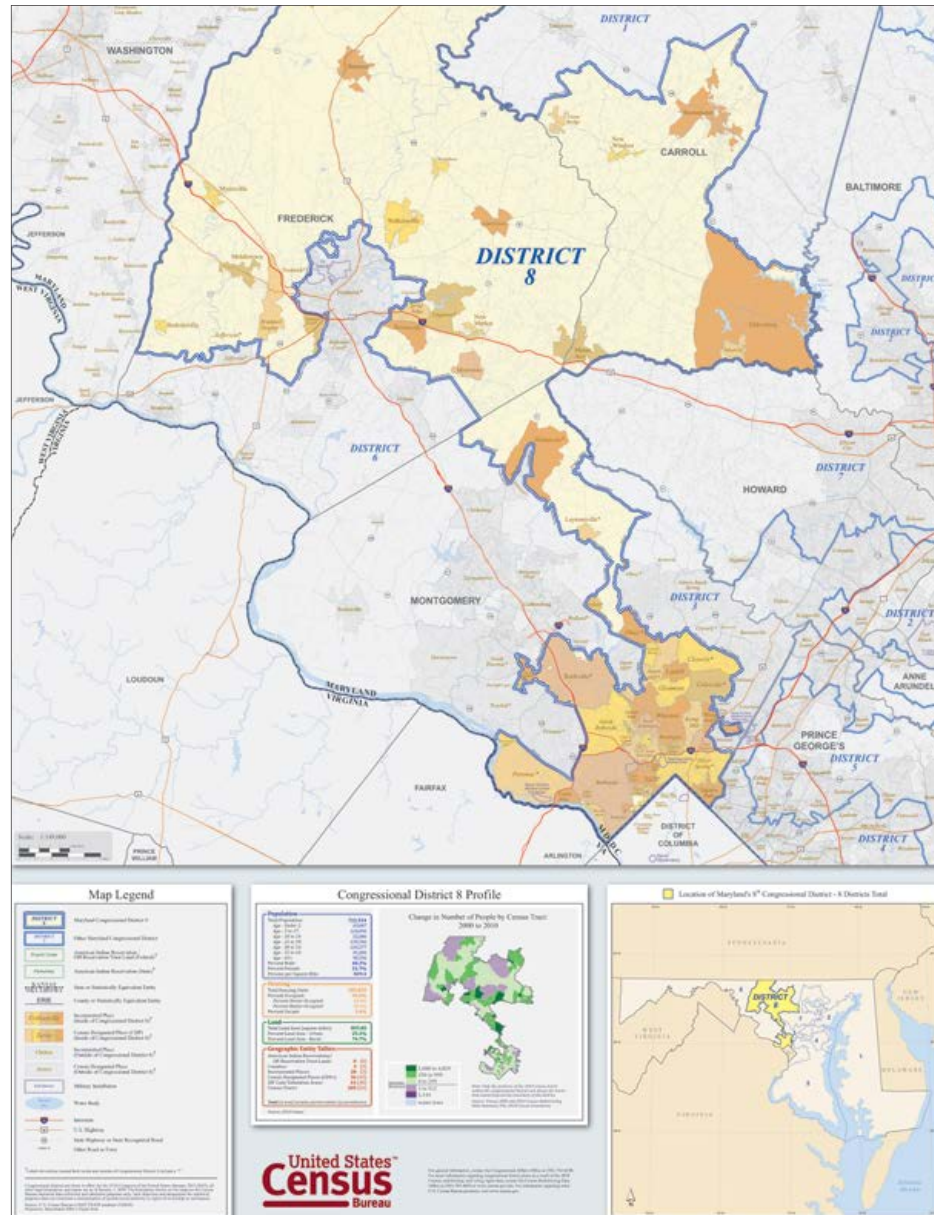
↑ The US Census Bureau's increased use of GIS will help states redistrict their jurisdictions quickly.

"Those are critical," he said. "And that's where geography plays such a major role [in] the census process."

Canvassing Addresses from the Office

For each decennial census, the goal for the US Census Bureau is to count everyone once and in the correct place. At the most basic level, this depends on having an accurate list of addresses across the United States. Local governments make addresses, so the Census Bureau works with them (and a few states that have good address records) to update its address list.

In the past, the Census Bureau checked the accuracy of the list by having employees walk or drive every street in the country—about 6.2 million miles of roads, which the Census Bureau maintains in a database.

"For address canvassing, we probably traversed hundreds of millions of miles, though, because people have to get to their assignment [and] they have to drive up and down," said Trainor. "That costs a lot of money."

For the 2020 Census, the geography program at the bureau proposed a continual update

of the address list instead of doing it all right before the count. This would now be feasible in part because the Geography Division could use the Census Bureau's American Community Survey (which is conducted every year) to get detailed demographic, economic, social, and housing characteristics about the American population. Additionally, over the last 10 years, the Census Bureau has become an increasingly heavy user of imagery.

The idea was to take the address list and use a variety of imagery sources to find each housing unit. This was possible because, during the 2010 Census, the canvassers walked up to the front door of every residence on every street and recorded the GPS coordinates.

"That was a very, very valuable dataset," said Trainor, since, as he pointed out, many addresses don't change over time. "Using those locations, we're able to link the address to that location."

When the Census Bureau began using imagery, staff scanned local government websites to see what imagery they posted and whether or not it met the census's accuracy requirements. The bureau also started using

the US Department of Agriculture's National Agriculture Imagery Program (NAIP) imagery.

"But as we go down the path of in-office address canvassing, the resolution of one- and two-meter imagery is not as high as what we need, really, to distinguish and discriminate housing unit types," said Trainor.

So the Census Bureau connected with the National Geospatial-Intelligence Agency (NGA) to gain access to its imagery as well. The bureau now takes NAIP imagery from 2009 and compares it to more recent NGA imagery to see what, if anything, has changed.

And with that, the Census Bureau no longer needs to employ more than 100,000 people to walk the streets of America to confirm addresses. Instead, a couple hundred people use imagery and GIS to canvass them from the bureau's National Processing Center.

"Looking at imagery with our address list, they can see where the address is on that space, and they can decide whether they've got the right number within the census block," explained Trainor. "They can just do a quick scan to say, hey, I have 10 [housing units] on my address list, I've got 10 dots on the map, and there are 10 units there. That looks pretty stable. Let's move onto the next block."

If an in-office canvasser comes across an image where it looks like there might be construction happening or there appears to be more or fewer housing units in the block than previously recorded, he or she puts that segment aside to revisit later—perhaps with some better imagery from a local government or, down the road, by sending someone out into the field to see what has changed.

In just six months, the Census Bureau analyzed more than 3.5 million blocks out of the 11 million it has to tackle. What's more, the address canvassing began three years before it would have in previous censuses.

"We're estimating a savings of about $900 million just in that one innovation alone," said Trainor.

Increasing Response Options

Another modernization for the 2020 Census is that the Census Bureau will offer people three different ways to fill out the census: by paper, by phone, and via the Internet.

Although it may sound outdated that people couldn't fill out the 2010 Census online, the digital transformation has really only recently gotten into full swing with the increased availability of mobile devices and a profusion of social media.

For the 2010 Census, "we determined through studies we'd conducted that the people who would use the Internet would still respond to the census using a paper questionnaire," explained Trainor. "So we didn't really see a benefit in the response rate."

At the time, it also would have been rather expensive to offer other options besides paper.

This time around, the Census Bureau will still send the census through the mail, as it did before, and each form will again have a unique code that identifies that particular housing unit. Some people may prefer to fill out the paper form and mail it back. Others may have questions about the census and call the questionnaire assistance center, where, in addition to providing support and answering people's inquiries, operators can actually fill out residents' census forms over the phone. Still other respondents may decide to fill out the census online.

To do this, residents can either input their form's code to identify their housing unit or, alternatively, enter their address. When a resident chooses the latter route, the system taps into the Census Bureau's list of 150 million US addresses. If the address matches what is on the list, the resident can fill out the questionnaire. But if the person types in *Main* Street and the Census Bureau only has a *Maine* Street in that town, the user will receive a drop-down list of addresses to choose from. If the resident decides that none of them are correct, a map will appear so he or she can identify the housing unit by pointing and clicking. Then, the person fills out the form and the Census Bureau has to validate the address.

With this, the Census Bureau no longer has to rely on hoards of employees to pore over millions of paper forms, keying in the data that could not be scanned. Instead, GIS automatically performs quality assurance checks on the geographic data submitted online, matching form codes and addresses to the geocoded housing units the bureau has on record.

Making Better Use of Administrative Records

But what about when people have multiple homes? If the Census Bureau wants to count everyone once, then issues like this are challenging.

"Some people have housing that they don't normally live at all the time, but we don't know that," explained Trainor. "I've got an address list, and it's got *[someone's]* primary home and it's got their secondary home. I don't know where they live most of the year. So we're going to send a form to every one of those units because they're on our address list and they're valid addresses."

The US Postal Service, however, has a good idea of when people have more than one home because residents often stop their mail when they're not going to be at one location.

For the 2020 Census, the bureau is looking to use third-party administrative records like these to fill in the gaps. So if a housing unit in Boca Raton, Florida, is unresponsive to the census, the Census Bureau can match postal service records with the census address list to see if that unit is designated vacant during the census. If so, there's no need to send someone to that house over and over to solicit the resident to fill out the census.

"That savings is going to be substantial," said Trainor.

Mobilizing Field Operations

That said, Trainor thinks the Census Bureau will save the most money by infusing its field operations with more GIS and mobile technology.

Although the census has a 65–67 percent response rate, which is exceptionally high, the Census Bureau still has to get the rest. And non-respondents live across the United States, so this ends up being a huge field operation that has to be completed in a short amount of time.

In the past, this has required hiring hundreds of thousands of temporary staff to go door-to-door to find the people who didn't fill out the census and convince them to do so. All these employees had supervisors as well to introduce them to their assignments and oversee each portion of the larger operation.

"We used mobile technology in 2010, but it was basically to ensure that we had complete coverage and to give folks an idea of where they were," said Trainor. "There was no navigation capability."

For the 2020 Census, however, the Census Bureau is looking to expand its use of mobile technology and incorporate navigation and workload management into it.

"When we hire *[these temporary staff members]*, we geocode them to their location…to give them assignments close to where they live so we don't have people traveling *[farther]* than they need to," said Trainor. "It's also an opportunity for us to manage whether or not we have enough people in a given area to do the work, which has always been one of our greatest concerns."

The Census Bureau also wants to use mobile technology to provide field employees with short, portable training segments.

"We're very good at making manuals, and we've made hundreds of pages of training manuals that some people read and others don't," said Trainor. "But we're moving away from that and trying to make it as easy as possible for people to understand…how to do their jobs"— ideally allowing them to refer back to their training materials while they're out in the field by using their mobile devices.

This will let the Census Bureau significantly reduce its field infrastructure and supervisory setup.

"This time around, we'll have six regional census centers and approximately 300 local census offices," estimated Trainor.

That's a 50 percent cutback in regional management and a 40 percent reduction in on-the-ground labor.

A More Seamless Census

The US Census Bureau is hoping that its increased use of GIS and other technologies will lead to a safe and easy 2020 Census and bring expenses down to 2010 levels.

"We're estimating we'll be in the neighborhood of a $5 billion savings," said Trainor.

Not only that, but by digitizing many operations and using GIS more pervasively throughout the census cycle, the Census Bureau anticipates a more efficient, seamless enumeration on census day, April 1, 2020. States across the country will certainly appreciate this, since they only have a few months after the first part of the census data is released in early 2021 to redistrict their jurisdictions for elections later that year.

Esri Partners
Work Smarter with Web GIS

Esri partners around the world are assisting our users in implementing the Web GIS pattern. Their efforts are helping organizations work smarter by migrating to a services-focused platform that facilitates connecting everyone, applying web-based analytics and visualization, and dynamically integrating disparate systems into a single platform. Bringing the various parts of an organization together fosters understanding and helps employees be aware, alert, and responsive in real time.
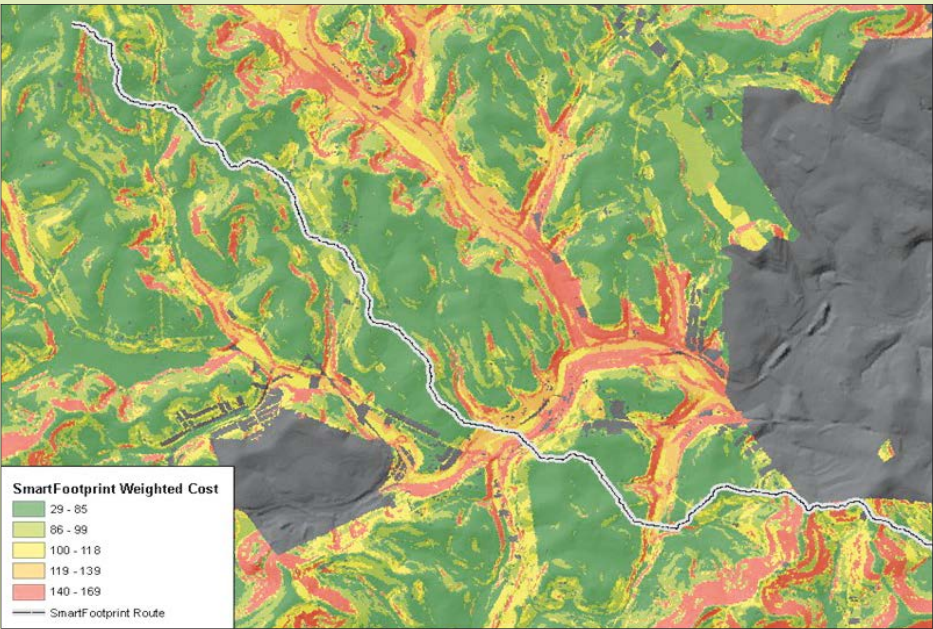
↑ To help manage its wide-reaching pipelines and processing stations, Williams reached out to Earth Analytic, Inc., whose SmartFootprint solution is integrated with the ArcGIS platform.

Managing Pipeline Infrastructure with Integrated GIS

Williams, one of North America's leading energy companies, owns and operates large-scale infrastructure that connects the continent's significant natural gas supplies to growing natural gas markets. To help manage its wide-reaching pipelines and processing stations, Williams reached out to **Earth Analytic, Inc. (EAI)**, which specializes in scientifically based geospatial solutions for energy and conservation projects.

EAI's SmartFootprint solution (earthanalytic.com/smartfootprint)—which is integrated with ArcGIS for Server, ArcGIS for Desktop, and ArcGIS Online—provides Williams with custom tools and datasets. It analyzes variables such as environmental sensitivity, population density, geomorphology, hydrology, and landownership to create least-cost paths (routes that cost the least amount of money to develop) for energy transmission lines.

Using the SmartFootprint tools in Williams' planning workflows has radically reduced the time it takes to put together a proposed route. Previously, planning a proposed 500-mile pipeline route could have required three to four months of staff time. But with the SmartFootprint Route Finder app, which uses custom cost surface datasets, staff time has been reduced to 18 hours. And the complete SmartFootprint solution enables Williams to calculate an optimal 100-mile route in approximately 20 minutes.

Since Williams no longer has to pay engineers to perform preliminary route analysis, the SmartFootprint system is saving the company millions of dollars annually.

↑ To improve how it documents the location and condition of traffic assets, the City of Colorado Springs' Traffic Engineering department implemented Cartegraph, which requires users to log in using the ArcGIS Identity.

Tracking Assets and Recouping Costs

The City of Colorado Springs needed to improve how it documented the location and condition of its traffic assets. So the Traffic Engineering department implemented **Cartegraph** (cartegraph.com) to start electronically tracking signs, traffic signals, and other assets. Cartegraph requires all users to log in to its asset management system using the ArcGIS Identity, which brings the spatial analysis capabilities of the ArcGIS platform into direct play. This allowed the division to visualize its asset inventory and streamline the maintenance process, including work orders.

It wasn't long until other teams within the city recognized the benefits of using Cartegraph's ArcGIS Identity and began to follow suit. Now, 10 of the city's 17 departments have made the move from a paper environment (in many cases) to a web-based operations management system that allows them to visualize data both in the office and out in the field.

According to Andy Richter, the city's asset management supervisor, "Colorado Springs has seen a $2 million *[return on investment]* since implementing Cartegraph and ArcGIS. The city relies on the software integration when recovering from natural disasters, such as wildfires and flooding. Using the systems together, they can accurately track lost assets, calculate expenses, and justify the costs to FEMA for restitution."

It is also helpful for routine asset damage. Prior to using Cartegraph with ArcGIS, Richter said the city was lucky to recoup $1,000 a year for damaged signs. With the software, it recouped $70,000 in the first quarter of 2016 alone.

The software assists with citizen awareness as well. For example, Colorado Springs' Cone Zones program informs the public of roadwork in the area. The data from these zones is fed directly into ArcGIS Online, populating a map for citizens to view on the Internet.

Reducing Field Inspection Time Ahead of Presidential Inauguration

The District Department of Transportation (DDOT) maintains a complex web of roads, paths, and bridges throughout Washington, DC, where planning and security are vital. DDOT has to regularly assess pavement and traffic conditions, as well as emergency vehicle access, all while overseeing as many as 70 large-scale construction projects at once.

"DDOT is challenged every day to identify changes in our road system and react quickly," reported José Colón, DDOT's chief information officer. "Each year, we're involved in helping plan and manage resources for some of the largest events in the *[United States]*, including nearly 500 block parties, 400 TV and film permits, 20 marathons, and 60,000 public space permits."

At the beginning of 2017, close to 1 million visitors are expected to descend on the US capital for the inauguration of the country's 45th president. Attendees will anticipate both convenience and security at the event. As usual, this will require DDOT to integrate dozens of data sources. But oftentimes, imagery is outdated.

To address this, DDOT is accessing high-resolution aerial imagery from **Nearmap** (go.nearmap.com) and using the geoanalytics capabilities available throughout the ArcGIS platform to identify features, measure distances precisely, and detect change with confidence.

This unique level of accuracy has allowed DDOT to reduce the time it spends on field inspections by 30 percent. At the same time, it gives DDOT insight that it can easily share with staff, citizens, and security agencies across the region.

↑ Using high-resolution aerial imagery from Nearmap, the District Department of Transportation in Washington, DC, has reduced the time it spends on field inspections by 30 percent.

## Making Cities Safer with Real-Time GIS

The City of Roswell, in the metro-Atlanta area, is ranked one of the safest cities in Georgia by SafeWise. Part of Roswell's safety plan is to ensure that its public safety agencies have access to effective and efficient data and analytics. The city connected with **Geographic Technologies Group (GTG)** to make sure this was happening.

GTG conducted a needs assessment for the city, revealing that the GIS apps it used for policing needed enhancements. The company also developed an enterprise GIS strategy for Roswell. From there, Roswell became the first city to implement GTG's SafeCityGIS solution (safecitygis.com).

"Public safety agencies often adopt GIS tools that are insufficient, resulting in underuse and disappointment," said GTG president Curtis Hinton. "GTG created SafeCityGIS to enable public safety agencies with an integrated suite—including GTG solutions combined with the ArcGIS platform— to serve the entire public safety organization with software that is intuitive and easy to use."

At the Roswell Police Department, officers and command staff can now see pertinent data for any scenario they may encounter, whether it involves proactive policing or officer safety, according to Kelly Hooper, a criminal intelligence analyst with the department.

SafeCityGIS includes GTG's Vantage Points Public Safety Analyst (PSA), SafeCityGIS Mobile Viewer, and SafeCityGIS Dashboard. Together, these tools provide users with access to interactive maps, better crime data, incident tracking and trends, real-time location tracking, analytical tools, and an intuitive dashboard available to all levels of staff.
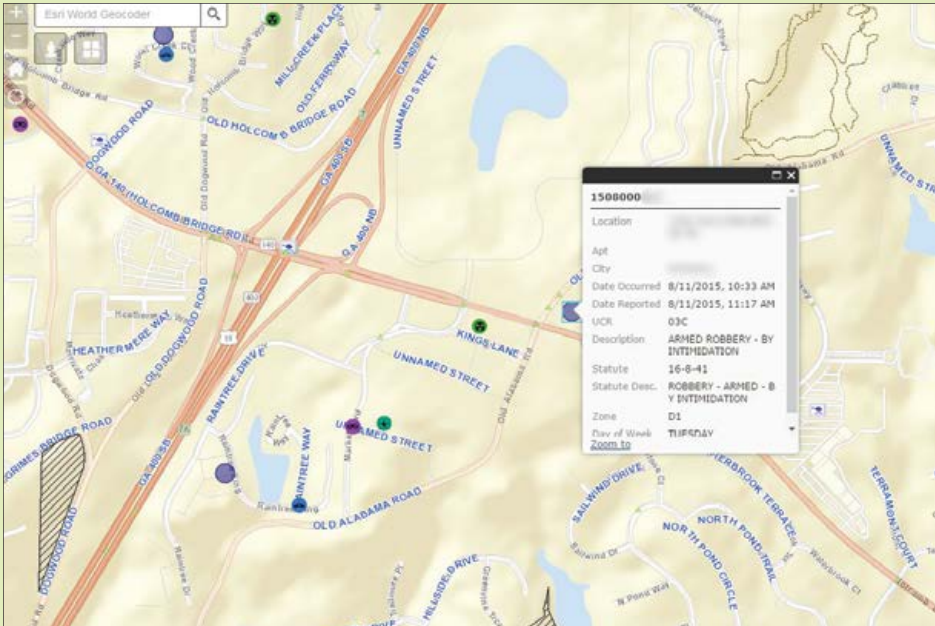
↑ With SafeCityGIS from Geographic Technologies Group, officers and command staff at the Roswell Police Department can see pertinent data for any scenario they may encounter, such as an armed robbery.

Interactive, Mobile-Friendly Zoning and Planning

Zoning professionals in city, county, and state agencies need to be able to visualize, use, and share accurate and timely data to make informed decisions and engage with other agencies.

When the Washington, DC, offices of zoning and planning realized that their zoning regulations and maps were long overdue for some revisions, they reached out to **Blue Raster** (blueraster.com) to develop an interactive, mobile-responsive mapping app that would empower the government, citizens, and developers to make better informed decisions using reliable data. Blue Raster created the new interactive map using the ArcGIS platform.

"The new ZR16 Zoning Map application and the Zoning Handbook are generating a greater active interest in zoning by presenting visual data and content in a clear and concise manner," said Nyambi A. Nyambi, chief technology officer for the District of Columbia Office of Zoning (DCOZ). "Blue Raster effectively worked to translate DCOZ's vision into an application we are all proud of."

The new Zoning Map, which features responsive design for mobile devices, includes customized reports for zoning and planning information, high-resolution cartographic printing and documents, and open data from the capital city's Office of the Chief Technology Officer.

"The Zoning Map and Handbook help residents in the DC area understand and use the updated zoning regulations," said Anthony Puzzo, Esri's business development team lead for state government. "Blue Raster created an intuitive, interactive map app to make the vast amount of important zoning information that is associated with properties in this area more accessible."
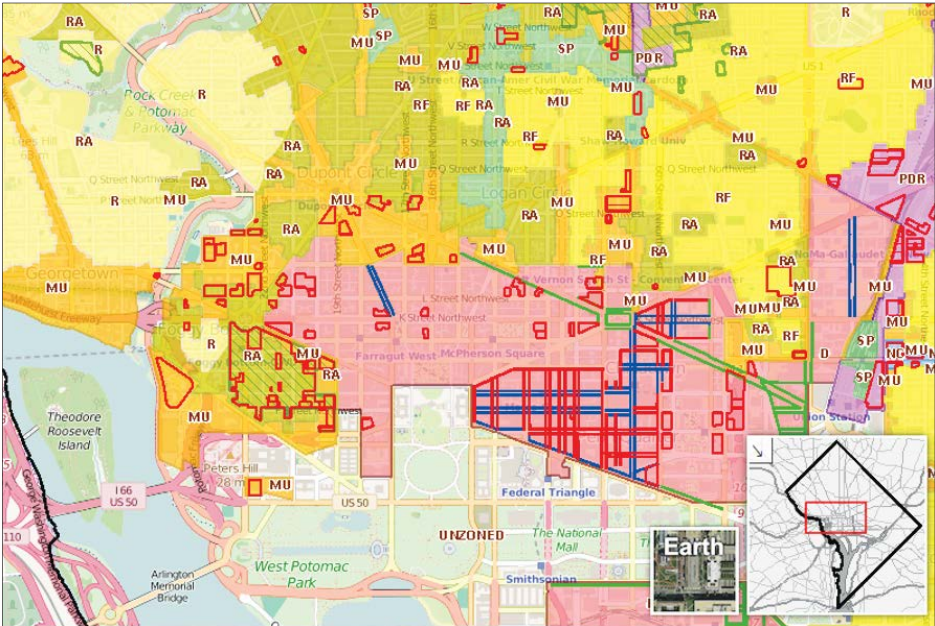
↑ When Washington, DC's offices of zoning and planning needed to update their zoning regulations, they had Blue Raster develop an interactive, mobile-friendly mapping app.

Esri's more than 2,200 global partners provide customer-focused, geoenabled solutions that span dozens of industries.
Products and services range from configured apps and custom-built solutions to complete ArcGIS system implementations and content.
To search and discover partners, solutions, and services that meet your needs, visit esri.com/partners.

Startups Advance Indoor and Outdoor Spaces with 3D Visualization

Three Esri Startup Program partners have harnessed the data power in ArcGIS Online, as well as the 3D visualization capabilities of the ArcGIS platform, to create truly innovative solutions for visualizing outdoor and indoor spaces.

Innovating Indoor Mapping

Knowing the inner dimensions of a building is crucial for facilities management, construction, safety, and more. The complete 3D documentation, mapping, and positioning of indoor spaces inform building maintenance (especially when it's lagging behind) and help decipher a space's construction history (particularly when record keeping has been poor).

Indoor Reality documents and visualizes indoor spaces in an efficient, sequenced process. A human operator wearing indoor lidar equipment walks through a building, capturing its dimensions 20 times faster than traditional, tripod-based solutions. The floor plans generated by this can be imported into ArcGIS Pro and ArcGIS Online, where they can be viewed and georeferenced as well as authored and shared as 3D web scenes.

Because Indoor Reality processes data via an automated pipeline, businesses and building owners can put together 3D floor plans in industry-standard formats twice as quickly as they could have with previous workflows. This means that building managers can document construction work daily, monitor restoration progress more accurately, ensure that elements of their models don't clash (occupy the same space) with one another, and pay subcontractors based on how much of the job they've completed.

Learn more about Indoor Reality at indoorreality.com.

A Portal to Collaboration

For capital engineering projects, in which new construction or renovations typically improve a piece of city infrastructure, it has always been challenging to share data. Usually, these projects involve multiple teams from various departments that, many times, hail from different companies in disparate locations. It is often difficult to get ahold of complete and comprehensive data to use to make informed decisions. But Web GIS portals have started changing that. By nature, they enrich teamwork and are ideal for reviewing these kinds of projects in their entirety.

Recently, a global engineering consulting company in the middle of a major multibillion-dollar pipeline project needed to have real-time access to data about the pipeline's right-of-way corridor. So the company enlisted **Civil Maps** and SkyTech Solutions Ltd. to populate a Web GIS app with the high-value data. First, SkyTech used a vehicle-mounted lidar unit and unmanned aerial systems (UAS) to collect data for the project area. Then Civil Maps used its machine learning feature extraction capability—which, by learning from the data, can perform predictive analysis on it—to rapidly map the entire 100-square-kilometer area. Within just a few weeks, Civil Maps had extracted more than 20 different feature classes with almost 4,000 discrete features.

Using ArcGIS for Desktop, the project team from Civil Maps and SkyTech did thorough quality control of the data and prepared it to go into the engineering company's relational database management system (RDBMS). The team used the company's own standards for feature extraction and quality control, which made it easy to track changes and load the final geodatabase into the RDBMS.

The engineering company is now using this comprehensive dataset, available to everyone working on the project via its Web GIS portal, to collaborate on the capital project. Not only is the dataset being used as a meeting tool, but it is also supporting discussions with the company's senior decision-makers.

Learn more about Civil Maps at civilmaps.com.

Mapping Cities in 3D

Urban operations, such as urban warfare or humanitarian relief in built-up areas, are challenging under any circumstances. Civilian responders and military operators need accurate 3D models to be able to conduct line-of-sight analysis, visualize buildings (including their heights), and ensure situational awareness. Because urban operations are not limited to a single city block and can occur anywhere in the world, 3D models must cover large geographic regions. They also need to be built using unclassified imagery so they can be shared with other governments and organizations in joint operations.

To fulfill these requirements, the 3rd (United Kingdom) Division of the British Army—the country's only division that maintains constant operational readiness—turned to **Vricon** and Esri to help with the planning and visualization required to conduct urban terrain analysis. The Division used Vricon's 3D Surface Model, which shows the entire globe in 3D at 0.5-meter resolution with three-meter absolute accuracy, with ArcGIS for Desktop to create a dynamic 3D visualization of a mission-specific objective. It then tested the 3D visualization in an exercise to train personnel for real-life scenarios.

The 3D model line-of-sight analysis took into account the actual (rather than estimated) heights of buildings. What's more, military operators and civilian responders could work with Vricon 3D data using the ArcGIS tools that they were already familiar with. Thus, they could dynamically visualize urban terrain and quickly share more precise results with decision-makers. Additionally, being able to fuse other data sources, such as social media feeds, with Vricon's 3D and elevation data—all within the familiar ArcGIS platform—provides limitless possibilities for supporting current and emerging urban operations that cover more than just a city block.

Learn more about Vricon at vricon.com.

The Esri Startup Program gives emerging businesses an edge by helping them integrate spatial functionality into their products and services. Program participants receive ArcGIS platform technology, training, support, and marketing opportunities to help them succeed. To learn more about the Esri Startup Program, visit esri.com/startups.
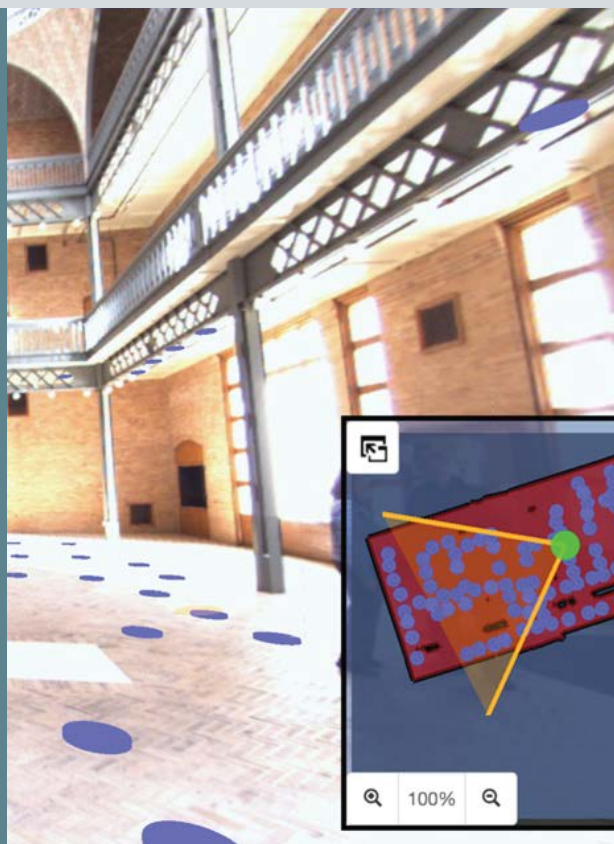
↑ Indoor Reality documents indoor spaces in a sequenced process to generate 3D floor plans that can be imported into ArcGIS Pro and ArcGIS Online.

↑ When a global engineering company needed real-time access to data about a multibillion-dollar pipeline, Civil Maps created a Web GIS app using ArcGIS.
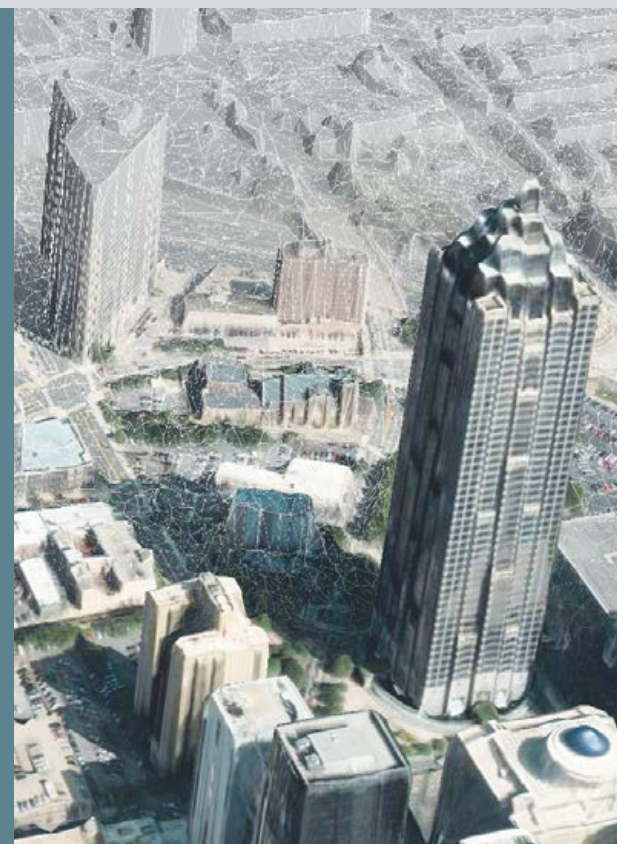
↑ Vricon created accurate 3D models of urban areas so military operators could conduct line-of-sight analysis and ensure situational awareness.

Take a New Path to GIS

MobileMapper® 50

Slim, compact, and very rugged, the MobileMapper 50 is built for everyday use in the field. Its small size and weight make it very handy, comfortable, and fitting for every pocket. The MobileMapper 50 provides all the capabilities and features GIS professionals require from a handheld device.

Slim and Strong

- Compact and lightweight
- Strong and waterproof casing, IP67
- Well-known Android user interface
- Complete field and office mapping solution

GIS Supports Demining Efforts Around the World

Story Maps Provide Link to Public

For people in war-ravaged regions, safe passage to and from work and school isn't a given, and cultivating farmland comes at the risk of life and limb—often decades after a conflict has ended. The ground can be so littered with lingering explosives that no one takes walking, driving, or working the land for granted.

Live land mines from past conflicts threaten millions of people worldwide. Unexploded ordnance (UXO)—including grenades, artillery shells, air-dropped bombs, and cluster munitions—not only kill and maim the innocent, but they also restrict the vitality of whole communities.

The challenge of removing UXO is formidable. But with GIS, awareness of the issue is spreading, and communities around the world are helping to rid the earth of hidden explosives.

Maps play an integral role in communication for the HALO Trust, a humanitarian organization that has been involved in demining since 1988. The trust uses GIS to organize demining data, display it on maps, and show patterns that enable basic locational awareness. In addition to

working with metal detectors, sandbags, and controlled detonation equipment, HALO's more than 6,000 extensively trained regional deminers employ GIS to orient themselves on missions, decide which areas to address, determine UXO locations, and depict successfully cleared minefields.

Recently, HALO also started using Esri Story Maps to convey the scope of its work in countries such as Laos, Cambodia, Sri Lanka, Zimbabwe, and Angola.

"We are always looking for new ways to bring our humanitarian work to life," said HALO director of communications Marcie Bell. "It's not always possible for our donors and partners to visit the minefields in person, so story maps are a way to experience these regions and survey their progress."

Circumstances vary from region to region, but, as the multimedia-rich story maps show, HALO's goals remain the same everywhere: to protect lives, restore livelihoods, and revitalize communities still threatened by the instruments of war.

LAOS

HALO has been working to eliminate embedded explosive remnants of war (ERW) from the rural eastern countryside of Laos since 2012. US military campaigns there during the Vietnam War, which caused Laos to become known as the most bombed country in the world, left a veritable powder keg in their wake.

The organization used an Esri Story Maps app to depict how UXO still impact the people of Laos and describe its local demining efforts. In a Story Map Journal (arcg.is/1PWj3TT), visual and textual narratives take viewers on a journey through the surveying, clearance, and community engagement processes—displaying areas where minefields have been found, showing how the organization informs and empowers community members through risk education sessions, and spotlighting the individuals who are directly affected by UXO. It also exhibits how GIS has contributed to operational decision-making, like when one map juxtaposes the locations of 2 million tons of UXO side-by-side with national poverty data to show the regions of greatest need.

In Laos, HALO has cleared more than 16,000 pieces of UXO from contaminated land.

↑ Visual and textual narratives in this Story Map Journal take viewers on a journey through HALO's surveying, clearance, and community engagement processes in Laos.

CAMBODIA

UXO also threatens Laos's southern neighbor, Cambodia, which is riddled with land mines laid by the Khmer Rouge, the Vietnamese army, and other militants. More than 64,000 people in Cambodia have been injured or killed by ERW since 1979.

HALO started employing local personnel to demine the country in 1992. The staff of 1,200 has destroyed over 220,000 mines to date.

The organization's Story Map Tour (arcg.is/2bbVuuU) on Cambodia focuses on the effects UXO has had on villagers who live in a largely agrarian society, where families have no choice but to farm perilous fields. Clicking on the thumbnails at the bottom of the map takes viewers to more specific points on the map and enlarges individual stories, from the father who never let his children on the family's land because he kept finding mines to the woman who had to keep supporting her family despite losing her leg in a land mine explosion near her house.
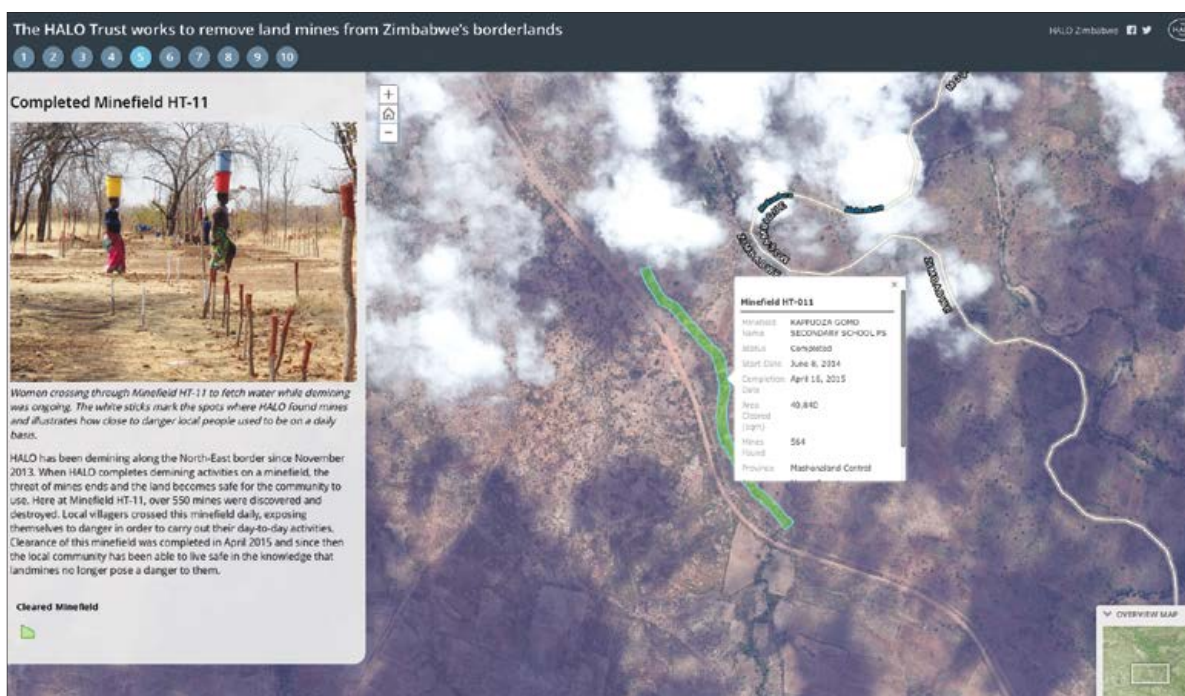
Thanks to HALO's demining and education efforts, more than 13,000 families that used to have to dodge mines on their land can now tread safely.
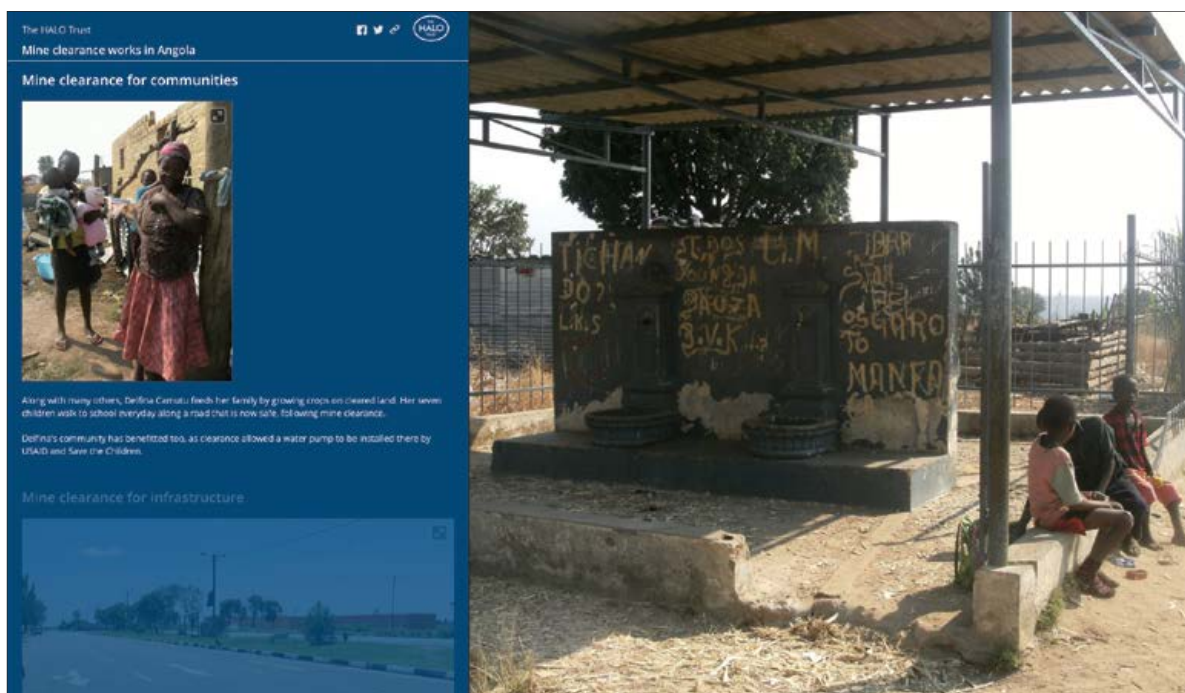

↑ Clicking on the thumbnails at the bottom of the Story Map Tour takes viewers to more specific points on the map and enlarges individual stories about how land mines have affected villagers.

↑ Following HALO's removal of 205,000 mines in northern Sri Lanka, the organization used Story Map Journal to show how this has rapidly reinvigorated the region.

SRI LANKA

Twenty-six years of civil war in Sri Lanka resulted in the country having one of the highest concentrations of land mines on the planet. Although the conflict didn't subside until 2009, HALO has been actively sweeping minefields there since 2002.

Following HALO's removal of 205,000 mines in northern Sri Lanka—clearing 5,000 from January to March 2016—the organization used a Story Map Journal (arcg.is/2aZ8faX) to show the region's rapid reinvigoration. Presenting four case studies in the easy-to-navigate format, the story map demonstrates how within months of an area being cleared, homes, schools, and community centers were built on formerly unusable land. Using the Story Map Swipe tool, HALO displays before and after imagery side-by-side to illustrate villages coming back to life—in some instances, even before the organization could completely rid an area of UXO.

HALO has restored safe passage in many areas around northern Sri Lanka and has helped community members reclaim their land. Now, communities are restoring fishing villages along the coast and resettling cleared areas that have some of the most fertile soil in the country.

↑ HALO used the bulleted layout of Story Map Series to give viewers an idea of how close to minefields some local Zimbabwean populations live and work.

ZIMBABWE

In the borderlands of Zimbabwe, villagers have had to tread lightly for more than 35 years. Civil war in the 1970s rendered the country rife with minefields, with some areas containing as many as 5,500 anti-personnel mines per square kilometer. These ERW limit communities' capacity to gain access to clean water, cultivate agricultural land, traverse trade routes, and properly implement sanitation measures.

HALO used the bulleted layout of the Story Map Series (arcg.is/2bbVhYB) to deliver a comprehensive overview of Zimbabwe's situation. Viewers begin with the history of Zimbabwe's Liberation War, get an understanding of HALO's role in removing land mines from the country's northeastern territory, and see how the process of demining has worked in specific areas. The story map conveys how quickly local people adopt the reclaimed minefields back into their communities and how the reduction of livestock-related accidents has aided economic stability.

↑ HALO's Story Map Journal on the situation in Angola depicts how mine clearance helps economic development, agriculture, communities, and infrastructure.

ANGOLA

Like Zimbabwe, the people of Angola experienced a prolonged civil war that left a legacy of UXO that has harmed tens of thousands of citizens even decades after the conflict has ended.

HALO's Story Map Journal (arcg.is/29lRPrT) on the situation in Angola depicts how mine clearance helps economic development, agriculture, communities, and infrastructure. Removing ERW has enabled new home construction, the installation of water facilities, and the refurbishment of the country's railway system. It has also made it possible for Angolans to make use of their country's land again.

In two decades, HALO has cleared more than 780 minefields from Angola—much to the benefit of the nation's increasing population.

Story Maps Spread Awareness

"Story maps help organizations convey the plight and struggle of demining," said Martin Engels, Esri nonprofit and global organizations account manager. "They tell the backstory of the villages and show the faces of the community, placing humanity alongside the facts and progress of the mission."

HALO's efforts are making communities safer, but there is still a lot of work to be done. GIS helps HALO focus its efforts in the field, and Esri Story Maps raise awareness of the organization's cause and work, which is also vital to achieving a land mine-free world.

What Does Your Symphony of Apps Look Like?

Apps are like musical instruments. Each app taken individually is impressive, as is a singular clarinetist playing composer Willson Osborne's *Rhapsody for Clarinet*. But when apps work together, they make unparalleled music—like the New York Philharmonic does when it plays George Gershwin's *Rhapsody in Blue*, in which a clarinetist produces that iconic opening glissando before the rest of the symphony joins in. The challenge is to figure out which apps work best for certain needs and when an app should work in concert with other apps—just like Gershwin had to determine how long to make the clarinet's solo and when to have the horns, trombone, and drums begin playing.

This chart can help you make those decisions. Select how you use ArcGIS—in the field, in the office, and/or in the community—and then move through the chart to see which apps work best for what you want to do. Choose from preconfigured apps (all of which can be customized) or build your own if you need more specific functionality. Like picking the instruments and melodies unique to your industry, you can select the apps that work best for you—and create your own orchestra.

THE FIELD

- To coordinate field crews? — Y → **Workforce** for ArcGIS
- To navigate? — Y → **Navigator** for ArcGIS
- To capture data?
  - Using a map? — Y → **Collector** for ArcGIS
  - Using a form? — Y → **Survey123** for ArcGIS
  - Using a drone? — Y → **Drone2Map** for ArcGIS
- To monitor operations? — Y → **Operations Dashboard** for ArcGIS

THE OFFICE

- For advanced GIS? — Y → **ArcGIS for Desktop**, **ArcGIS Pro**, **ArcMap**
- To visualize location data?
  - On a dashboard?
  - In Microsoft PowerPoint?
  - On a 2D map? — Y
    - As a static image for print or the web? — N → **Explorer** for ArcGIS
  - In 3D, including KML? — Y → **ArcGIS Earth**
  - As orthomosaics and 3D meshes?
- To analyze location data?
- For design?
  - To rapidly test planning scenarios? — Y → **GeoPlanner** for ArcGIS

I want to use ArcGIS Apps for

THE COMMUNITY

In Microsoft Excel? — Y → **ArcGIS Maps for Office**
↓ N

In Microsoft SharePoint? — Y → **Esri Maps for SharePoint**
↓ N

To explore data quickly in different visual formats? — Y → **Insights for ArcGIS**
↓ N

To select sites and segment customers? — Y → **Esri Business Analyst**
↓ N

To optimize community resources? — Y → **Esri Community Analyst**
↓ N

To use drone-captured still imagery?

For 3D city planning and designing virtual worlds? — Y → **Esri CityEngine**
N → **To produce high-quality maps for print or the web?** — Y → **ArcGIS Maps for Adobe Creative Cloud**

The Community (right side)

To communicate information? — N → **To crowdsource information?** — N →
↓ Y (communicate) ↓ Y (crowdsource)

By opening up some data for public use? — Y → **ArcGIS Open Data**
N →

By asking people to tag photos you publish? — Y → **Photo Survey**
↓ N

By having people report observations and comment and vote on them? — Y → **Using a web app?** — Y → **Crowdsource Reporter**
↓ N ↓ N

Crowdsource Polling ← Y — **By getting people's feedback?**

Using a native app? — Y → **AppStudio for ArcGIS** (Quick Report)

To analyze user-submitted observations? — Y → **Crowdsource Manager**
↓ N

Esri Story Map Crowdsource ← Y — **By asking people to submit photos and stories?**

BUILD YOUR OWN APP
- Using ArcGIS app builders, which require no coding: **esri.com/appbuilders**
- With ArcGIS SDKs and APIs: **developers.arcgis.com**

OR SEARCH FOR SOMETHING ELSE
- Industry-specific, open-source apps built by Esri: **solutions.arcgis.com**
- Apps from Esri partners: **marketplace.arcgis.com**

esri.com/apps

ArcGIS Maps for Adobe Creative Cloud
Gives Photoshop and Illustrator Users Direct Access to Esri Content

Making maps for marketing and communications purposes just got simpler. ArcGIS Maps for Adobe Creative Cloud, a new app from Esri, brings the ArcGIS platform together with Adobe Photoshop and Illustrator to more seamlessly integrate geography and design.

Now, design and communications professionals can have access to data-driven maps and geographic content from the Adobe programs they are already familiar with. This makes it easier for organizations to design maps that align with their branding conventions and that can be used for external projects and presentations.

The ArcGIS and Adobe integration opens GIS up to an expanding group of design- and communications-focused users, who can now make direct use of spatial information. Cartographers can have the best of both worlds, too, since they can now work in Adobe and ArcGIS simultaneously.

The ability to create distinct maps that fit any company's style has never been more manageable, precise, or scalable.

A Built-In Connection
With ArcGIS Maps for Adobe Creative Cloud, users have access to thousands of data-driven maps, right inside Adobe's design applications. This built-in connection to ArcGIS Online allows Adobe users to download spatial data—such as street maps, political boundaries, event layers, and satellite images—directly into Photoshop or Illustrator as editable vector layers or high-resolution images.

The integration between ArcGIS and Adobe is seamless. For the first time, users have tools that allow them to keep their content within ArcGIS and share it to Adobe's design apps. Maps for Adobe Creative Cloud allows users to define map extents geographically or in Photoshop and Illustrator. Cartographers in particular can run spatial analysis in ArcGIS and access the results inside Adobe apps to create captivating maps.

### ArcGIS Content Accessible from Adobe
The geographic content available from within Maps for Adobe Creative Cloud includes maps and data layers compiled from Esri user organizations, open data sources, commercial vendors, and the Living Atlas of the World. Users also have direct access to their own organization's maps, satellite images, and other geographic data.

Users can search for this content from within Maps for Adobe Creative Cloud and filter by publisher or category. They can also search solely for their own GIS department's collection of maps and data. When a deadline is looming, designers can quickly find the maps they want, preview them, and download them to use as is or to immediately start building on—all from within Photoshop and Illustrator.

Cross-Departmental Collaboration
Maps for Adobe Creative Cloud lets GIS users share their map assets with the design department in formats that designers know. To help them easily keep track of everything, the app allows designers to maintain editable vector artwork layers with descriptive names in Illustrator. This means that if a layer in an ArcGIS map is labeled State and National Parks, that layer will appear in Illustrator with the same title.

Fostering cross-departmental collaboration like this cuts down on the valuable time teams typically spend going back and forth to improve the quality of derivative GIS products. It also makes it easier to use GIS not only for internal decision-making but for external communications, too, since designers know how to make data and analysis visually pop, as well as have maps conform to a company's branding.
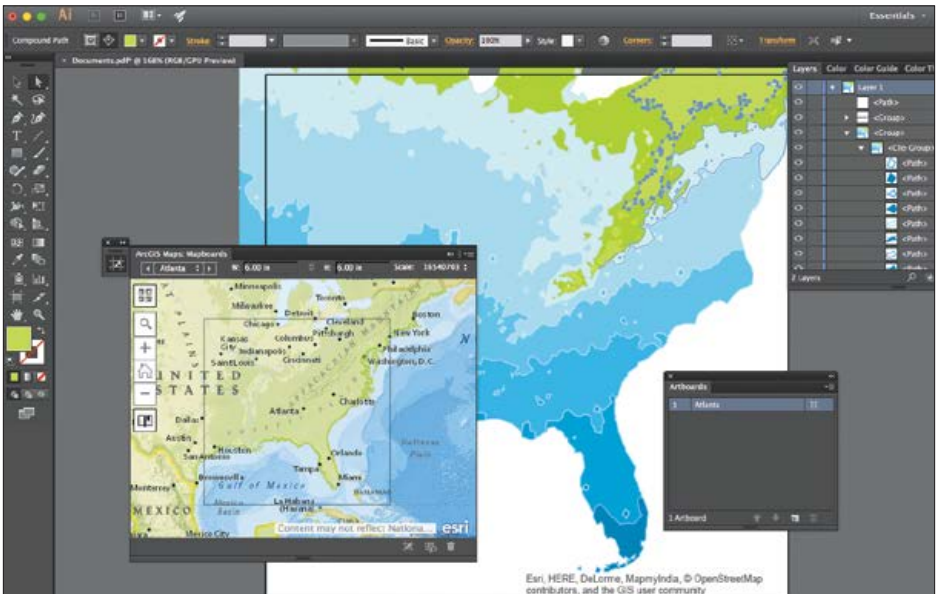
↑ In Adobe Photoshop and Illustrator, users can download maps as editable vector layers or high-resolution images.

Extend the Value of GIS
Maps for Adobe Creative Cloud lets organizations extract maximum value from their ArcGIS and Adobe investments, boosting returns on investment for both suites of software. It also enhances collaboration and mutual productivity throughout an organization, saving both time and money.

With Maps for Adobe Creative Cloud, GIS professionals can extend the significance of their work by making geographic analysis and maps available to larger audiences. That improves decision-making both inside an organization, with senior managers and executives, and externally, with clients and soon-to-be customers.

Get Access
For more information and to download the Maps for Adobe Creative Cloud beta, visit esri.com/adobecc. YouTube tutorials are available at arcg.is/2bBrqoF. Send Esri your feedback as well by heading to the forums on the Early Adopter Community website.

Major Advances in ArcGIS Online

The September release of ArcGIS Online includes more content and enhanced apps and continues efforts to enrich Esri's commitment to open data standards.

New Content
Although ArcGIS Online already hosts the most extensive digital collection of geographic content, Esri keeps incorporating more. ArcGIS Online now includes Cyprus as a preferred region, so anyone can make it the default extent for new maps. For vector basemaps (which is still in beta), Esri updated several regions of the world and augmented some of the basemaps' capabilities, such as their display in high resolution and the ability to customize map styles, including labels.

Expanded Interoperability
Esri continues to amplify its support for Open Geospatial Consortium, Inc. (OGC), services by upholding standards and working toward increased interoperability. The map viewer in ArcGIS Online now contains additional options for appending custom parameters to OGC Web Map Service (WMS) layers, OGC Web Map Tile Service (WMTS), and OGC Web Feature Service (WFS) requests. Additionally, when adding WMS data to a map using the map viewer, users can choose which layers they want to add instead of adding the entire WMS service.

Improved Apps
The September release of ArcGIS Online brought many improvements to ArcGIS apps as well. Users of Web AppBuilder for ArcGIS can now edit related records, conduct local searches, turn filters off on a map, and extrude polygons in 3D. Collector for ArcGIS now supports high-accuracy GPS receivers and allows users to attach PDF and Microsoft Word documents. Workforce for ArcGIS users can easily launch Collector and Survey123 for ArcGIS from their assignments, and both Collector and Survey123 now preserve the Exif metadata associated with device-captured photos. Survey123 has more than 20 new mathematical functions for user input validation rules, and the app's reporting capabilities have been enhanced with added support for PDF exports. Creating surveys in a web browser is now easier too.

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

Safeguarding Life, Property During Devastating Storms

Mobile, Web GIS Help Ireland's Galway County Council Respond to, Prepare for Floods

When a chain of severe storms swept across western Ireland in December 2015, the county of Galway experienced devastating floods that cut off 472 properties from roadways, flooded 62 homes, and rendered major transportation routes impassable. Public safety was of utmost concern.

But Galway County Council was able to coordinate a fast and effective emergency response by employing the ArcGIS platform. In 2013, the council replaced all its separate, multivendor GIS packages with Esri's suite of technology. Having all its geospatial data in one place—and accessible via the web and in the field—enabled Galway County Council to rapidly and intelligently protect property and safeguard lives during the crisis.

Seamless Data Integration

From the moment the first flood warnings were issued, Galway County Council was acutely aware of the challenges it would face. A similar flooding incident had occurred in the county six years earlier. On that occasion, the council struggled to collect data on the rising waters quickly enough to support emergency responses. It also found it difficult to share critical information with the public and other stakeholders, such as the Irish Defence Forces and the Gardaí (Ireland's national police force).

↓ With ArcGIS, Galway County Council could see precisely which homes and businesses were flooded or in danger of flooding, as well as which roads were closed and damaged.

This time, however, the council was better prepared. It had recently implemented new GIS software from Esri Ireland, which gave the council the ability to react remarkably quickly to the emerging crisis.

The council used ArcGIS for Server to store its spatial information in one centralized spot, which was a first. This eliminated multiple databases and reduced data duplication; it also made a single source of accurate data available to all the council's GIS apps.

"ArcGIS gave us seamless integration of data and GIS services across mobile, desktop, server, and web platforms [both] online and offline," said Mark Conroy, Galway County Council's information systems project leader.

So while the 2015 storms raged over Ireland, the council was working quickly to mitigate their effects.

Capturing Flood Information

Galway County Council swiftly set up a GIS-based web service to capture flood information. This data was then stored in the cloud using ArcGIS Online.

Regional engineers, technical staff, and other council employees used Collector for ArcGIS to conduct field surveys and upload flood details to the web service via their smartphones and tablets. Simultaneously, staff in council offices employed ArcGIS for Desktop to add information about road closures and upload new satellite imagery when it became available. All this information was automatically integrated into

interactive maps in ArcGIS Online. These maps were immediately made visible to all staff, partners, media, and the general public.

"Within an hour of getting our first call about flooding, we had a system up and running for capturing information via mobile devices and sharing it externally," recalled Conroy. "The out-of-the-box functionality of ArcGIS allows us to develop new GIS web services and apps at a moment's notice, enabling us to address the challenges of a rural county as they occur."

A Faster, More Effective Response

With ArcGIS, Galway County Council could see precisely which homes and businesses were in danger of flooding. This allowed the council to quickly deploy resources to the places that needed them most and keep everyone who was involved informed.

Rather than waste time collating data and responding to requests for information, staff instead focused on making arrangements to clear drains, dig culverts, and elevate roads. Thanks to the timely implementation of such protective measures, Galway County Council helped save 63 properties from immediate threats caused by the storms.

During the height of the crisis, Galway County Council also used its ArcGIS maps to share situational information each day with partners that included the Office of Public Works, the Health Service Executive, the Gardaí, and the Irish Defence Forces that were called in to assist. The maps helped the different agencies

better coordinate their activities and make effective decisions.

"Without a doubt, ArcGIS played a key role in helping us to focus on vulnerable households, deliver constructive support, and alleviate suffering in the worst affected communities," said Conroy.

Additionally, to keep citizens informed about areas of risk, Galway County Council used Twitter, Facebook, its own website, and local media to direct people to its online flood map.

"The general public was getting updated information as quickly as we were in the council," said Conroy. "Everyone could follow the progress of the flooding, see which roads were closed, and plan safer routes accordingly. By enabling us to share flood information instantly, ArcGIS certainly helped us to improve public safety."

Increased Confidence in the Council

Galway County Council looked back on how it handled the crisis with satisfaction. Not a single life was lost in the entire county.

The council also now has a full GIS-based record of the extent of the flooding. Using this, Galway County Council will collaborate with the Office of Public Works to make flood alleviation and mitigation plans.

"ArcGIS has helped give internal employees, partners, and the general public confidence in the council's ability to manage floods and other similar emergencies," Conroy noted. "When the next incident arises, we can be confident that we have the ability to handle it quickly and effectively."

GIS-Based Security and Disaster Relief in the Philippines

The Armed Forces of the Philippines Uses ArcGIS to Sustain Operations

The Armed Forces of the Philippines (AFP) works with the Philippine National Police and other agencies on national security initiatives, disaster relief, and recovery operations. Coordinating these efforts used to be difficult. The Philippines comprise more than 7,000 islands, and the capital of Manila is one of the busiest port complexes in the world, given that more than half of commercial shipping navigates the South China Sea.

Several years ago, the AFP implemented an enterprise-wide ArcGIS platform to make it easier to analyze information and share geospatial data both within its department and with other agencies as needed. Not only does this make it easier for the AFP to manage Manila's dynamic port, but it also helps the agency keep the booming capital and the rest of the country safe and secure—especially during the regular staging of political, cultural, and religious events, which swell the local population significantly.

When Religious Gatherings Attract Record Numbers

The AFP uses ArcGIS for mission planning and situational awareness during operations. To give planners and commanders easy access to its operations geodatabase, the agency developed a portal that is supported by ArcGIS for Server. Additionally, the AFP began testing the use of ArcGIS Online in its operations shortly after the software was released in 2006. With

↑ A multiagency coordination center used Operations Dashboard for ArcGIS to monitor criminal incidents, traffic conditions, and protests in and around the areas where APEC delegates were meeting.
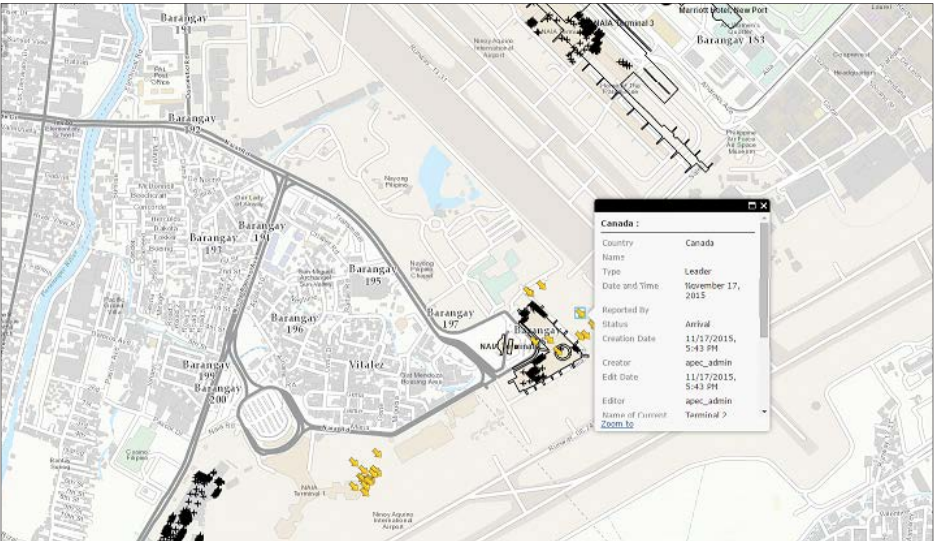
↑ ArcGIS Online helped the Armed Forces of the Philippines (AFP) keep track of the many leaders that were in the country for the Asia-Pacific Economic Cooperation (APEC) meeting.

assistance from Geodata Systems Technology, Inc. (Esri's distributor in the Philippines), the AFP also implemented Operations Dashboard for ArcGIS in 2012.

That same year, the AFP put its robust ArcGIS implementation to the test when it was used to coordinate security operations for Manila's Feast of the Black Nazarene, celebrated each January 9. This festival, wherein a life-size statue of Jesus is carried along a jam-packed 4.5-mile route over a period of about 20 hours, attracts millions of Catholic pilgrims to Manila's Quiapo district so they can have a chance at touching the statue, which some believe has healing powers.

"Operations Dashboard was transformational for us," said AFP Lieutenant Colonel Constancio Espina II. "It provided us with a real-time common operating picture."

Using ArcGIS Online, the AFP pulled in existing data for the procession area and added a temporary street closure layer to get a better understanding of the flow of foot traffic and how it might affect vehicular traffic, which is typically congested throughout metropolitan Manila. When incidents such as crowd surges or car accidents occurred, field officers reported them and they were immediately added to the AFP's dashboard.

"This allowed us to establish live feeds of authoritative incident data that we could share with our staff and other agencies involved in the security operations so that we could quickly dispatch police officers or emergency services when necessary," said Espina.

Since GIS worked so well during that religious gathering, the AFP used ArcGIS Online again for planning and security operations when Pope Francis visited the Philippines in January 2015. This was the largest papal event on record, with a reported 6 million worshipers attending the Pope's final Mass at Manila's Luneta National Park. The agency used ArcGIS Online to monitor and update the Pope's location and keep track of where security forces were deployed.

When World Leaders Meet

In 2015, the Philippines also hosted a series of meetings for the Asia-Pacific Economic Cooperation (APEC). The organization, which provides a forum for 21 Pacific Rim countries and select invitees to discuss common financial concerns and ways to establish new markets or expand existing ones, rotates its annual meetings among members.

For the Philippines assembly, a series of high-level meetings was staged throughout the country, beginning in the last quarter of 2014 and culminating at the APEC Economic Leaders' Meeting (AELM) in Manila in November 2015. This last meeting was attended by business leaders, as well as some heads of state from APEC member nations, including US president Barack Obama, Chinese president Xi Jinping, and Japanese prime minister Shinzō Abe.

Security preparations for the meeting were extensive. Because of its high-level nature, a multi-agency coordination center (MACC) was set up with 18 Philippine government agencies contributing data and managing the center's operations.

"ArcGIS Online, particularly Operations Dashboard, was very useful to us in the MACC for monitoring the summit," said Espina. "It helped us keep track of the many delegates and leaders that were in the country—where they were staying, when they arrived or left their housing areas, which conferences they attended, and other information. We kept a very close eye on our guests for security purposes."

The AFP also used the dashboard to monitor criminal incidents, traffic conditions, and protests that happened both inside and outside the areas where delegates were meeting. This was critical because local residents had access to the areas near the summit locations. The AFP used Twitter feeds as one of its layers to help monitor what people were saying about APEC. This is particularly important for real-time, netizen-based situational awareness.

"ArcGIS Online and Operations Dashboard helped a lot with our situational awareness," concluded Espina. "One of the features that I like about it the most is that it can be easily configured and deployed."

Espina said that for nonprogrammers like himself, it is easy to design an app, give it some functionality, and publish it when there is an immediate requirement for situational awareness and monitoring.

When a Tremendous Storm Strikes

An immediate need like this arose when Typhoon Haiyan, known in the Philippines as Super Typhoon Yolanda, made landfall on November 8, 2013. The record-breaking storm produced winds estimated at 196 miles per hour (315 kilometers per hour), according to the Joint Typhoon Warning Center. It devastated areas of Southeast Asia, particularly in the Visayas, a group of islands in the central region of the Philippines. Around 6,300 people were reported dead with nearly 30,000 injured. Property damage estimates were between $6.5 and $14.5 billion, according to AIR Worldwide.

After the storm hit, the AFP received immediate support from Esri's Disaster Response Program (DRP), which is available around the clock to help with emergencies. Using ArcGIS Online, the AFP coordinated relief services and deployed troops to help maintain order. The agency also used GIS to determine the conditions of roadway infrastructure and plan alternative travel routes where necessary. In the aftermath of the typhoon, the AFP Command Center built an app that monitored the distribution of relief goods to make sure there were adequate supplies in affected areas.
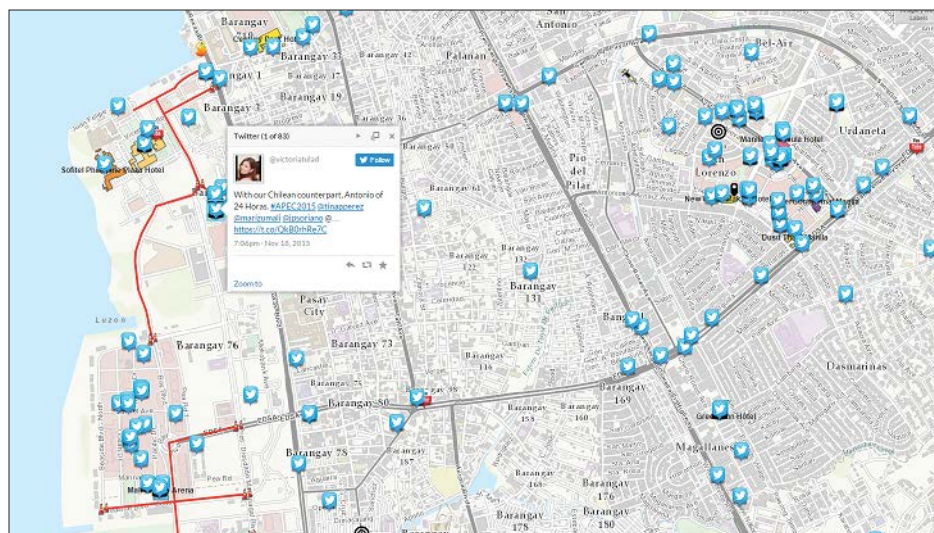
↑ The AFP used Twitter feeds as one of its layers to monitor what people were saying about APEC.

Esri's Disaster Response Program: Ready to Help 24/7

When complex emergencies like Typhoon Haiyan occur, Esri's Disaster Relief Program (DRP) provides direct support to the organizations and agencies charged with handling these exceptional situations.

The impetus to create the DRP came on September 11, 2001, when terrorists commandeered two airliners and destroyed the World Trade Center's twin towers. New York City's state-of-the-art Emergency Operations Center (EOC) was also wiped out in the ensuing inferno. Computers, data, software—the EOC's entire infrastructure, including the ArcGIS software it relied on for emergency response and recovery—were lost in an instant.

Esri and other organizations quickly responded to the city's call for help. A temporary EOC was set up on Pier 92 on the Hudson River in Manhattan, and regional Esri staff members began providing critical software licenses, personnel, and data to support New York's mapping needs. At Esri's headquarters in Redlands, California, the technical support staff worked around the clock to fulfill the growing number of mapping requests.

"Following 9/11, we immediately realized that the potential for disaster was ever present and GIS technology could play a fundamental part in the response and recovery efforts," said Russ Johnson, Esri's director of global public safety business development. "We established a formal program, and the resultant DRP has been very successful during the past 15 years. To date, we have responded to nearly 1,950 requests for assistance."

The DRP has provided support for a number of recent, high-profile emergencies, including the downing of Malaysia Airlines flight MH17 over Ukraine in July 2014. The attack took place on the final day of the Esri User Conference in San Diego, California, and conference attendees from Malaysia's Department of Survey and Mapping quickly joined Esri specialists and key partners to form a team of multidisciplinary geospatial experts. They gathered in a meeting room at a local hotel where the DRP had set up a temporary operations center. The assembled team rapidly established a website that provided the Malaysian Armed Forces with access to a common operating picture that included detailed maps and demographics for Ukraine.

Among other requests for assistance, the DRP provided the Armed Forces of the Philippines (AFP) with mapping support for their recovery efforts from the destruction caused by Typhoon Haiyan in 2013. Later, the team donated an ArcGIS Online organizational license to the AFP to assist in the agency's extensive security preparations for the APEC Economic Leaders' Meeting in Manila in 2015.

"We realized that the DRP was receiving an increasing number of requests to support large, high-profile events like the AELM," said Chris McIntosh, director of public safety industries at Esri. "So we added a special events component to it and launched the Special Events Management Program (SEMP) in 2014."

This prompted a reorganization of Esri's response programs. Both the DRP and SEMP now fall under the newly established Esri Public Safety Assistance Program (EPSAP). The EPSAP was recently on alert to provide mapping support for the 2016 Democratic and Republican National Conventions in the United States.

"The mission of Esri's response programs is to reinforce its reputation as a good corporate citizen by providing software and support to organizations and agencies impacted by complex emergencies and large-scale special events," said McIntosh. "Esri staff members are available at all times to respond to an emergency whenever or wherever it happens."

How It Works

To receive assistance, an agency or organization first needs to fill out a request form on the DRP website. The DRP team then receives an automatic notification that a request has been filed.

"[We] are on call 24/7/365 to monitor, review, and process requests to support emergencies or events anywhere in the world," said Brenda Martinez, public safety sector marketing specialist at Esri. "After we receive the request, it is reviewed to determine the specific need and then sent to the appropriate Esri staff members or departments for processing."

For more information about the Esri Disaster Response Program or to request assistance, visit esri.com/disaster. The website contains resources, including public information maps, examples of disaster response and recovery methodology, web map templates, how-to guides, live-feed data, social media feeds, case studies, and videos.

Ensuring Water Quality in Kuwait

Real-Time GIS Helps Monitor Pollutants to Meet Country's Growing Needs

Kuwait is hot and dry. Located on the Arabian Peninsula, this desert country lacks freshwater resources. It does have access to saline sea- and groundwater, though. Thus, Kuwait is a leader in desalination, having purchased and installed six desalination plants—all of which it continues to operate and maintain.

To ensure that water supplies meet Kuwait's growing needs, the government established a specialized center to research the current and anticipated demands on water resources. The Water Resources Development Center (WRDC), which now resides in the Ministry of Electricity and Water, relies heavily on GIS to study water development and conservation and assess problems that have affected or could impact the country's water system.

One of WRDC's tasks is to monitor water quality in Kuwait. The country is developing quickly. As of 2014, its population was 3.75 million with an estimated population growth of 4.3 percent, according to the World Bank. And the five-year Kuwait Development Plan, currently in the works, seeks to make the country a trade and financial hub in the region by 2035, so infrastructure projects abound.

WRDC's water surveillance has to be precise and expansive, beginning with the desalination process and extending all the way until the water is distributed to consumers. To keep all its field operations in order, WRDC uses the ArcGIS platform extensively.

Setting Standards for Monitoring Water Pollution

Water can convey bacteria and substances that lead to diseases such as cholera and dysentery, along with other serious health problems. Monitoring waterborne pollutants is imperative.

When the government created WRDC, it also established two labs—a bacteriological one and a chemical one—as part of the center to check water samples regularly for these kinds of pollutants. The first of their kind, the labs put in place standard operating procedures for dealing with cases of water contamination.

Desalination by itself does not yield ready-to-use water. The process removes both harmful and beneficial substances from water, so the desalinated water must be infused with chlorine (Cl_2) and sodium hydroxide (NaOH), for example, before it can be delivered to customers. Additionally, many other factors, such as damaged or old pipes, can affect the water as it makes its way to distribution points and, ultimately, the public.

The sample collectors from the bacteriological and chemical labs need to be able to follow the water's flow from the desalination plant to the distribution point. For that reason, staff determined that sampling points should be located as closely as possible to the main lines that carry drinking water from pumping station sites and reservoirs to the sector mains, which typically supply water to several distribution zones and district metered areas.
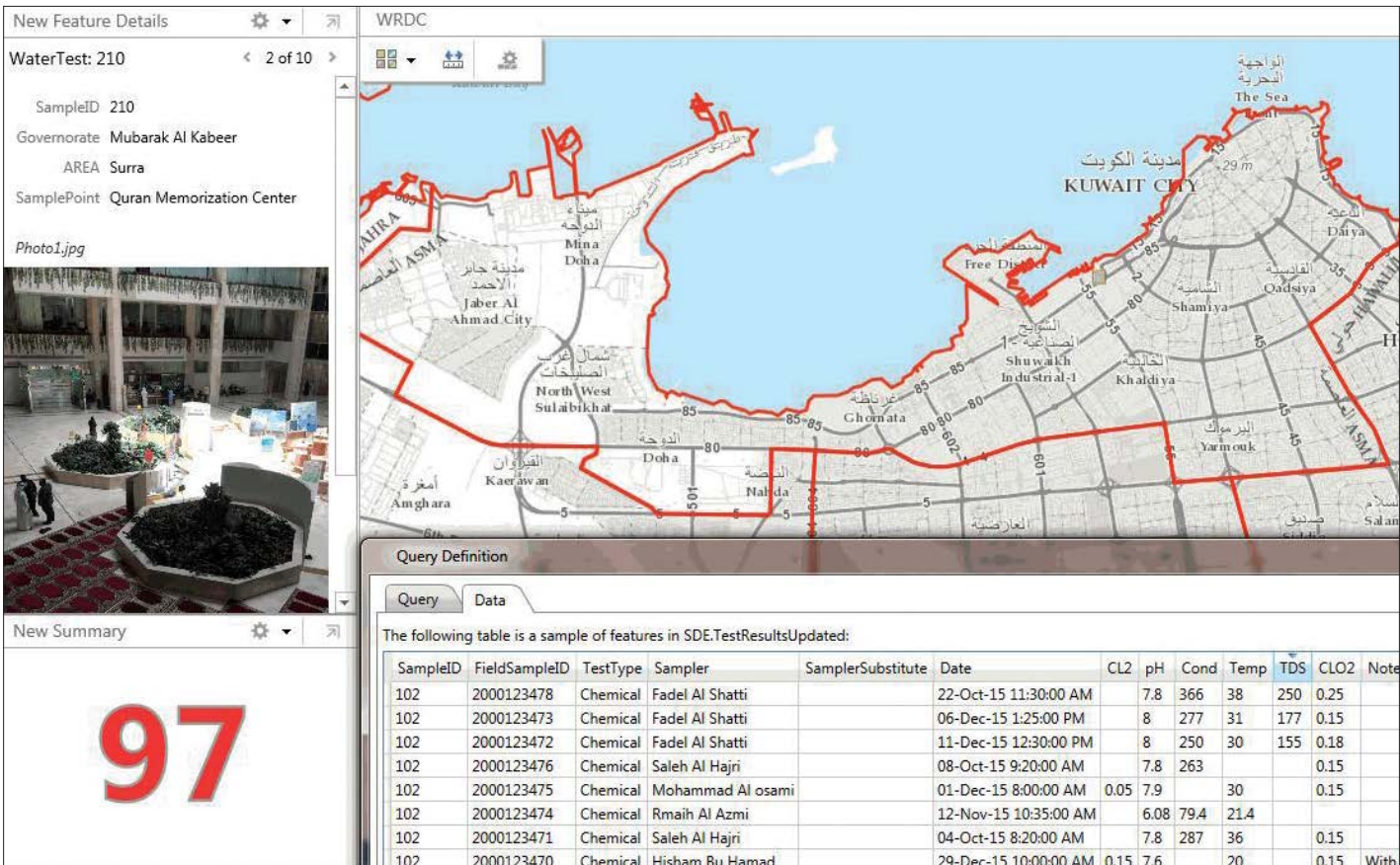
The labs also figured out that the number of sample points should reflect the population density of each area, since more consumers in one place means more water flows through that network. So WRDC determined that an area with a population of 20,000–50,000 should be sampled every two weeks, for example, while an area with 50,000–100,000 people should be sampled every four days.

Together—and implementing standards like these—WRDC's bacteriological and chemical labs ensure that Kuwait's drinking water is up to international standards.

More Efficient, Comprehensive Data Collection

The lab teams—each consisting of a lab technician, a sample collector, and a driver—gather water samples from more than 700 locations as often as the areas' population sizes prescribe. The samples are tested in the field for residual chlorine, pH levels, conductivity (the ability of water to conduct an electric current), temperature, total dissolved solids (TDS), and chlorine dioxide (ClO_2). The results of these tests must comply with local and international organizations' water quality standards—especially those of the World Health Organization.

To help easily ensure this adherence, WRDC employs ArcGIS when it conducts field tests. Using this software reduces the amount of time-consuming paperwork that the lab teams have to do and cuts down on data entry mistakes. It also allows for more unified and comprehensive data—especially given that sample collectors can attach images and videos to their data.

WRDC used ArcGIS for Desktop to create a map for collecting water sample locations and test results. It then published the map to ArcGIS for Server as a feature service, added it as an item to Portal for ArcGIS, and made it accessible through the Collector for ArcGIS app. The lab technicians and sample collectors could then use the map to record the water quality tests while still in the field. Additionally, since it is difficult for teams to memorize the exact locations of their many sample points, the ministry used the ArcGIS Network Analyst extension to develop a routing service for Kuwait's street networks, which WRDC field teams also use in Collector.

To make data entry as straightforward and accurate as possible, WRDC created drop-down menus for the Collector map to help the lab teams filter the 700 sample locations by governorate, neighborhood, block, and location type (according to Kuwait's administrative divisions). WRDC also created domains that show the test type (bacterial or chemical) and the names of the lab technicians who perform the field tests. Setting these up as domains, or lists, makes it easy for field staff to filter these choices on the go. Additionally, the Collector app lets lab teams record the time at which a test is taken, since Kuwait's hot midday temperatures can affect test results.

The completed results are kept in a table that displays relationships in a one-to-many format, which makes it easier to monitor trends over time at the sample sites. For example, if a sample site is tested for pH once a month over the course of a year, those 12 test results can be displayed as a line chart to see how the pH levels tend to change. Being able to attach photos and videos of the sample points also lets WRDC staff monitor their conditions over time.

Working with Real-Time Results

To attain an International Organization for Standardization (ISO) certification in water quality, WRDC needed to have the ability to track the data collection process in real time. The organization uses Operations Dashboard for ArcGIS to check the submitted sample results right away. Not only does this help pinpoint problems more quickly, but it also demonstrates that field technicians get to the correct testing point and follow specific procedures when conducting field tests.

Additionally, when a lab team submits the Collector form with test results, the information automatically gets uploaded into the database—which makes it easy for a GIS operator at WRDC to update the map in ArcGIS for Desktop and generate reports. The information shown in these reports varies and can include details on the progress of each team, the number of samples taken in a specific area, and which specific tests are conducted over time. In most cases, these reports are displayed to WRDC managers as charts and maps, which allow them to easily absorb the information and make quick, informed decisions.

Implementing the ArcGIS platform has certainly made WRDC's work a lot easier—and smarter.

↑ With Operations Dashboard for ArcGIS, the Water Resources Development Center can track the data collection process in real time, which is one of the requirements of attaining an International Organization for Standardization (ISO) certification. (Image courtesy of Eyad Ghattasheh.)

SampleID	FieldSampleID	TestType	Sampler	SamplerSubstitute	Date	CL2	pH	Cond	Temp	TDS	CLO2	Note
102	2000123478	Chemical	Fadel Al Shatti		22-Oct-15 11:30:00 AM		7.8	366	38	250	0.25	
102	2000123473	Chemical	Fadel Al Shatti		06-Dec-15 1:25:00 PM		8	277	31	177	0.15	
102	2000123472	Chemical	Fadel Al Shatti		11-Dec-15 12:30:00 PM		8	250	30	155	0.18	
102	2000123476	Chemical	Saleh Al Hajri		08-Oct-15 9:20:00 AM		7.8	263			0.15	
102	2000123475	Chemical	Mohammad Al osami		01-Dec-15 8:00:00 AM	0.05	7.9			30	0.15	
102	2000123474	Chemical	Rmaih Al Azmi		12-Nov-15 10:35:00 AM		6.08	79.4	21.4			
102	2000123471	Chemical	Saleh Al Hajri		04-Oct-15 8:20:00 AM		7.8	287	36		0.15	
102	2000123470	Chemical	Hisham Bu Hamad		29-Dec-15 10:00:00 AM	0.15	7.6		20		0.15	With

Pioneering Enterprise GIS, One Relationship at a Time

Building relationships is at the heart of everything Ingrid Bruce does. Whether creating and maintaining a citywide enterprise GIS or meeting with refugees in Germany to show them support, Bruce believes that making meaningful connections with people is essential.

"That's why we have been able to progress as far as we have," said Bruce of the City of Rancho Cucamonga, where she is deputy director of the Department of Innovation and Technology.

The city initially hired her on December 1, 1986, to do GIS. Rancho Cucamonga was burgeoning, so the city had invested in the fledgling technology to manage development.

"Lots of homes [were] being built," said Bruce. "Their main thing was keeping up with the amount of parcels that were being created."

Bruce had never used GIS before, but she had a background in land surveying and cartography. Originally from Guyana, Bruce studied cartography in a government program for high school graduates. The South American nation didn't have any universities at the time, so this was a continuing education program.

In it, she explored architectural and structural engineering mapping. But it wasn't until she got to cartography that mapping really piqued her interest. She was given a 36-by-24-inch piece of paper and a novel; she had to draw leader lines by hand and transcribe the text from the book. It turned out, she had the outstanding penmanship the government was looking for in cartographers, so she was encouraged to stick with the vocation.

"Once I started to learn about it all and go out in the field and…use the instruments for surveying, I was hooked," she said.

She worked for Guyana's Ministry of Public Works and Communications in its cartography and hydrographic departments before moving to Southern California, where she was suddenly a single mom looking for work and trying to raise her daughter in a new country.

"Going back to school full-time to get a degree was out of the question," she said.

So after she got the job at the City of Rancho Cucamonga, she would take classes here and there to help advance her skills. She even took a course at Pasadena City College to prove that she knew what she was talking about when it came to cartography. She did. And during this time, when technological trailblazers were still fighting to use computers in the workplace, Bruce also understood how groundbreaking GIS was and how it could guide city planning in ways that weren't possible before.

"She, among other people [who] were in that early phase, saw a vision of what the technology can do, and they tried to move that vision forward," said Chris Thomas, Esri's global manager for government activities,

who was managing GIS for the neighboring City of Ontario when Bruce was starting out. "She never gave up. She just kept moving that needle forward."

When Bruce began at Rancho Cucamonga, the city was in the midst of an unprecedented growth spurt that had started in the 1970s. But because of a California law that capped property tax increases and limited reassessments, the booming city wasn't making enough tax revenue to cover all the needed infrastructure and community services. So Rancho Cucamonga created special districts—areas in which the city sold bonds to raise the funds to build infrastructure, such as streetlights and parks. Each parcel in a special district is assessed every year and taxed accordingly to repay bondholders.

As Bruce pointed out, "it was a perfect marriage to use GIS to manage special districts," which was what she did, because a large part of Rancho Cucamonga's tax revenue was tied directly to parcel data, which is inherently spatial.

But what really calcified the principal role of GIS in Rancho Cucamonga was when the community development director, Jack Lam, became city manager in 1989. He also understood the importance of GIS for development, and when he took the helm of administering the entire city, he kept GIS under his wing. That meant that, while the GIS department worked with other facets of the city, such as the fire and police departments, it reported only to the city manager.

"That was the start of us creating the enterprise GIS that we have for the city," said Bruce. "We were doing enterprise GIS before 'enterprise GIS' became [a] buzzword."

GIS was later moved to the Administrative Services Department, which internally supports all departments within the city. This helped cement the identity of Bruce's team. Additionally, the love of GIS demonstrated by Rancho Cucamonga's current city manager, John Gillison, launched the technology to the stature it has attained within the City of Rancho Cucamonga.

"That has been really what has propelled us forward into the GIS that we have right now," said Bruce.

While that is true, Thomas wants to make sure Bruce gets the credit she deserves for broadening the use of GIS.

"We have to acknowledge that it wasn't just the organization that was behind it, it was an individual," he pointed out. "That individual that's been a constant in Rancho Cucamonga's GIS history is Ingrid Bruce."

According to Thomas, who worked in close collaboration with Bruce for years, she always found new ways to use the technology and consistently shared her city's spatial data.

"She played the part of any pioneer, which is to make sure others understood the value of what we were doing," said Thomas.

Bruce did that by fostering creativity and connections.

"We have the freedom to think and come up with new ideas and push the technology in new ways that have allowed us to flourish," said Solomon Nimako, the GIS supervisor at the City of Rancho Cucamonga. "We have very strong relationships with every department. […] We can take our ideas to them and they're willing to learn and understand."

Nimako hopes that when Bruce retires this year—30 years to the day after taking up her post at the City of Rancho Cucamonga—the department can continue executing Bruce's philosophy of relationship building both internally and externally.

Which is essentially what Bruce will do in her retirement, just in a different capacity. Following on one of her recent mission trips in which she traveled to Germany and met with refugees from all over world to encourage them, she plans to work with a new ministry at her church geared toward refugees. She will also increase the lay counseling she provides to women and looks forward to spending more time with her daughter, whom she put through college, and grandchildren.

She is proud of her time at the City of Rancho Cucamonga.

"Not having the degrees, the letters behind my name that the world says I'm supposed to have, and to be able to accomplish what I have is very humbling," she concluded.

Now the question is, who takes up the reins of this pioneer?

← Ingrid Bruce

GIS Hero

Restaurants' Inspection Results Shared by Location

Arizona County Residents Can Use GIS App to Look Up Select Eateries

By Tisha Taylor and Mark Brewer, Maricopa County, Arizona

In Maricopa County, Arizona, the management team for the Environmental Services Department was sitting on a gold mine of food inspection data. But it needed a better way to get this information to the public than by just depositing it into a difficult-to-search database on its website.

Sharing food inspection results encourages businesses to work to reduce the risk of foodborne illnesses and allows consumers to make better-informed choices about where to eat. So Maricopa County developed a GIS app that now puts inspection results at every smartphone user's fingertips.

Hard-to-Find Food Safety Results

Food-borne illnesses are estimated to cause 48 million cases of sickness, more than 128,000 hospitalizations, and 3,000 deaths in the United States each year, according to the Centers for Disease Control and Prevention. To help curb those numbers, the environmental services department in Maricopa County ensures that food provided to the public in its jurisdiction is safe.

Every year, the department conducts more than 60,000 inspections at food establishments.

Departmental staff maintain the county's food inspection results, which include overall inspection grades; priority violations, such as insufficient hand washing or incorrect food temperatures; and businesses that participate in the county's food safety partnership, which promotes best practices and recognizes quality food safety systems.

Until recently, inspection grades were only available to the public in two ways: businesses that participated in the voluntary grading system could post their grades at their establishments, or the results were available on the county's website. To get a report of the inspection results, interested parties could run a query from the website, searching by inspection date. But the search and reporting features had limited functionality. There was no way for people to see the results for a particular restaurant or for any of the restaurants nearby. So citizens—including the media—often had to contact staff to get more information. This caused delays in the department and decreased efficiency.

Making Restaurant Ratings Mobile

With help from the county's GIS and IT teams, the Environmental Services Department developed a custom web app called Mobile Restaurant Ratings. It provides the same inspection results that the county's website previously offered, except they are now displayed on a map based either on the user's current location or search criteria.

Environmental health specialists upload their inspection results daily. A three-day waiting period ensues, which allows businesses to express any concerns they have about the inspection before the results are released to the public. During this time, the Environmental Services Department can correct or clarify any violation details prior to posting the inspection report. After that, the results are available on the app.

When a user clicks or taps a restaurant on the map to view its ratings history, the information is retrieved in real time from a SQL Server database. The restaurant locations displayed on the map are stored in a map service hosted on ArcGIS for Server. The county also has an ArcGIS Online organizational account, which allows users to add the map service for restaurants to their own maps and apps.

Increased Transparency

Maricopa County launched its Mobile Restaurant Ratings app in August 2015. Now, people can access food inspection results for any one of Maricopa County's 8,000 restaurants, 2,200 permitted grocery stores, and 4,800 convenience and retail food establishments.

"If you are out on the go and decide to eat at a restaurant that you are not familiar with, you see how they do on their inspections," said Andrew Linton, the Environmental Health Division manager at Maricopa County. "This is a really easy way to get an idea of how they are doing."

The app has improved transparency, since inspection violations are now posted on it whether or not a business elects to participate in the grading system. It has also increased public awareness of the benefits the Environmental Services Department provides to the public each day.

Local media have taken an interest in the app, writing about it in newspaper articles and doing stories on it for television. In just three months (from when the department first set up web analytics), the number of website hits increased by 17 percent.

The Mobile Restaurant Ratings app has also increased interest in the Environmental Services Department's food safety partnership, called the Cutting Edge Program. Participants are featured in a special section of the app, which also provides information about the program. From August 2015 to February 2016, the rate of enrollment doubled from 8 percent to 16 percent compared to the previous six months.

A Solution, Despite Minimal Resources

When food industry leaders such as the Maricopa County Restaurant Association, the Arizona Food Marketing Alliance, and several fast-food chains initially approached the Environmental Services Department to see about improving accessibility to food inspection results, developing an app was the immediately preferred plan of action.

"The app was a quick solution for a department with limited resources," said Linton. "It has provided a great return on investment by increasing food safety awareness and highlighting the important role [the Environmental Services Department plays] in protecting the health and safety of our community."

↑ Maricopa County's Mobile Restaurant Ratings app lets people access food inspection results for restaurants, grocery stores, and retail food establishments across the county.

← When a user taps a restaurant on the map to view its ratings history, the information is retrieved in real time from a SQL Server database.

About the Author

Tisha Taylor is the management analyst for the Environmental Services Department at Maricopa County, and Mark Brewer is a GIS database administrator there. For more information, contact Brewer at mrb@mail.maricopa.gov or 602-506-2953.

How Hollywood Builds and Destroys Cities with 3D GIS

There's a scene in *Independence Day: Resurgence* where Singapore's iconic Marina Bay Sands hotel gets blown to bits. Hundreds of cars along the nearby Esplanade Bridge get sucked into the sky. It's alien Armageddon.

But before extraterrestrials could destroy Singapore, Hollywood had to build its cityscape—a 3D version of it, at least.

To lend an air of authenticity to its urban scenes, Scanline VFX, one of the visual effects companies behind *Independence Day: Resurgence* and many other blockbusters, hired Matthias Buehler, a specialist in Esri CityEngine.

"In the movie you see the entire Singapore sky burning, and it is impossible to film this—you need visual effects," said Buehler, who worked as an environment developer lead at Scanline VFX. "A lot *[of]* the story is told in front of a green screen, and the rest of the environments are computer generated."

The alien invaders in this sequel to the 1996 hit *Independence Day* don't just single out Singapore. The landing of the mothership causes apocalyptic destruction in Washington, DC, and London as well.

Buehler helped build digital 3D replicas of portions of these cities using his extensive experience with Esri's 3D modeling software. The Swiss native was part of the development team at Procedural, the startup company that created CityEngine. When Procedural was acquired by Esri in 2011, Buehler stayed on as a product engineer focusing on technical support, training materials, and developing CityEngine example content. Recently, he founded his own consulting firm called vrbn, which offers expert CityEngine services in the fields of architecture, urban planning, geodesign, visual effects, and gaming.

"CityEngine is the standard, and more people are getting to know it for large-scale city work," he said. "There's no other tool that has these capabilities."

Buehler, who has a master's degree in architecture, also has expertise in photorealistic rendering and technical scripting, which was crucial to developing the custom workflows. That is how he began his project for *Independence Day: Resurgence*.

His goal was to integrate CityEngine into the existing production pipeline so that all departments (modeling, animation, layout, and effects and rendering) could work together. This involved a lot of research, technical scripting, and close collaboration with the visual effects supervisor, Mohsen Mousavi, as well as pipeline developers.

"All the data in CityEngine had to be made available so other artists could work with it in their specific creative tools—to add light, explosions, and render it," said Buehler. "That was the biggest technical challenge. The whole system also had to be scalable for very large amounts of buildings and large geographic areas."

Using CityEngine, Buehler designed a sustainable city workflow tailor-made for the needs of Scanline VFX. It allows specifically trained artists to replicate multiple styles of city environments, from rural to urban.

With the system in place, other artists can now learn how to create an environment in a matter of two to three days. Buehler also trained two technical artists to tweak the system so that in the future they will be able to create multiple large-scale environments for alternate designs, and they will be of the same quality as seen in *Independence Day: Resurgence*.

Buehler worked for nine months on what amounted to approximately 40 seconds of film sequence. Yet the system he put in place can be efficiently reused in any upcoming movie.

He was contractually forbidden to explain to friends and family the work he was doing. Finally, though, when the movie opened in theaters, Buehler was able to wow them with the impressive visual effects.

"I have to say, it was a very proud moment—especially when I saw my name for the first time in the film credits and people around me were clapping," he said.

For Buehler, it was a moment he had worked toward since childhood. At age 13, he started playing around with 3D graphics as a hobby, using 3D software demo versions from computer magazine CDs.

"I like the freedom of 3D graphics," he said. "You can create any type of world—worlds that don't exist, better worlds."

And even worlds that get destroyed in less than a minute.

Counties Organize Evacuations Well in Advance

With New High-Resolution Imagery, New York Area Is Better Prepared to Weather Storms

By JoAnne Castagna, US Army Corps of Engineers, New York District

Hundreds of thousands of people were ordered to evacuate before Hurricane Sandy hit the United States' East Coast in late October 2012. The storm—which reached category 3 status before weakening to a (still powerful) post-tropical cyclone prior to making landfall in New Jersey—became the second-costliest tropical storm in United States history.

In Suffolk County, on the east side of New York's Long Island, the Office of Emergency Management worked hard to keep residents safe.

"During Sandy, we rescued 250 people from their flooded homes *[and]* evacuated two major hospitals and several adult homes," said Edward Schneyer, director of emergency preparedness for the Suffolk County Office of Emergency Management.

He said he and his colleagues at the agency were able to do this effectively because they had storm surge maps created by the US Army Corps of Engineers (USACE), New York District. These maps—which depict where significant amounts of water are likely to get pushed up from the sea and onto land during a tropical storm—help emergency managers in all hurricane-prone states understand the potential extent of storm surges for category 1–4 storms. They identify areas where people should evacuate if faced with the threat of a storm surge.

The USACE recently used ArcGIS for Desktop to update these maps with higher-resolution imagery and modeling from the National Hurricane Center's Storm Surge Unit so that agencies can have more accurate information to use when educating the public about how to protect themselves and their property.

Evacuation Planning Made Easier

Developing the storm surge maps is the first step in analyzing hazards for the hurricane evacuation process.

"Historically, 49 percent of human casualties from hurricanes are due to storm surge," said Donald E. Cresitello, USACE Hurricane Evacuation Study program manager for the State of New York. "Other impacts—like riverine flooding due to rainfall, falling trees due to high winds, and indirect impacts like carbon monoxide poisoning and electrocution—can cause deaths *[too]*."

The Army Corps manages hurricane evacuation studies for the National Hurricane Program. The USACE, New York District, is the agency responsible for creating storm surge maps in the New York area as well. To produce the *New York Hurricane Evacuation Study Hurricane Surge Inundation Maps*, it collaborates with the New England and Baltimore districts of the USACE.

The New York District's storm surge maps go to emergency managers in New York City, Westchester County, and Nassau and Suffolk Counties on Long Island. To help emergency managers learn how to use the maps, the Army Corps also supplies them in HURREVAC, a decision-making software developed by Sea Island Software for the National Hurricane Program.

Agency officials can use the maps "for evacuation planning *[and]* to redefine their hurricane evacuation zones, identify where shelters should be located, and identify where assets should be staged prior to impact from a storm," said Cresitello.

"The storm maps serve as a very valuable resource for both government and private sector agencies, as well as private residents," said Schneyer. "As a government agency tasked with emergency management responsibilities pertaining to evacuation and sheltering of the public, we use the maps to gain insight and perspective into the geographical area impacted and use this information to determine the number of buildings or population potentially impacted by a flood."

The Suffolk County Office of Emergency Management can also use the information in the maps to preidentify damage assessments before a storm even hits the region. This is very helpful for an area like Suffolk County, which has approximately 1,000 miles of shoreline and 225,000 residents in its hurricane evacuation zones.

Mapping with New, High-Resolution Data

To make the higher-resolution storm surge maps, the USACE used ArcGIS for Desktop. It took the latest storm surge elevation information from the National Oceanic and Atmospheric Administration's (NOAA) SLOSH model (which stands for Sea, Lake, and Overland Surges from Hurricanes) and layered it over high-resolution lidar imagery provided by sources such as the US Geological Survey and offices of emergency management in New York City and New York State. The imagery, which had horizontal resolutions of 0.7 to 2.0 meters, showed the topography of areas in New York that could be affected.

"To come up with the actual depth of water through GIS, we *[overlaid]* the data out of NOAA's SLOSH model and *[subtracted]* out the ground elevations using digital elevation models," said Cresitello.

The interagency team working on the project also wrote a Python script to automate tasks such as subtracting the land elevations from the SLOSH model water surface elevations and exporting the maps into PDFs. The team then created maps using Data Driven Pages and geodatabase annotation to automatically build a series of layout pages that showed the potential storm surges for the different counties.

Better Allocating Post-Storm Resources

The new maps are a considerable improvement from the older maps because their higher-resolution storm surge modeling data and topography are more detailed and accurate than before. The new maps not only show the landward extent of inland storm surges, but they also depict the depths of the water (in feet) during different categories of storms. Additionally, the maps illustrate areas that will face more flooding and areas that will experience less.

"Knowing what the depth of water may be in those areas helps emergency managers better perform their initial response after a storm and helps them know what kind of impacts they may expect during these types of storms," said Cresitello.

This will allow emergency managers to better focus their limited resources as they make critical decisions and lead recovery efforts.

"These storm maps provide the geographical area of primary concern where efforts and resources need to be focused to make essential and accurate damage assessments to determine life and property hazards," said Schneyer. "In the
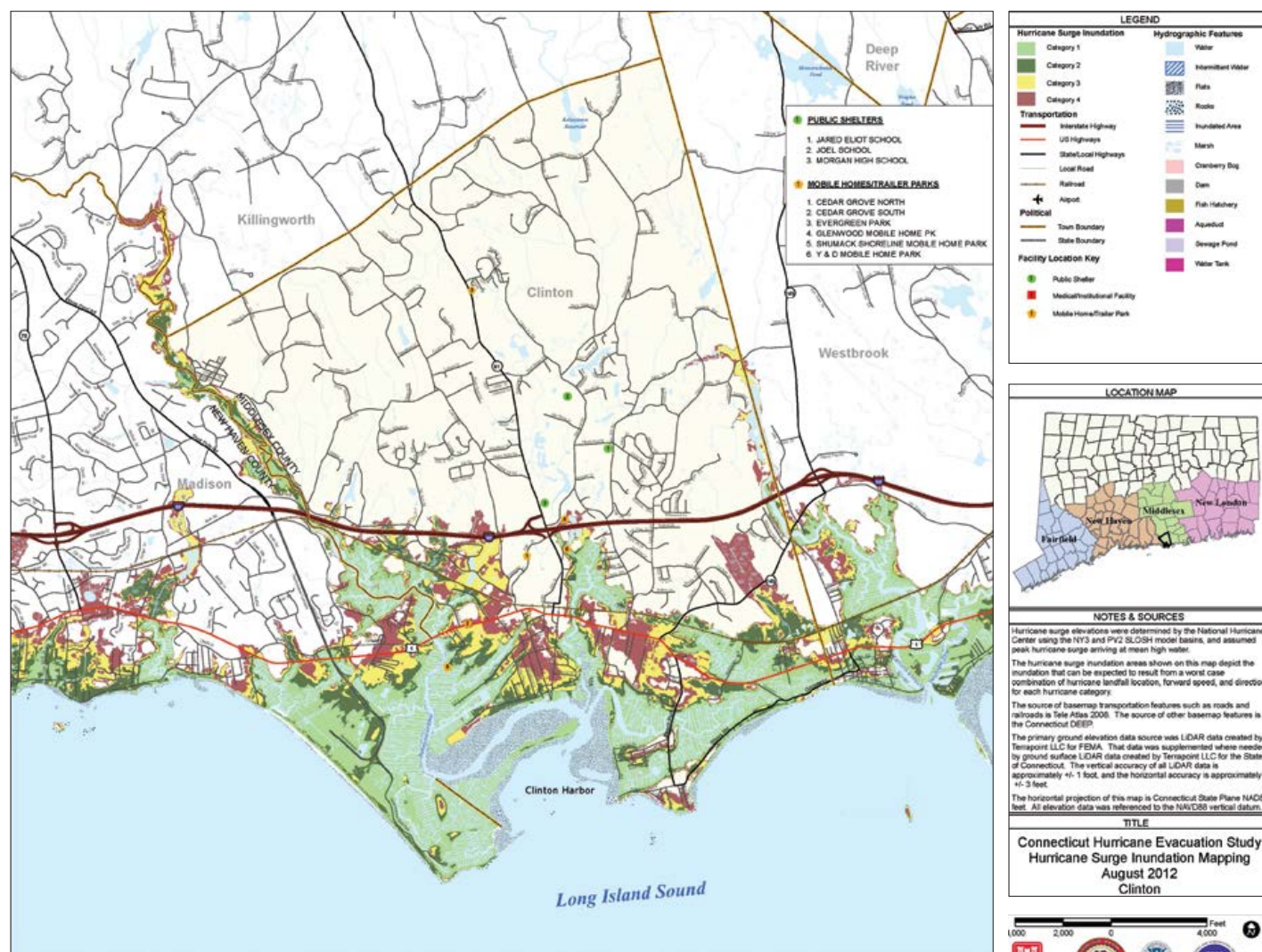
↑ This storm surge map for part of the Connecticut coastline shows the extent of surge for worst-case hurricane landfall scenarios for category 1–4 storms. (Image courtesy of the US Army Corps of Engineers.)

→ The storm surge from Hurricane Sandy flooded Ocean Avenue in Sheepshead Bay, Brooklyn, actually producing waves on the major thoroughfare. (Photo courtesy of JoAnne Castagna.)

↑ Hurricane Sandy flooded the Battery Park Underpass, which keeps traffic flowing independently of the labyrinthine streets that make up the southern tip of Manhattan. (Photo courtesy of the US Army Corps of Engineers.)

initial stages of a response, our recovery resources are limited—especially for an event the size of Sandy. If resources are dispatched to areas that were not impacted, valuable time is lost mobilizing and reassigning those resources."

Bringing Awareness to Residents

New York's *Hurricane Surge Inundation Maps* are also for use by the general public.

"These maps provide an important level of awareness to residents that either live in a flood area or are preparing to purchase property located in a potential flood zone or hurricane storm surge zone," explained Schneyer.

That is why the Suffolk County Office of Emergency Management is bringing this awareness directly to its residents. Agency officials have entered the information from the Army Corps' maps into an interactive map on the county's website. Residents can use the web-based map viewer to locate their homes and see if they live in a hurricane storm surge zone. The map displays nearby shelters as well.

The Army Corps also wants the public to use these resources.

"It's important for people to know their specific zone," said Cresitello. "The public should be aware of what evacuation zone they live in and should listen to their local officials...so they don't question or ignore an official emergency evacuation order."

During Hurricane Sandy, many people who should have evacuated didn't, and they were stranded without help. They faced many dangers, including electrocution from downed power lines and fires from massive gas leaks.

"We don't want the public deciding on their own if they should evacuate or not," continued Cresitello. "If a location is in danger, then they should heed the evacuation order. It doesn't matter if it's six inches or 10 feet of water."

"The more information—especially information resulting from scientific studies and available technology—the more situationally aware we and our residents will be," added Schneyer. "This very valuable resource is an excellent tool for public education, emergency management planning, and emergency preparedness in general."

The counties that the USACE, New York District, work with, including Suffolk County, had access to the maps when the 2016 hurricane season began.

About the Author

JoAnne Castagna, EdD, is a public affairs specialist and writer for the US Army Corps of Engineers, New York District. She can be reached at joanne.castagna@usace.army.mil or on Twitter as @JoAnneCastagna.
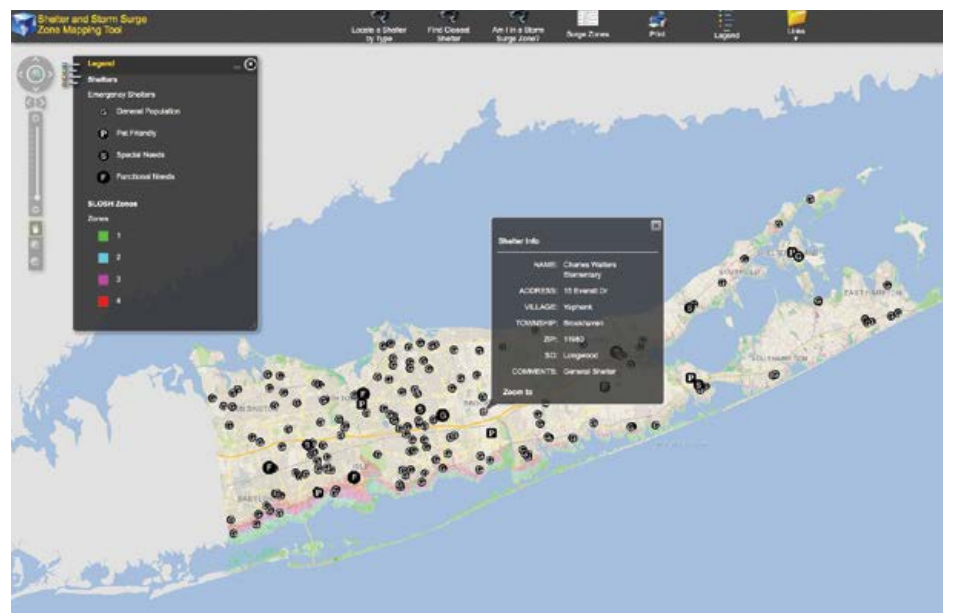
↑ The Suffolk County Office of Emergency Management used the storm surge maps to create an interactive web map its residents can use to locate their homes and find nearby shelter locations. (Image courtesy of the US Army Corps of Engineers.)

GIS Plays Pivotal Role in Global Change

How Advanced Geospatial Technology Will Help Meet Sustainable Development Goals

It takes initiative to formulate a plan to fix global problems. In 2014, the United Nations (UN) created such a plan and presented it at the UN Sustainable Development Summit the following year. Called *Transforming Our World: The 2030 Agenda for Sustainable Development* (Agenda 2030 for short), the proposal outlines 17 Sustainable Development Goals (SDGs, or Global Goals) to overcome the world's challenges, including poverty, inequality, and the effects of climate change. Organizations representing all sectors of society recognized the feasibility of the plan and officially adopted it in September 2015.

The SDGs build on decades of work on the Millennium Development Goals. One leader at the forefront of creating and carrying out the Global Goals is Nikhil Seth of India. With more than 35 years of experience as an international and national civil servant, Seth joined the UN Institute for Training and Research (UNITAR) as executive director in June 2015. One of his responsibilities is to oversee UNITAR's Operational Satellite Applications Programme (UNOSAT), which allows UN member states to easily access GIS technology and imagery from UNITAR for international disaster response and sustainable development efforts.

Seth, who also played a key role in constructing the Millennium Development Goals, recently talked with Esri about how GIS is critical to accomplishing the Global Goals by 2030.

The SDGs are a set of ambitious objectives. How can technology bring the sustainable world community's mission into focus and help organizations and people stay on track?

I could go through each of the Sustainable Development Goals and demonstrate how important technology is for their realization, particularly for poorer countries. Let's look at the first one on eradication of poverty. It's very clear that financial inclusion plays a key role in poverty eradication. In fact, countries that have managed to dramatically increase financial inclusion have had significant increases in their gross domestic product (GDP). Mobile technology has great potential for increasing financial inclusion.

What value does the GIS community bring to the SDGs?

The kind of information that is made available through GIS and how the community uses the technology—whether it's remote sensing or mapping—have critical relevance to the goals, particularly environmental goals and goals on disaster risk reduction and resilience. The GIS community has a pivotal role to play in helping countries accomplish all the SDGs by 2030 by providing policy makers with data to facilitate evidence-based decision-making.

What, in your opinion, is an overarching need that connects the goals?

The SDGs reflect human aspirations—human aspirations of an economic nature; human aspirations of a social nature; human aspirations reflecting environmental concerns; and, of course, human aspirations for peace and justice. All these have been brought under one very logical umbrella, and that is the context in which we should see the work of UNITAR. The SDGs put a strong emphasis on the necessity for data to support evidence-based decision-making. They call for a large amount of disaggregated data, and I think in all these areas, UNOSAT will provide geospatial intelligence and data for the realization of the SDGs.

As diverse as the SDGs are, as you mentioned, they are under one umbrella—one broad umbrella. Do you see similarities between the Global Goals and the GIS community, as they both cross all sectors of society? How do you see this relationship bringing the SDGs to fruition?

One basic principle of the SDGs is that they have to be realized in an integrated way. Agenda 2030 is not a shopping list of things to be done but is a network of interconnections. Spatial analysis—and the kinds of relationships that you see through spatial analysis—is the right way to go when you're looking at the complexity and the interrelated nature of the SDGs. GIS helps in seeing this interrelationship.

Agenda 2030 was created by the engagement of all, including the business sector; academia; governments, of course; and civil society at large. Because GIS permeates all sectors, technology and the GIS community are critical to the SDGs. Spatial analysis helps us to understand the integration of different issues and the complexity of the relationships among the environment, the economy, and society, and, of course, between justice and peace. All these components have come together in this agenda, and we have the challenge and opportunity to use GIS to understand these interconnections. GIS is also critical in engaging everyone—especially those from the humanities who are not traditionally engaged, such as the economic and social sectors. These connections will emerge much stronger than ever before.

What role does UNOSAT have in helping countries achieve the Global Goals using geospatial technology, data, and imagery?

I say this to everyone—UNOSAT is the crown jewel of UNITAR. Its overall mission is the same: enabling policy makers—especially in developing countries—to develop capacities and enhance their decision-making abilities. By providing satellite imagery analysis and mapping products, UNOSAT is helping countries improve evidence-based decision-making to achieve the Global Goals. The applications of UNOSAT are numerous—in the UN's humanitarian fieldwork, environmental work, and resource mapping. UNOSAT's work is critical for disaster risk reduction and postdisaster reconstruction. UNOSAT is also involved in urban planning and, as we saw in Palmyra, Syria, is linked to the preservation of the cultural heritage of humanity. UNOSAT's applications are diverse, touching on all the program areas of UNITAR. I'm very proud of what we do and what we will continue to do to help countries achieve the SDGs.

What advice do you have for the people and organizations working toward achieving the Global Goals? How do we accomplish the long-term vision and not get sidetracked by short-term challenges?

In all my years in the development business, what I've found throws us off is sudden and unexpected shocks. These shocks could come through disasters, environmental shocks, economic shocks like the financial crisis we saw in 2008, or social shocks of the type we are seeing all over the Arab world. So how do you keep your long-term vision when experiencing such shocks has become the new norm in our lives?

Every day you expect to read in the news about some big disaster—economic, social, or environmental in nature—or about a crisis with respect to peace and justice. The lesson I've learned is to be determined, be resilient. The communities engaged in long-term development should not waiver from their long-term determination. They should not be carried away by political short-termism, which seems to be the defining characteristic of our world today. Every four or five years, we get diverted in one political direction or another, by elections, and so on, with very short-term horizons. My appeal to the community would be to look at these things with more long-term vision. By definition, GIS and the work we do is long term. We should be unwavering in this vision because the seeds of shock result from the absence of long-term vision.

In the past, we've been jerked around from one issue to another, and as a result, we've lost the longer-term perspective. If you look at the root causes of all the problems that are happening around us today—whether it's migration or refugees—these are all triggered by things such as the absence of employment opportunities for the youth, the absence of peaceful and just societies, and all kinds of environmental consequences caused by neglecting issues such as climate change. What we need to do with this long-term perspective is stay determined, stay on track, and not get swayed by these temporary shocks and aberrations that seem to strike our world with increasing frequency.

↑ Nikhil Seth, executive director of the United Nations Institute for Training and Research (UNITAR)

Cartography Contributes to Meeting Sustainable Development Goals

The Sustainable Development Goals (SDGs)—adopted by the United Nations (UN) in September 2015—aim to end poverty, protect the planet, and ensure prosperity for everyone. To make this happen, the UN encourages everyone to do their part—not only governments, the private sector, and civil society but also us as individuals.

For us, the UN set up a website called The Lazy Person's Guide to Saving the World. It has tips on what we can do from our couches and in our neighborhoods to contribute to these solutions.

While the recommendations are really worth pursuing, I do not like being categorized as a lazy person. So it made me think: How can the International Cartographic Association (ICA) contribute to meeting the SDGs by 2030?

Let's first look at what the 17 SDGs encompass. Each goal—from ending hunger and attaining gender equality to ensuring peace and justice and building strong institutions—has several targets. If the more than 160 targets are reached, humanity and our planet will experience economic, social, and environmental improvements.

The targets are judged based on more than 300 indicators. Take Goal 4, which seeks to ensure quality education for everyone and encourage lifelong learning. This goal includes 10 targets, one of which is to ensure that all children receive free and good primary and secondary educations. The success of this target is measured by two indicators: the percentage of children who are proficient in reading and mathematics and the rate of students who complete primary and secondary schools.

So, how can we cartographers be relevant in helping society reach these targets? Mapping the indicators seems like a good first step. We all know that well-crafted maps can effectively exhibit known facts in a visual way. What's more, online mapping technology can disseminate these facts globally to increase awareness of current states of affairs. And then there are the interactive map dashboards—connected to geographic databases at multiple scales and with space-time analytical functions—that allow decision-makers at various levels to monitor and compare indicators for policy development and action at different geographic scales.

That said, at ICA, we decided to do things a little differently. ICA's aim is to promote the discipline of cartography throughout the world. Not least because 2016 is International Map Year, we decided that ICA should demonstrate how diverse maps and cartography really are and how they can convey all sorts of metrics, insight, and relationships with regard to the SDGs.

Thus, we decided to create an exhibition of cartographic posters about the SDGs. The posters are on the ICA website, where anyone can access and use them to enrich their own map displays, especially those related to International Map Year. Additionally, in the spirit of Goal 4, the ICA's exhibition allows us to educate people on the importance of the SDGs while also informing them of how powerful maps can be.

ICA's commissions, which address a wide range of topics that cover nearly the entire discipline of cartography, each adopted one of the goals. As a starting point, the commissions selected a target of their chosen SDG, along with its indicators. Then each commission expressed its topic cartographically, through the lens of that commission's objectives. For example, the poster for protecting life on land, made by the Commission on Map Projections, tells the story of how certain map projections can be good or bad depending on how the mapmaker wants to display all the earth's land. The ending poverty poster, made by the Commission on Topographic Mapping, encapsulates how to use topographic maps to better understand what causes poverty. Other posters acquaint viewers with open-source technologies, the relevance of selecting the correct level of detail for administrative units, and the effects of using color in map design. Taken together, all the posters tell a story of cartographic diversity, of mapping options, and of multiple map perspectives.

Maps that matter—and are well designed—are engaging, instantly understandable, and relevant to society. They should raise interest, which is exactly what the first exhibition of these posters did when it was displayed at UN headquarters in New York during the Sixth Session of the UN Committee of Experts on Global Geospatial Information Management (UN-GGIM) in August 2016.

Does this mean that ICA has contributed enough to achieving the SDGs? Does this poster exhibition mean we can stop? No. ICA is now planning to create an atlas of good practices for mapping the SDGs.

Let's make the world a better place with maps.
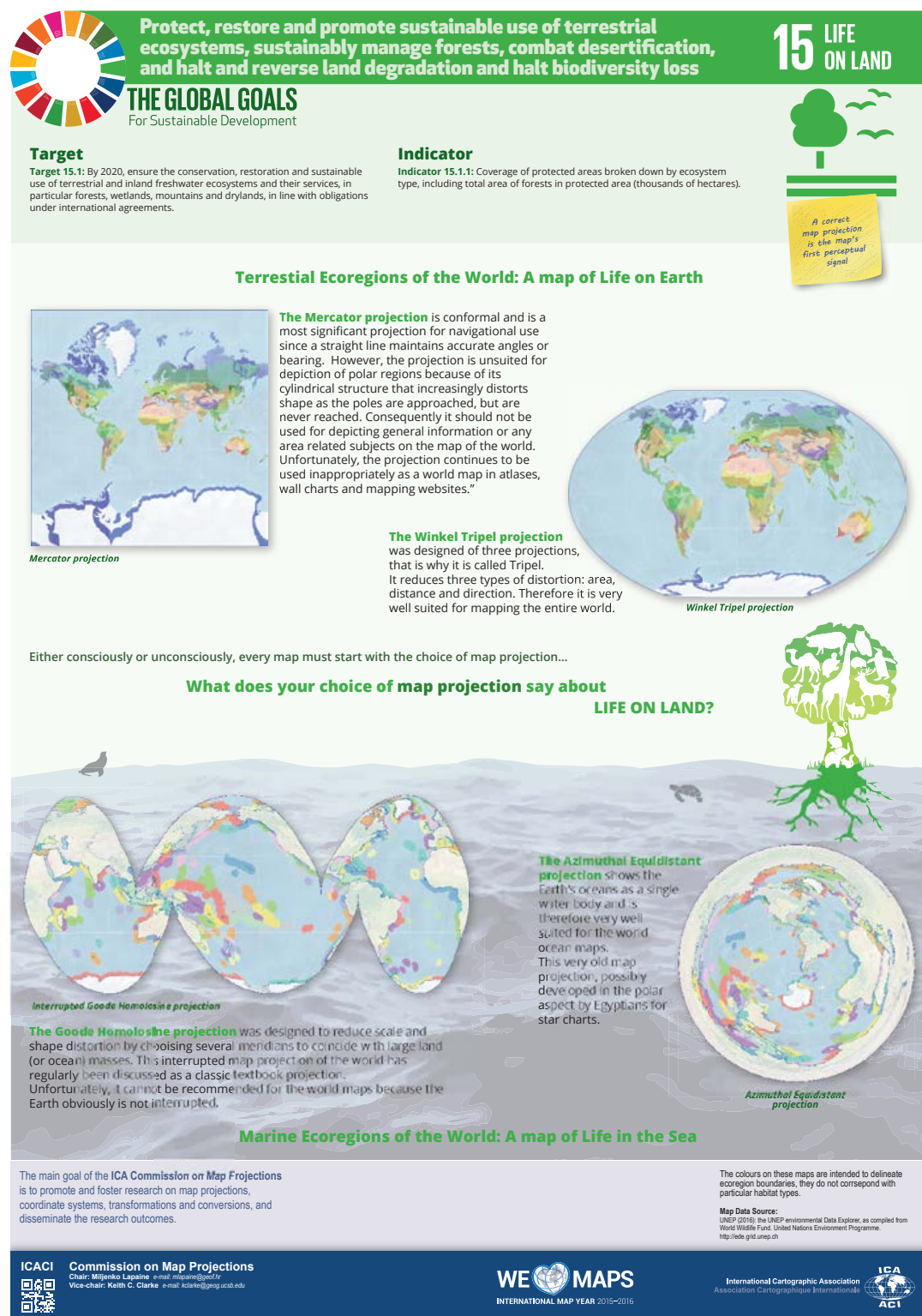
↑ The International Cartographic Association's posters about the Sustainable Development Goals teach the principles of cartography while educating viewers about the goals.

The posters, along with an accompanying catalog, can be downloaded at icaci.org/maps-and-sustainable-development-goals.

About the Author

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

Esri Education Team Recognized for Contributions

Cameron and Brooklyn Conner are so well versed in geography that they take in GIS concepts in their California home before they go to school. The siblings, in fourth and second grades, respectively, get help from their Esri T-shirts—and their GIS librarian mom, of course.

In Bogotá, Colombia, 19-month-old Victoria contemplates what being Map Girl actually entails. Thanks to her dad, solutions engineer Deiro Gonzalez, she's already learning!

Heidi Jerke and her three boys get ready for GIS Day at their school in South Dakota. The Minnehaha County GIS coordinator has already taught her kids a lot about mapping, and they love teaching their friends all about GIS.

This year, **GIS Day** falls on November 16. Visit gisday.com to find activities near you—and even get inspired to put on your own event.

During the last 25 years, the Esri education team has established itself as a valuable member of the geospatial education community. In recent months, the team's stature was recognized four times over when three of its education managers received prestigious awards.

Charlie Fitzpatrick was presented with the National Council for Geographic Education's (NCGE) highest honor in July when he received the George J. Miller Award for Unwavering Support of Geography Education. The NCGE also selected a paper written by Tom Baker and a research group of seven others as the Best Article for Geography Program Development. And Joseph Kerski was awarded the National Geospatial Technology Center of Excellence's Lifetime Achievement in Geospatial Two-Year College Education Award in June. This followed closely on the heels of Texas State University's Department of Geography presenting Kerski with its Outstanding Support from the Business Community Award in May.

Reflecting on this streak of honors, Kerski noted that although the Esri education team is not seeking accolades, "it's very gratifying to know that we are thought of highly and that we are considered to be a key part of the community."

"It means that some people recognize that this all makes a difference," echoed Fitzpatrick.

Teaching K–12 Teachers to Use GIS

When Fitzpatrick joined Esri in 1992, it was difficult to get K–12 schools to use computers, much less GIS. But the first time he saw the technology, he said, "Holy cow! This is what I need in my classroom."

Fitzpatrick never returned to the classroom as a full-time teacher, though. Instead, he took a job with Esri doing what he had already started to love: teaching teachers to use computers in their lessons—particularly ones that involved geography.

"I thought, foolishly, that I would have the job for four years," Fitzpatrick recalled. "By that time, *[I figured GIS]* would have swept the countryside."

Almost 25 years later, Fitzpatrick still manages K–12 education at Esri, working with students, teachers, administrators, education policy makers, geography alliance coordinators, and math and science alliance leaders. He develops materials, creates and licenses procedures and policies, establishes contracts, instructs teachers, and organizes networks of people to help others learn how to use GIS. And he's still as passionate as ever about it.

"He is very technically competent as well as a good educator," lauded Kerski, who, when he spoke at the NCGE awards ceremony, asked who in the room had ever been in one of Fitzpatrick's workshops. Almost everyone raised their hand.

"We've directly touched thousands of teachers, who have then influenced millions of kids," said Fitzpatrick. "And all I had to do was do what I love to do for a long time."

Researching GST Education

Baker's work, while more academic in nature, has a similar trickle-down effect. The paper he helped write, entitled *A Research Agenda for Geospatial Technologies and Learning*, is intended to guide future research on precollegiate education in geospatial technologies (GST) and should eventually help to develop instructional materials for teachers.

"For two decades we've had academics and graduate students…do research that is oftentimes poorly connected to the larger body of work," said Baker. "Frequently, the research conducted doesn't have sufficient scale and very, very seldom has research in that space ever been replicated."

The paper is meant to help formalize the GST education community and create a framework for best practices. It encourages focusing GST education research on four main issues: exploring the connections between GST and geospatial thinking, figuring out how students learn GST, investigating how teachers learn GST through professional development, and designing coherent curriculum for learning GST.

Baker believes that receiving this award from NCGE will increase the agenda's visibility—ideally among people in fields similar to GST, such as science, technology, engineering, and math.

"If we can bring their eyes onto the agenda and have them internalize and act on what we're advising, that's the real win," said Baker.

Connecting with Colleges and Universities

As that begins to happen, it will continue an evolution in GIS education that is already taking place at the college level.

For years, said Kerski, he worked with trailblazers who spent long hours learning and exploring GIS on their own time. Now, however, he is seeing the technology spread to an early majority of adopters.

"At the university level, GIS is now starting to be viewed as something not just for the geographers, environmental scientists, and urban designers but as something that other instructors in fields such as health and history can use to teach or do research with," said Kerski.

Receiving a lifetime achievement award from the National Geospatial Technology Center of Excellence (known as the GeoTech Center) means a lot to Kerski because the center is a leader in GIS at the community college level.

"For years, they've been on the cutting edge of why geospatial education matters," said Kerski. "That they actually consider me and our work to be a big part of their community is really special."

He gives similar accolades to Texas State, which has the largest geography department in the country in terms of enrollment.

"They've got *[GIS]* embedded in a lot of different courses," said Kerski, including health, urban geography, and water resources. "They're teaching GIS in teacher education programs too. That's a big deal!"

More Work to Do

According to all three award recipients, school should be a place of engagement where students are encouraged to be creative, understand information, and learn to make valuable decisions. That's what geospatial thinking and GIS education help students do. And that's what Fitzpatrick, Baker, and Kerski will continue to champion.

↓ From left to right, Charlie Fitzpatrick, Tom Baker, and Joseph Kerski have done award-winning work in GIS education.
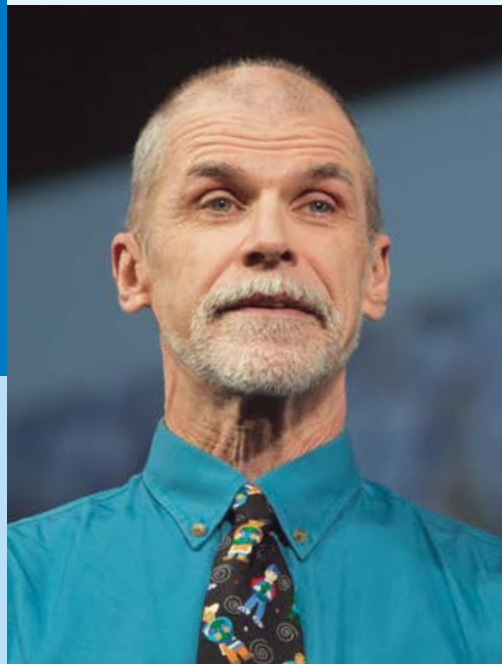
Advanced Placement for GIS&T

The American Association of Geographers (AAG) is leading an effort to develop and implement a new Advanced Placement (AP) course for students in the field of Geographic Information Science & Technology (GIS&T).

The AP GIS&T course proposal was developed with a grant from the Geography Education National Implementation Project (GENIP), a consortium of geography organizations that includes the AAG, the National Geographic Society, the National Council for Geographic Education, and the American Geographical Society. GENIP coordinates and supports the development of major national initiatives for geography education, including Geography for Life: National Geography Standards and AP Human Geography (APHG).

ADVANCED PLACEMENT
GEOGRAPHIC INFORMATION SCIENCE & TECHNOLOGY
A PROPOSED NEW AP COURSE FOR HIGH SCHOOLS

Learn more and register
your support at **apgist.org**

APHG has proved to be one of the most successful and fastest growing AP courses. In 2016, nearly 180,000 high school students took the APHG exam. The AAG believes that an AP course in GIS&T is needed and would be equally successful for the following reasons:

1. GIS&T has rapidly become a vibrant component of education, research, and innovation in the United States and internationally. As a key element of science, technology, engineering, and mathematics (STEM) education, GIS&T is a major field of research and teaching with a strong presence in US higher education. Several hundred academic programs offer undergraduate and graduate-level coursework in GIS&T, and they prepare students for exciting and lucrative careers across a wide array of public and private sector organizations.

2. Access to geospatial technologies has never been greater. GIS, GPS, virtual globes, satellite imagery, geographic visualizations, and other spatial technologies are available to display, manage, and analyze geographic data. Mapping apps and locational tools are now ubiquitous in mobile devices, cars, and computers. Educators in schools enjoy free access to numerous web mapping and open-source geospatial software. And with Esri's $1 billion gift of cloud-based GIS software to US schools in support of the Obama Administration's ConnectED initiative, more than 3,000 educational institutions have brought GIS into their classrooms.

3. The GIS&T industry is rapidly growing and evolving. A recent study from UK-based economic consultant Oxera estimates the value of the GIS&T industry's global services at $150–$270 billion per year. The demand for a geospatially trained workforce is forecasted to grow considerably in the future. Current US Department of Labor projections call for faster than average or much faster than average growth in jobs for geographic information scientists, technicians, and analysts, with upwards of 15,000 additional employees needed annually through 2022 and beyond.

4. GIS&T is an ideal context for interdisciplinary learning. An AP GIS&T course would have broad appeal and connect with high school subjects across the curriculum, including geography, biology, history, math, social studies, computer science, environmental studies, and earth science. AP GIS&T would dramatically advance the capacity of American schools to enhance the geographic literacy and proficiency of high school students.

The AAG is working with college and university departments to ensure that college credit will be granted for AP GIS&T. We are also collaborating closely with high schools across the nation to encourage them to offer this important learning opportunity.

The AP GIS&T program will be an unparalleled opportunity for high school students to experience one of the most dynamic, innovative, and transformative scientific fields of the twenty-first century. Along with APHG, AP GIS&T can serve a vital role in providing students with the geographic knowledge, skills, and abilities they need to make sense of a rapidly changing planet.

For more information, visit apgist.org or contact Michael Solem of the AAG at 202-234-1450. If you know of high schools or colleges and universities that would be interested in participating in this new AP GIS&T program, please let the AAG know and we can provide them with details.

Doug Richardson and Michael Solem from the American Association of Geographers coauthored this column.

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

Learning to Be a Leader
at the Project Management Level

By Tripp Corbin, eGIS Associates, Inc.

Why did you get into GIS? Were you fascinated by the technology and intrigued by all the cool things it could do to data? I was, and that's why I settled into this field.

But as my career progressed, I moved from being a staunch techie immersed in the world of technological advancements to managing projects, teams, whole departments, and now an entire company. This required expanding my skill sets beyond just dealing with the data and the technology. I had to scramble to figure out what I needed to do to oversee projects, supervise people, administer budgets, and more. Sadly, too many of my GIS peers have had to do the same.

So what are some of the skills we need to learn to be good managers? Surprisingly, we can learn a lot from when we first got started in GIS, as well as that first project we managed.

Let's take a look at how those inceptive undertakings can make us better managers— and leaders.

Getting Started

For many GIS professionals, the road down this path begins by going to school and getting a degree or certificate in GIS. In class, students learn about geographic theories, data collection, GIS-based analysis, and creating and editing maps.

Often, this is a person's initial exposure to the tools used in GIS, such as the ArcGIS platform. More and more, students get to do field collection using GPS and other mobile devices. And, generally, part of this formal education involves participating in an internship, which turns out to be many young people's introduction to "real-world" uses of GIS.

After completing school (or sometimes concurrently), degree and certificate holders get jobs, ideally in GIS or a related field. If an employer values training, the company may send the new GIS practitioner to classes to stay current on software updates, learn about new technology, get exposed to how other people and organizations use the same tools, and see what's coming next. Young GIS technicians and analysts tend to be in the know and are constantly improving at what they do.

At some point, someone notices how good the GIS technician is and decides that he or she should be promoted. Suddenly, this person is forced to shift beyond his or her comfortable technical zone and into management.

Moving into a Leadership Role

This transition brings with it a whole new set of challenges that a technical background may not have addressed. It is one thing to know how to administer and manage a database. It is quite another to administer and manage projects, people, meetings, and budgets.

I always say that life would be simple without employees or clients. Of course, without either of those I would not have a wife; a home; food; electricity; a car; cable television; or any other amenities, necessities, and relationships that I enjoy.

To deal well with employees and clients, managers must develop a completely new set of skills outside the technical realm. They have to turn ideas into tasks and results; handle employee issues; write proposals; procure software, equipment, and services; manage and renew software licenses; and do so much more. So how do GIS technicians learn to do this?

Learning from Project Management

Luckily, most people's first move into the realm of management comes at the project level. A GIS technician is given a small project to carry out and manage, such as overseeing the update of a layer or performing a specific analysis and presenting the results.

Managing simple projects like these may sound easy at first, since the new project manager has undoubtedly been part of project teams in the past. However, it is never as easy as it seems. And this first foray into administration can teach someone with a technical background a lot about what will be needed to succeed in management down the road.

Project management requires paying a lot of attention to things that GIS technicians and analysts are not typically concerned with. Project managers no longer focus solely on production. They also concentrate on the scope of the project, making sure that everyone involved understands the desired outcomes, the project budget, developing workflows, managing personnel, keeping an eye on the schedule, communicating with team members, ensuring that all team members have the resources they need to complete the project, quality control, and delivering the final project.

The first part of this is knowing what the project is—or, in official project management lingo, what is the scope? According to the Project Management Institute (pmi.org), the scope defines all the work required—and only the work required—to complete the project successfully. While it seems like a project scope would be easy to understand, I have seen many projects hit bumps along the way because either the vendor or the customer did not share a common view of the scope. This seems to happen a lot when the two come from different backgrounds or are at different technical levels. Thus, project managers need to make sure everyone has a complete and identical understanding of the scope.

Projects also have a nasty tendency to take on a life of their own. So project managers need to watch out for scope creep—when elements start getting added or removed from the project. In many cases, this drives up costs, which can bite the team in the backside down the road.

That said, not all scope creep is bad. The project manager may find out new information that was not known before, or new technology comes to market, or the client's goals change. These are legitimate reasons to change the scope of a project.

To keep all this straight, the project manager must document all the specifics—when and why the project took on a new direction, what changes were made and where—so that this information is available to everyone involved. If costs go up, project managers need to get the proper approval for that as well. All this keeps the project from becoming an eight-legged monster that nobody can control and that will pull the team into the dreaded deep.

Being a Leader, Not a Boss

When a project manager pays attention to project parameters, ensures that everyone understands the scope of a project, and documents all the project's details, that usually results in a job well done. It also establishes the project manager as a leader.

There is a big difference between being a leader and being the boss. People like to work with and for leaders. They don't like to work for bosses.

When a management situation seems too far outside your scope of technical training, remember the simple ways in which you managed your first successful project. Repeating those steps— just with more encompassing situations—will put you on the path of leadership.

About the Author

Tripp Corbin is the CEO of Esri partner eGIS Associates, Inc., and the current president elect of the Urban and Regional Information Systems Association (URISA). He has more than 20 years of geospatial experience and has been in management positions for 15 of them. Corbin holds multiple certifications, including GISP, ArcGIS Desktop Professional, Microsoft Certified Professional, and Certified Floodplain Manager.

New Training and Certification Offerings

Training

New Instructor-Led Courses

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

To learn Web GIS workflows, check out the following recommended courses:

- **ArcGIS 4: Sharing Content on the Web**
  In this course, GIS professionals learn how to publish an organization's authoritative GIS data, maps, and tools as services that can be discovered on the organization's public or private ArcGIS portal, easily accessed from desktop and online applications, and featured in web and mobile apps.

- **Deploying Portal for ArcGIS**
  This course teaches ArcGIS for Server administrators how to install, configure, and deploy Portal for ArcGIS to meet their organization's need for private geospatial content sharing. It covers techniques to ensure security and high availability as well.

- **User Workflows for ArcGIS Online Organizations**
  This half-day workshop serves as an introduction to web maps, apps, and other authoritative content available through ArcGIS Online organizational sites. Learn to infuse projects with geographic context, meaningful visuals, and additional business intelligence.

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

- **E-Learning Spotlight: Learning Plans**
  Learning plans are a popular feature of the recently expanded and enhanced online *Training Catalog*. Each plan contains a set of sequenced e-Learning courses and other self-paced resources that help learners acquire specific conceptual knowledge and ArcGIS skills. Topics include ArcGIS Online administration, spatial analysis, surface modeling, and mapping and visualization.

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

Certification

The following Esri Technical Certification exams have been updated for ArcGIS 10.4 and are open for registration:

- ArcGIS Desktop Entry
- ArcGIS Desktop Developer Associate
- Web Application Developer Associate
- Enterprise System Design Associate
- Enterprise Administration Associate

Additionally, certification candidates can now purchase technical certification exam vouchers from the Esri Store (store.esri.com). Candidates who are ready to schedule their exam appointments may visit the Pearson VUE website (pearsonvue.com/esri) to select their preferred date and location. Pearson VUE operates more than 5,000 test centers worldwide.

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

Esri Press

Map Use: Reading, Analysis, Interpretation, Eighth Edition
By A. Jon Kimerling, Aileen R. Buckley, Phillip C. Muehrcke, and Juliana O. Muehrcke

Map Use: Reading, Analysis, Interpretation, Eighth Edition, is a comprehensive, foundational textbook designed for college curriculum. With a new chapter on map design—including for web maps—the new edition also addresses contemporary topics on cartography, such as web concepts and the use of imagery and remote sensing. *Map Use* not only imparts to students the skills they need to read and understand maps, but it can also be a thorough reference resource for professional cartographers. It features nearly 600 full-color maps, photographs, and graphs that illustrate the big ideas behind communicating with maps and has an extensive glossary that defines key topics. Accommodating current developments in mapping, GPS, and GIS technology, the eighth edition renders basic cartographic principles accessible to all—from students of cartography and map design to those without a formal geography education. October 2016 (e-book) and November 2016 (print), 670 pp. E-book ISBN: 9781589484696 and paperback ISBN: 9781589484429.
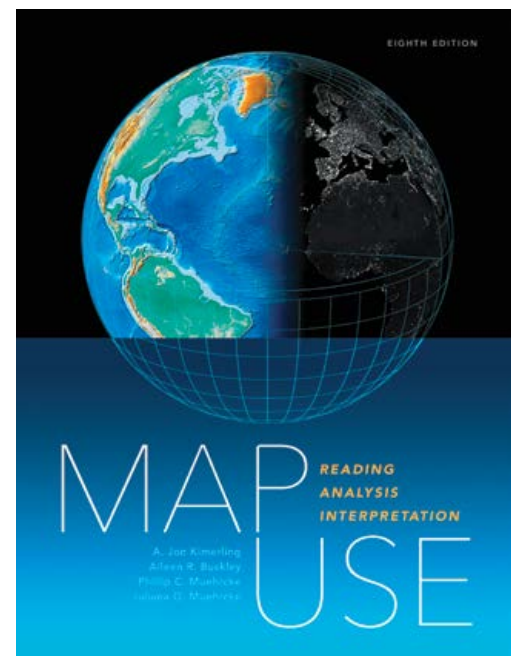
Esri Corporate Headquarters

esri.com

Esri Technical Support
esri.com/support

Esri Desktop Order Center and Software Information
Tel.: 1-800-447-9778 (USA only)

Esri Products
esri.com/products

Esri Store
esri.com/store

Esri Developer Network
edn.esri.com

Customer Care Portal
my.esri.com

Esri US Regional Offices

Boston—Middleton, MA
Tel.: 978-777-4543

Charlotte—Charlotte, NC
Tel.: 704-541-9810

Denver—Broomfield, CO
Tel.: 303-449-7779

Minneapolis—St. Paul, MN
Tel.: 651-454-0600

Olympia—Olympia, WA
Tel.: 360-754-4727

Philadelphia—Chesterbrook, PA
Tel.: 610-644-3374

Redlands—Redlands, CA
Tel.: 909-793-2853, ext. 1-1906

San Antonio—San Antonio, TX
Tel.: 210-499-1044

St. Louis—St. Charles, MO
Tel.: 636-949-6620

Federal Office

Washington, DC—Vienna, VA
Tel.: 703-506-9515

For additional information about Esri US regional offices, visit esri.com/about-esri/usa.

Esri Distributors Worldwide

Esri Australia Pty. Ltd.—Australia
www.esriaustralia.com.au

Esri BeLux N.V.—Belgium
www.esribelux.com

Esri Bulgaria Ltd.—Bulgaria
www.esribulgaria.com

Esri Canada Limited—Canada
www.esri.ca

Esri Chile S.A.—Chile
www.esri.cl

Esri China (Beijing) Holding Co. Ltd.—China
www.esrichina.com.cn

Esri Colombia SAS—Colombia
www.esri.co

Esri Northeast Africa—Egypt
www.esrinea.com

Esri Finland Oy—Finland
www.esri.fi

Esri France S.A.—France
www.esrifrance.fr

Esri Deutschland GmbH—Germany
www.esri.de

Esri China (Hong Kong) Limited—Hong Kong
www.esrichina.hk

NIIT GIS Limited (Esri India)—India
www.esriindia.com

Esri Italia Sp.A.—Italy
www.esriitalia.it

Esri Japan Corporation—Japan
www.esrij.com

Esri Eastern Africa Limited—Kenya
www.esriea.co.ke

Esri Lebanon sal—Lebanon
www.esrilebanon.com

Esri Southern Africa—Mauritius
www.esri-southernafrica.com

Esri Nederland B.V.—The Netherlands
www.esri.nl

Esri Muscat Co LLC—Oman
www.esrimuscat.com

Esri Panama, S.A.—Panama
www.esri.pa

Esri Polska sp. z o.o.—Poland
www.esri.pl

Esri Portugal—Sistemas e Informação Geográfica, S.A.—Portugal
www.esri-portugal.pt

Esri Romania S.R.L.—Romania
www.esri.ro

Limited Liability Company ESRI CIS—Russia
www.esri-cis.ru

Esri Saudi Arabia Ltd.—Saudi Arabia
www.esrisaudiarabia.com

Esri South Africa (Pty) Ltd.—South Africa
www.esri-southafrica.com

Esri Korea, Inc.—South Korea
www.esrikr.com

Esri South Asia Pte. Ltd.—Singapore
www.esrisa.com

Esri España Soluciones Geospaciales SL—Spain
www.esri.es

Esri Sverige AB—Sweden
www.esri.se

Esri (Thailand) Co. Ltd.—Thailand
www.esrith.com

Esri Bilgi Sistemleri Muhendislik ve Egitim, Ltd.—Turkey
www.esriturkey.com.tr

Esri (UK) Ltd.—United Kingdom
www.esriuk.com

Esri Ukraine Ltd.—Ukraine
www.esri.ua

Grupo Esri de Venezuela, C.A.—Venezuela
www.esriven.com

Esri has more than 80 distributors in other countries around the world. For more information, contact Esri (tel.: 909-793-2853, ext. 1-1235; fax: 909-307-3070) or visit esri.com/distributors.

We Are Esri

Career Opportunities

Esri is hiring smart people with all levels of experience for positions at our headquarters, regional offices, and R&D Centers. Your work will affect the way people live and how organizations solve problems. We offer exceptional benefits, competitive salaries, profit sharing, and a collaborative and stimulating environment. Join us and be part of Esri's mission to make a difference in our world.

Software Development and ArcGIS Product Engineering

GIS Apps Product Specialist: Design next-generation apps by developing cross-platform mapping and GIS solutions that run on the latest mobile devices.

GIS Apps Developer: Take the lead in building innovative technology by creating responsive and intuitive GIS apps for mobile, desktop, and web systems.

JavaScript Engineer: Use your JavaScript expertise to develop front-end apps that make it easier for people to visualize their data.

Software Security Engineer: Work with development teams to solve security challenges at a massive scale by conducting penetration testing and building secure solutions.

Graph Algorithm Programmer: Design and implement high-performance algorithms and solvers for cutting-edge network analysis apps.

Software Developer—Search, Geocoding, Language Processing: Leverage your creativity and coding abilities to build geosearch algorithms that sift through big data to find things on a map.

Map Exploration Product Engineer: Help design, test, maintain, and document the many tools and capabilities that allow Esri users to filter and explore their GIS data.

Product Engineer—Sharing Data and Content: Leverage your Web GIS skills to develop the publishing and sharing capabilities of Esri software.

Product Management

Product Manager—Content: Be the primary contact for Esri's content products. Collaborate with Esri's development staff, regional offices, international distributors, and partners to provide pre- and postsales support.

Professional Services and Consulting

Platform Configuration Engineer: Work closely with partners and users to identify, design, and certify key ArcGIS workflows.

Technical Adviser: Help new and seasoned users develop best practices for implementing the ArcGIS platform to reach their business goals.

Educational Services and Technical Support

Instructor—GIS: Teach software courses in traditional and online classrooms to help Esri users stay at the forefront of ArcGIS technology.

Technical Editor: Help create effective training materials by editing and publishing educational content that meets Esri's high standards.

Support Analysts: Draw from your extensive ArcGIS knowledge base and collaborate with other team members to give Esri users solutions and improved workflows that fit their needs.

Business Development

Account Managers and Account Executives—Retail, Insurance, Transportation, and Local Government: Work with an account team to sell and promote the adoption of the ArcGIS platform to individual organizations.

Presales and Solution Engineering

Solution Architect: Use your technical background and business acumen to support Esri's business development team by translating system requirements into software architecture and design specifications.

Solution Engineer—Sales Enablement: Improve sales productivity by promoting the use of Esri's sales process, internal tools, technology, and selling methodology.

Marketing

Product Marketing Specialist: Envision and execute product marketing plans that drive awareness, demand, and adoption of Esri's products by millions of users around the world.

Industry Marketing Manager—Electric and Gas: Develop and oversee the execution of global go-to-market strategies to propel growth in new and existing electric and gas markets.

Esri is an equal opportunity employer (EOE). All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability status, protected veteran status, or any other characteristic protected by law.

esri.com/careers   Follow @EsriCareers on Twitter

esri®
380 New York Street
Redlands, CA 92373-8100

Is Your Community Healthy?

Governments and health service providers work together by sharing information to assess health risk, track disease, determine where health services are needed most, and prioritize areas for interventions. They share this knowledge with the public to help citizens understand health issues and find resources when they need them. When forward-thinking leaders include health services in their smart technology strategies, community health becomes a community mission.

Everyone wants a healthier community. Find the way to yours with Esri.

Learn more at
esri.com/an-healthycommunities

esri®