

ArcUser

The Magazine for Esri Software Users

**Maximizing the
Freight Economy 10**

**Six Reasons You Should
Use ArcGIS API 4.0 for
JavaScript 36**

**Youth Mappers Unite for
a Good Cause 66**

COULD YOU MAP CANADA IN A SEASON?



SPOT 6/7: BREATHTAKING ACCURACY AT RECORD BREAKING SPEED.

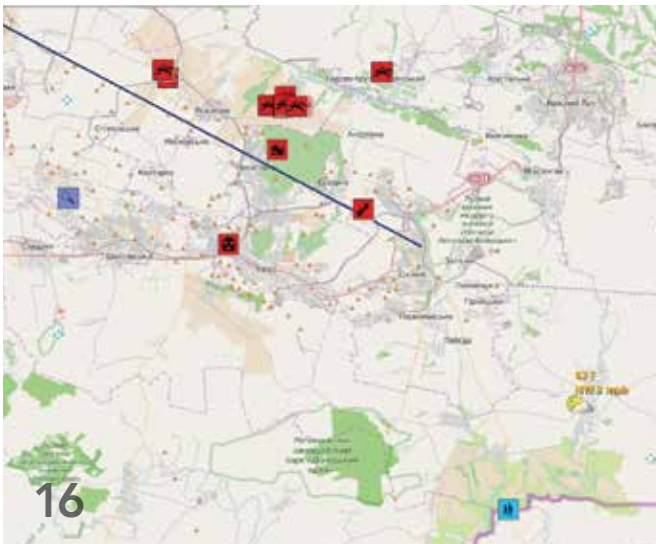
A pair of satellites, operating in unison, offers the triple benefits of unrivalled coverage, precision and speed. Areas as big as Canada can easily be mapped within a season, minimising inconsistencies caused by environmental changes. If you want accurate maps and you want them fast, talk to us. Find out more at geo-airbusds.com

ASK US
 **AIRBUS**
DEFENSE & SPACE



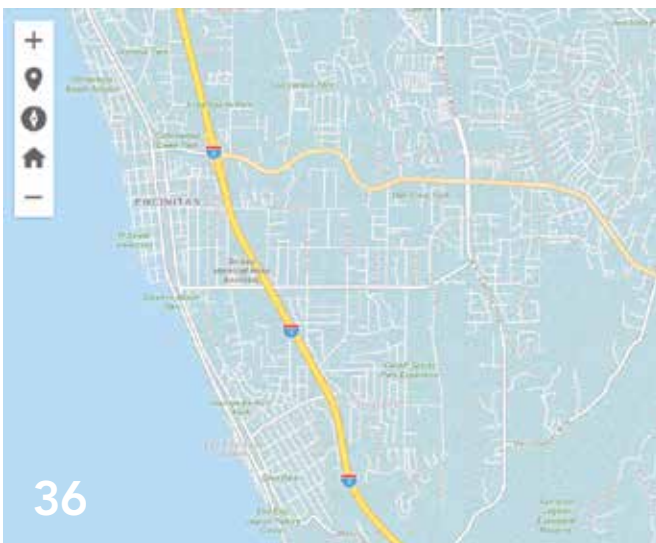
Focus

- 10 Maximizing the Freight Economy
- 13 The Drucker Approach to Supply Chain



Feature

- 16 ArcGIS Online Aids Response to Downed Airliner
- 20 Pop-Up Wetland Habitats Benefit Migrating Birds and Farmers
- 23 Four23
Lessons Learned from the BirdReturns Project



Special Section

- 36 Six Reasons You Should Use ArcGIS API 4.0 for JavaScript
- 41 The Map Object and Web Map Synergy

“When we try to pick out anything by itself, we find it hitched to everything else in the Universe.”

John Muir, *My First Summer in the Sierra*

This quote underlines the interdependence of the natural world. GIS was developed to gain a more profound understanding of these interrelationships and the impact of our actions. Although originally conceived as a way to tease out the relationships of components in natural systems, the value of GIS in helping comprehend increasingly complex economic systems is becoming more widely appreciated.

Just as GIS can inform policy to protect the health of a natural system such as a watershed, it can also be applied to promote well-being of economic systems such as the transportation network. “Maximizing the Freight Economy,” an article in this issue, highlights the development of the *National Freight Economy Atlas*, which promotes a deeper understanding and appreciation of the role of the freight transportation system by policy makers and the public. Although this infrastructure may seem invisible—especially in an era of online shopping—the transportation of goods underpins the economy.

A collection of web maps and Esri Story Map apps, the *National Freight Economy Atlas* was created through a partnership that includes Claremont Graduate University, Esri, and the University of Minnesota, with financial backing from BNSF Railway and the State of Minnesota. The atlas visualizes the relationships between commodity sources, industry clusters, and the freight transportation infrastructure in the United States using easily accessible maps.

Defined by a geographic area, industry clusters are groups of related companies linked by similar markets, technologies, workforce types, and commercial relationships. They are the building blocks of modern economics. Understanding clusters and their relationship to the transportation network on national, regional, and local levels can help drive economic growth by encouraging the retention or attraction of industries vital to a cluster and supporting the transportation networks of those industries.

Just as GIS enables us to become better stewards of the natural world, it can provide insight and build consensus that will aid in more intelligently managing the economic landscape.

Monica Pratt
ArcUser Editor

editor's page

ArcUser

Summer 2016 Vol. 19 No. 3

Editorial

Editor: Monica Pratt
Contributors: Jim Baumann, Keith Mann, Matthew DeMeritt
Technical Adviser: Paul Dodd
Copy Editing: Linda Thomas

Design

Creative Director: James Hitchcock
Designer: Doug Huibregtse
Photographer: Eric Laycock
Illustrators: Daniel Gill, David Lauruhn
Print Coordinator: Lilia Arias

Advisory Board

Corporate: Marianna Kantor
Corporate Alliances: Renee Brandt
Products: Damian Spangrud
International: Dean Angelides
Marketing Communications: KC Higgins
Industries: Russ Johnson

How To Reach Us

Visit the *ArcUser* website (esri.com/arcuser) to download tutorials, read current and past issues, and access additional resources.

Manage Your *ArcUser* Subscription

To subscribe, unsubscribe, or make changes to your Esri publication subscriptions, please go to esri.com/updates.

Outside the United States, please contact your international distributor to subscribe, unsubscribe, or change your address. For a directory of distributors, visit esri.com/distributors.

Advertise in *ArcUser*

For information regarding placing an advertisement in *ArcUser* magazine, contact the advertising coordinator at ads@esri.com.

Editorial Inquiries

Monica Pratt, *ArcUser* Editor
380 New York Street
Redlands, CA 92373-8100 USA
arcuser_editor@esri.com

Visit the *ArcUser Online* web pages (esri.com/arcuser) to read the article submission guidelines and copyright policy.

ISSN 1534-5467

ArcUser is published quarterly by Esri at 380 New York Street, Redlands, CA 92373-8100 USA. *ArcUser* is written for users of Esri software and distributed free of charge to registered users.

Departments



Software and Data

- 6 Put Your Drone to Work
- 8 Real-Time GIS as a Managed Service

Manager's Corner

- 26 The Business Impact of GIS
- 30 Apply Security Best Practices to an ArcGIS Server Site

Developer's Corner

- 32 The Top Ten Takeaways from the Esri Developer Summit
- 34 A Force for Good

Hands On

- 44 Attacking Coordinate Systems and Datums
- 48 Six Easy Ways to Improve Your Online Maps

Bookshelf

- 54 GIS Bookshelf
- 55 Start Making 2D and 3D Web Maps with ArcGIS Pro

Faces of GIS

- 56 An Exceptional "Normal" Person Changing the World

Education

- 60 A Good Map Teaches You to Ask a Better Question
- 62 Kenyatta University Quickly Becomes a Center of GIS Excellence in Eastern Africa
- 63 Esri's 100 African Universities Program
- 65 Arizona State's MAS-GIS Program Prepares Grads for the Real World

End Notes

- 66 Youth Mappers Unite for a Good Cause
- 67 Mapping a Better World



PUT YOUR DRONE TO WORK

By Tony Mason, Esri Imagery Services

Drones are fun toys. They are great for flying around and capturing images and videos of family events. However, with the recent advances in drone technology, the drop in price, and the introduction of Drone2Map for ArcGIS, you can now put that same consumer drone to work for your organization.

Drone2Map for ArcGIS is a desktop app that takes geolocated pictures from drones of all shapes and sizes. The app detects camera and sensor parameters and then intelligently applies appropriate defaults and creates professional imagery products, such as orthomosaics and 3D meshes—in minutes—not days. The photogrammetry engine in Drone2Map for ArcGIS is powered by Pix4D, an industry leader in professional image processing software.

These products can be used for visualization and analysis in ArcGIS. Land analysis, infrastructure inspection, and monitoring are just three of the many ways this imagery can be used in ArcGIS. Other areas that can benefit from Drone2Map for ArcGIS include defense, law enforcement, precision agriculture, forestry, disaster response, asset and facility management, transportation, insurance, real estate, city planning, and mining.

Land Analysis

Remotely sensed imagery has been used for years to perform land analysis. Traditionally, these images came from satellites, airplanes, and helicopters. While large areas could be captured, the introduction of drones and Drone2Map for ArcGIS allows microgeographies—small, specific locations such as subdivisions—to be flown, processed, and analyzed in the same day.

A key industry leveraging Drone2Map for ArcGIS is agriculture. Farmers need the ability to apply remedies to their crops immediately when a problem is detected. Traditionally, processing imagery is a specialized operation that takes a long time. Waiting days or weeks for imagery to be collected and analyzed can mean an immediate

loss of revenue. Farmers can now deploy drones to collect imagery that detects the health of their crops and see that imagery the same day it was flown. They do not need to know anything about imagery or formulas to create special imagery-derived products. Drone2Map automatically detects if the camera used to collect the imagery is capable of creating imagery products to assist them in analyzing their crops. Drone2Map will automatically create a crop health map that allows farmers to visualize areas of their fields that are underperforming, allowing them to apply treatments before it's too late.

Infrastructure Inspection

Critical infrastructure keeps our communities running, providing power to our cities, water to our homes, and many other amenities that we take for granted. The teams that maintain the infrastructure that power these services put themselves in harm's way through routine inspections. To ensure critical infrastructure continues functioning properly sometimes requires that teams be in perilous situations. Drones offer a unique

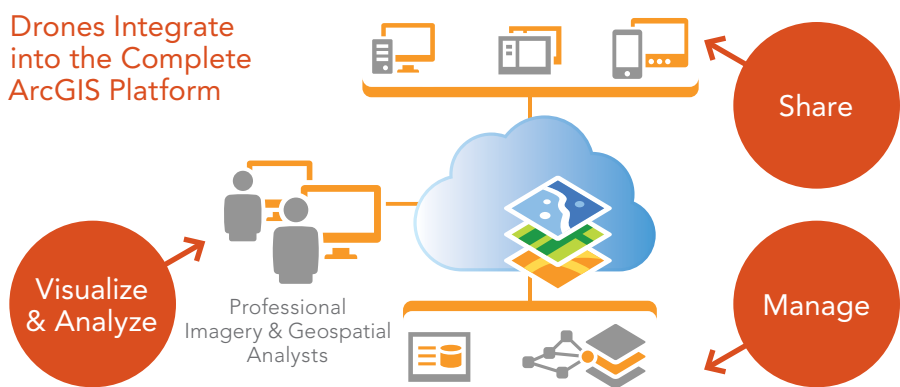
alternative to climbing towers or hanging out of the side of a hovering helicopter. Quadcopters can be deployed using autonomous flight planning and control to collect images of infrastructure at angles that are too risky to get to in person.

The oblique images captured from these drones are not ideal for creating products that are draped onto a map and mashed up with other datasets. Instead, these images are best visualized in a viewer that properly orients them and allows you to interact with a map. Drone2Map for ArcGIS has the capability to process oblique imagery and display this imagery in a viewer that allows you to interact with the map to quickly orient yourself around the object being inspected. Soon Drone2Map will be updated to add annotations to the images to quickly make notes about issues and share the information with others in your organization.

Monitoring

Monitoring for change is a powerful capability to make informed decisions within the time window to effect change. Many industries monitor change. Construction sites monitor development to gauge progress and inform stakeholders. Environmental agencies monitor change in vegetation to

Drones Integrate into the Complete ArcGIS Platform

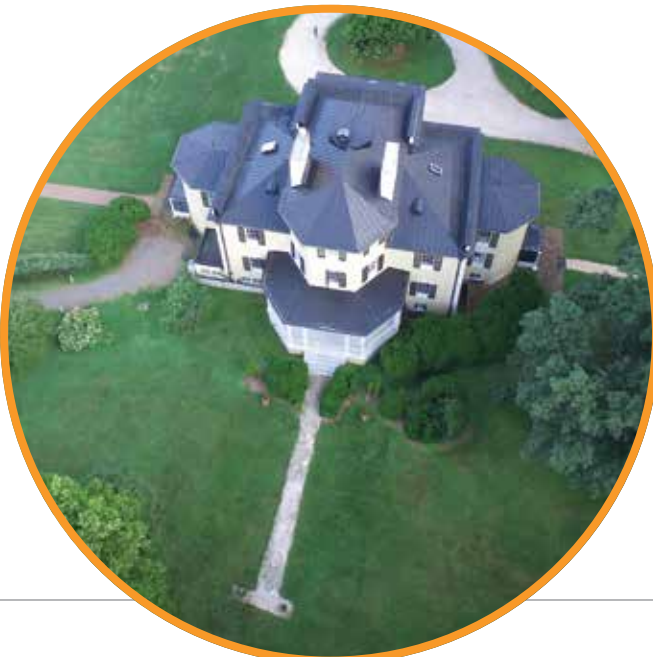




2D Imagery Products



3D Imagery Products



Smart Inspection Photos



understand habitat degradation of key species. Drone2Map for ArcGIS produces 2.5D and 3D datasets that speed monitoring features. Digital surface models (DSMs) provide a fast and accurate way to monitor stockpiles. Whether it's gravel or wood chips, Drone2Map produces highly accurate surfaces for performing analysis. In addition to DSMs, Drone2Map produces dense point clouds that allow feature extraction and 3D analytics. Drone2Map, coupled with ArcGIS for Desktop, provides a powerful platform for monitoring change through drone processing and analytical capabilities.

**Geocortex®
Implementation &
Customization Services**

- Geocortex® Installation & Configuration
- Application Design & Implementation
- Advanced Workflow Development
- Report and Map Template Design
- Geocortex® Custom Development

www.DigitalDataServices.com
303-986-6740

Geocortex® BUSINESS PARTNER **esri** Partner Network Silver
Esri trademark provided under license from Esri

Real-Time GIS as a Managed Service

If you're not factoring real-time geospatial analytics and mapping into your GIS strategy, you're leaving an immense gap in your ability to truly understand what's going on, why it's happening, and how you should respond. Later this year, Esri will unveil the ability to deploy Real-Time GIS as a managed service, enabling you to reliably ingest, analyze, and store millions of sensor events per second. You will be able to quickly visualize, replay, explore, and perform fast batch analytics on billions of features.

Currently, Esri offers Real-Time GIS capabilities via ArcGIS GeoEvent Extension for Server, which can be deployed on-premises or in the cloud. Ready-to-deploy images of ArcGIS for Server, including ArcGIS GeoEvent Extension for Server, are available via ArcGIS Server Cloud Builder on Amazon Web Services and for Microsoft Azure. GeoEvent Extension is currently used by hundreds of organizations across numerous industries, including agriculture, government, natural resources, transportation, and utilities.

The number of connected devices is rapidly increasing, and those devices are producing exponentially more data, creating a demand for higher data ingestion rates and faster analytics. While on-premises Real-Time GIS can process thousands of events per second—a rate that meets the requirements of many organizations managing small fleets of vehicles or sensor networks—the new Real-Time GIS as a managed service will reliably ingest, process, analyze, and store events that range from the tens of thousands to millions per second. That's fast enough to support smart cities the size of Los Angeles or London. It's fast enough to monitor all the sensors and smart meters used by major water, oil, gas, and electric utilities. It can efficiently track and analyze the movement and disposition of large fleets of trucks, ships, and aircraft, which are essentially moving sensor warehouses.

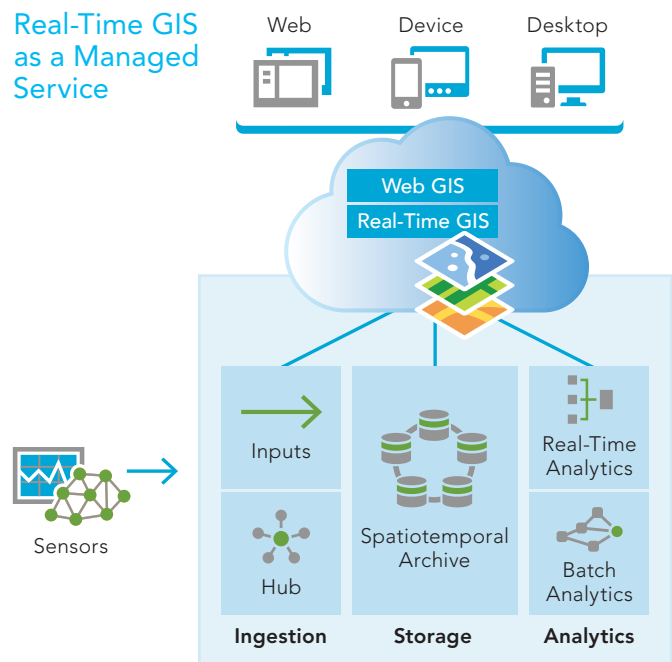
You can use Real-Time GIS to ingest real-time data streams from in-vehicle GPS devices, sensors, mobile devices, and social media providers. It accommodates multiple streams of data flowing continuously through filters and processing steps that you define so you can focus on only the most important aspects of your operations. It can track dynamic assets that are constantly moving (vehicles, aircraft, vessels, and people) or stationary assets that have attributes that constantly changing (pressure valves on a pipeline and weather monitoring stations).

This new Real-Time GIS as a managed service offering is composed of a distributed computing architecture designed to support the processing speeds and volumes of data produced by an emerging constellation of connected devices and sensor technologies. This technology will be offered through Esri Managed Cloud

Services. Esri will provide customers with ready-to-use instances of ArcGIS running in the cloud that can be easily scaled depending on your requirements. You can choose a cloud provider (initially Microsoft Azure and Amazon Web Services) and will be able to choose the cloud deployment region. Real-Time GIS as a managed service leverages multiple aspects of the ArcGIS platform including web GIS, real-time, and batch analytic capabilities that work with the spatiotemporal big data store. The Spatiotemporal Big Data Store is a central component of Real-Time GIS as a managed service. End users will be able to interact with the observational data stored in the spatiotemporal big data store using standard ArcGIS clients such as ArcMap, ArcGIS Pro, and web maps. Rather than display millions or even billions of points on a map, data can be aggregated on the fly for more effective visualization.

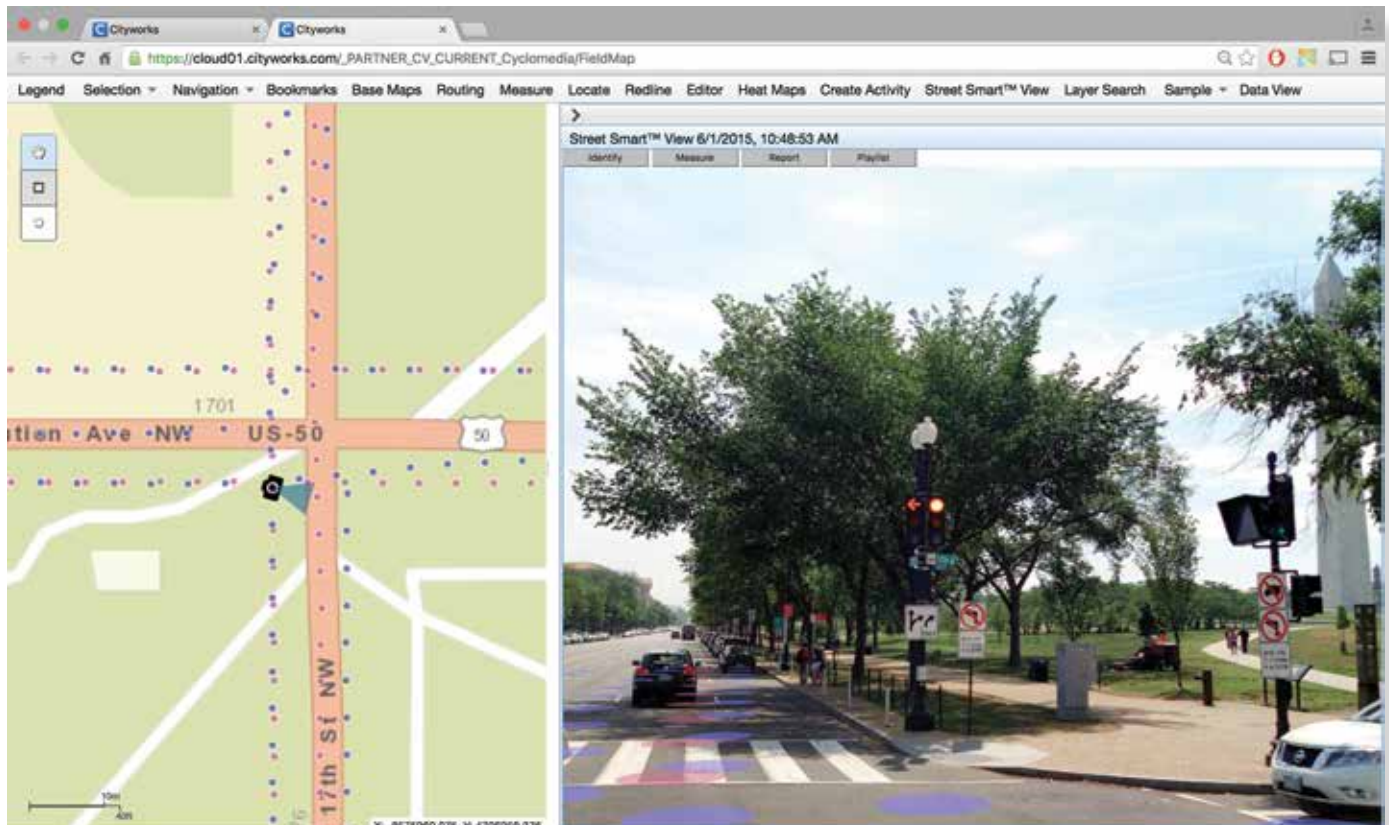
When the new Real-Time GIS as a managed service becomes available later this year, you will be able to reliably ingest, process, analyze, and store millions of sensor events per second. You will be able to visualize, replay, and explore extremely large datasets and perform fast, coarse-grained analytics on billions of records. Since you will be able to specify the region to deploy based on a selected cloud provider, you will be able to run continuous real-time analytics on nearby data with faster, more local access.

Real-Time GIS as a Managed Service



Even Better Than Being There!

CyloMedia Street Smart Imagery is comprised of accurate, high-resolution images embedded with geometrically true coordinates, date and time stamps and other metadata. When assembled, the resulting GeoCycloramas provide seamless, 360-degree street-level viewing so authorized personnel can remotely assess sites, assets, features and conditions and even perform precise linear, area and volume calculations.



View. Plan. Do.

Built right into Cityworks® software to leverage the power of the Esri® ArcGIS® platform and its robust asset data management repository, CyloMedia Street Smart™ functionality lets your city workers remotely **view** sites of interest using GeoCycloramas, then **plan** and **do** work more efficiently and cost-effectively than ever before.

CyloMedia GeoCycloramas and **StreetSmart View** enable a wide range of personnel to work smarter and do their jobs better: Public Works, Planning, Building, Zoning, Finance, Compliance, Transportation, Fire, Police and Public Safety are just a few of the municipal departments that will drive ROI.

CyloMedia GeoCycloramas are one of the smartest investments your city can make!

Seeing is Believing! For a demonstration, please contact info-us@cyclomedia.com or call 1-800-790-3652.

Learn more at www.cyclomedia.com.



Maximizing the Freight Economy

An ArcGIS-enabled resource broadens understanding of business's "last dark continent."

By A. J. Mangum

In the spring of 2012, Thomas Horan, dean of the Drucker-Ito School of Management at California's Claremont Graduate University (CGU), found himself at dinner with the late James Oberstar, a former United States Representative for Minnesota, and Matt Rose, then CEO of the railroad giant BNSF Railway Company. Something of a debate took shape.

Oberstar, who served for four years as chairman of the Transportation and Infrastructure Committee, asserted that greater public-sector investment in the United States' freight-rail infrastructure was needed and that such support deserved to be recognized as an essential economic driver. Rose countered that *private-sector*

investment in moving goods and services by rail was more critical to economic progress.

"It was a *My Dinner with Andre* experience," Horan said, referring to the film in which a simple over-dinner conversation results in unexpectedly broadened world views for those at the table. In weighing Oberstar's argument for public-sector freight-rail support

against Rose's advocacy for private investment, Horan—a public-policy specialist whose work has influenced health care legislation as well as transportation policy—arrived at an epiphany that came in the form of a third point of view: "They were *both* right."

As the conversation progressed, the three agreed that an easily accessed information

private-sector comprehension of the potential of freight rail and create opportunities to improve the freight-rail infrastructure by identifying efficiencies and weaknesses in the movement of goods.

That moment of inspiration has led to the *National Freight Economy Atlas*, an ArcGIS-powered online resource developed by a partnership that includes Claremont Graduate University, Esri, and the University of Minnesota, with financial backing from BNSF Railway and the State of Minnesota. With a menu of interactive maps, the atlas illustrates relationships between commodity sources and the United States' freight infrastructure and offers tools to gain an improved grasp of concepts like industry clusters—sets of interconnected stakeholders within a geographic area—and location quotients, economic ratios comparing regional attributes to those of the country as a whole.

“There’s been attention to the technical and logistic aspects of supply chain—how to get things from here to there, how to optimize [routing]—all of which is important,” Horan said. “There hasn’t been a broad understanding of the spatial aspects of supply chain, and the National Freight Economy Atlas has allowed us to [offer] that in ways

easily understood. Our target audiences are the decision makers handling not only those technical aspects but also the policy, organizational, and corporate aspects—maximizing value, making it all happen, and working with various companies throughout a supply chain to deliver [a] quality enterprise.”

Prior to his work with the *National Freight Economy Atlas*, Horan had already earned a reputation for creating innovative platforms with which to share critical data with the public. In 2008, he codeveloped, with CGU professor Brian Hilton, the website Safe Road Maps (www.saferoadmaps.org), which presents mapped data—state by state and even street by street—on traffic fatalities and auto accidents. [See “Mapping Roadway Fatalities—Website increases awareness and understanding” in the summer 2012 issue of *ArcUser*.] By simply zooming in on a particular geographic location, site visitors can call up historical information on accidents that have occurred along a particular route, allowing them to gauge travel risks. Demand for such information was so strong, Horan said, that on the site’s launch date, several additional servers had to be brought online to handle the unexpected user volume. To date, he estimates, the site has earned more than 15 million hits.

→ The *National Freight Economy Atlas* offers a visualization of regional industrial specializations in relation to freight routes. Image courtesy of Center for Information Systems and Technology/Claremont Graduate University

source—one tailored to an audience that could include legislators, business leaders, and freight analysts—was needed to foster a greater understanding of the United States’ freight infrastructure, its effect on the economy, and the value of both public and private investment in freight-rail capacity. Such a tool, they theorized, could also improve





↑ Brian Hilton directs Claremont's Advanced GIS Lab, where the *National Freight Economy Atlas* was built. Photo courtesy of Claremont Graduate University

"We took this data—which had existed in a data warehouse but had not been mapped—and enabled understanding by the public," Horan said. "When you can do that, those are great moments. It's inspiring to see a situation and realize GIS and spatial analysis will represent a breakthrough moment."

In the challenge that emerged from his conversation with Oberstar and Rose, Horan recognized a similar opportunity to foster awareness—in this case, of the economic value of freight—by again using GIS to deliver data in a fashion meaningful to a mainstream audience. He envisioned an approach modeled after the Dartmouth Atlas of Health Care, an online resource offering geospatial data on medical procedures,

health care access, and costs.

"Dartmouth's health atlas has had a huge impact on health care policy over the last 20 years, charting spatial disparities," Horan said. "If they could do that, we could do that for supply chain."

Work on the *National Freight Economy Atlas*, began within a GIS practicum course—in which students develop GIS-based solutions for real-world challenges—at Claremont's Center for Information Systems and Technology (CISAT), then moved to the Advanced GIS Lab at CISAT, headed by Professor Hilton.

Using data from the Bureau of Economic Affairs, the Freight Analysis Framework (produced through a partnership between the Bureau of Transportation Statistics

and Federal Highway Administration), and the 2012 United States Census Commodity Flows Survey, the atlas identifies major industry clusters within a state and uses location quotients to provide measurements of a state's industrial specializations. That data is depicted in relation to local freight-intensive routes that lead to major freight-rail corridors.

"We use ArcGIS for Desktop to create the basic maps," Hilton explained. "We then publish them online as map services using ArcGIS for Server. We use ArcGIS Online to organize and manage them, and then publish them as story maps using various templates."

The resultant analytical picture, Hilton said, provides a "specialized understanding of commodity movements within and



↑ Location quotient data compares regional industrial attributes to those of the country as a whole. Image courtesy of CISAT/Claremont Graduate University

between regions.” Using United States Department of Transportation data, the atlas goes further, identifying the proportion of a region’s production associated with freight movement and helping create a picture of the economic impact of that freight traffic.

“*[A region’s]* trading clusters can really leverage economic growth,” Horan said. “Two-thirds of the economic growth in this

country *[can be attributed to]* trading clusters. With the *National Freight Economy Atlas*, we’re taking on some of those clusters and showing local communities that the business around the corner—because it’s part of a trading cluster—is really important, as is the supply chain around it.”

Horan points to an example: Due to the demand in China for commodities, Minnesota’s grain industry has outpaced

urban-based industries in the economic rebound. “Farms in Minnesota are doing great because China buys their soybeans,” he said. “A community getting new jobs in rural Minnesota is getting those jobs because of grain being delivered by BNSF. We’re able to show, through maps and analysis, that *[this industry cluster]* is important.”

Horan expects the atlas to help mainstream users achieve a greater awareness of supply chain concepts. Such a need is especially apparent, he explained, among policy makers and legislators.

“I’ve worked on transportation policy on Capitol Hill,” Horan said. “There isn’t a good understanding of the spatial dimensions of supply chain—across states, across the country—or how policy affects economic value. Through these story maps and cluster analyses *[published on the National Freight Economy Atlas]*, we give a sense of understandability to the idea of supply chain.”

Early response to *National Freight Economy Atlas*, he adds, has been especially strong among state-level policy makers and administrators responsible for investments in and long-term planning for rail infrastructure, as the atlas has provided a tool with which to observe and quantify both the demand and

The Drucker Approach to Supply Chain

Based at Claremont Graduate University’s Drucker-Ito School of Management in Claremont, California, the Center for Supply Chain and Logistics launched in 2015. Its curriculum and research agenda have been shaped by the teachings of management guru Peter Drucker, a figure regarded as among the most influential in forging the mechanics of the modern business culture.

Drucker viewed management as a philosophy, one encompassing psychology and sociology, and as a discipline that required a holistic approach centered on creativity, the value of people, and the societal implications of a business’s activities. He developed such concepts as the knowledge worker, the employee whose value is based on intellect and creativity—and management by objectives—a collaborative approach to goal-setting in which managers and workers partner in strategy creation. Drucker held that business had a responsibility to positively affect society and viewed profit not as a primary motivator but as a by-product of innovation.

“We bring the Drucker philosophy to [supply chain and logistics], in terms of management, leadership, and people skills,” said Thomas Horan, dean of the Drucker-Ito School. “What the center brings to the equation are the management issues surrounding supply chain and logistics. Our take is how to deal with [the discipline] holistically.”

Offering graduate degrees in supply chain and logistics, the center provides coursework stressing Drucker-influenced management approaches, public policy, and data-driven strategy development. Partnerships with the likes of Disney, Toyota, and UPS provide real-world opportunities for students to examine supply chain challenges and innovations. And, in the Drucker tradition, the program emphasizes working in ways that benefit society.

“When you look at supply chain,” Horan said, “it exposes huge human value of people getting [goods]. It isn’t just about technical aspects and logistics but is also about the value to both companies and communities. It’s a great set of dots to connect.”



↑ Thomas Horan, dean of the Drucker-Ito School of Management, has led the effort to create the *National Freight Economy Atlas*. Photo courtesy of Claremont Graduate University

the untapped potential for freight rail services. Horan contends the site also gives weight to arguments for public-private partnerships that can enable trading clusters and supply chains, “or at least not thwart them.”

Next, Horan hopes to expand the *National Freight Economy Atlas*'s scope to include data and analysis of other transportation modes, beginning with air freight. He and his *National Freight Economy Atlas* collaborators have been working with Federal Express on strategies to illustrate the value of the air-freight infrastructure in moving high-value, low-weight products.

As vital as GIS has proved in the development and presentation of *National Freight Economy Atlas* and as a platform for the wider analysis of supply chain, Horan and

Hilton agree that its full potential is still unrealized.

“GIS has impacted the supply chain and logistics field, though it seems more at the descriptive levels of analysis and decision-making: what happened, and why did it happen?” Hilton said. “Where I see it making an impact in the future is in the predictive and prescriptive levels—what is going to happen, and what should we do about it?”

Given the fundamental nature of supply chain and logistics—fields devoted to moving goods over distances—Horan foresees moving past a stage at which GIS fuels operational research and into an environment in which the tools of geospatial analysis are ubiquitous across the shipping industry. GIS, he contends, has the potential

to conquer what the renowned management theorist Peter Drucker—the “Drucker” in Claremont’s Drucker-Ito School—regarded as one of the business world’s greatest challenges: attaining a full comprehension of the science of moving goods.

“Drucker called logistics the ‘last dark continent,’” Horan said. “It was a black hole. But through GIS and the visualization it offers, we can deliver an everyday understanding to companies and governments of the importance of supply chain. That’s not just an operational issue, but really a value issue for companies and the communities in which they operate.”

About the Author

A. J. Mangum is a writer based in Colorado.

Spatial Adds a New Dimension to Business Data

Spatial Processing with SAP HANA, Analytics, and Applications

SAP HANA

Run high-performance and interactive location intelligence processing on SAP HANA directly from your ArcGIS® suite

ANALYTICS

Visualize both geospatial and business data with SAP BusinessObjects BI solutions

APPLICATIONS

Enrich SAP Business Suite applications with map-based business process execution paradigm

APP CENTER

Easy access and FREE trial to Esri-enabled solutions on SAP HANA App Center

Trademarks provided under license from Esri.



hana.sap.com



ArcGIS Online Aids Response to Downed Airliner

By Jim Baumann, Esri Writer

When Malaysian Airlines flight MH17 was shot down over a rural area of Ukraine on July 17, 2014, it galvanized into action an international team of GIS specialists even as there was a worldwide outpouring of grief for the 298 passengers and crew members who were killed.

The attack took place at approximately 6:15 a.m. (PDT), just as attendees at the Esri User Conference (Esri UC) in San Diego, California, were waking for the final day of the event.

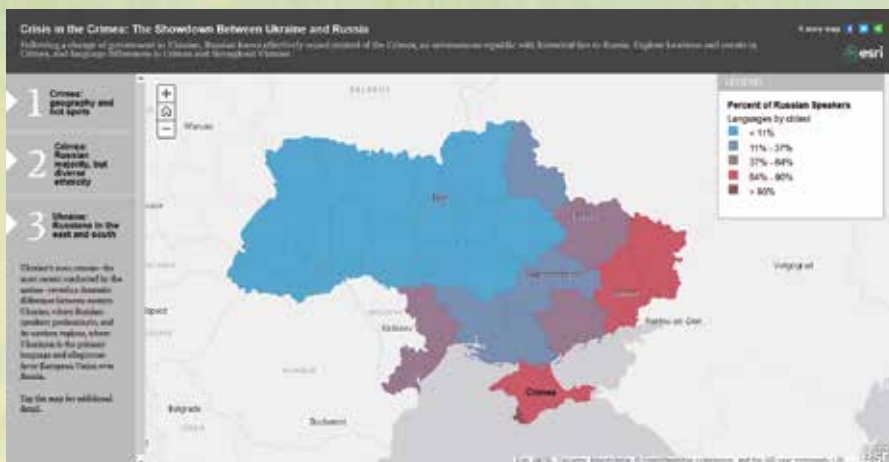
Two representatives of Bahagian Geospasial Pertahanan (BGSP), the division

of Malaysia's Department of Survey and Mapping that supports the Malaysian Armed Forces, were attending the conference. Brigadier General Hj. Abu Sufian bin Ahmad and Col. Dr. Mohd Zambri Mohamad Rabab were contacted shortly after the attack by the Malaysian Armed

➤ Searching ArcGIS Online using the keyword “Ukraine” produced useful information, including the separatist regions of Ukraine and the languages spoken in those regions, that was communicated in an Esri Story Map app.

➔ By loading the Automatic Dependent Surveillance Broadcast (ADS-B) track and comparing it with aeronautical charts and waypoints, the team rapidly developed situational awareness to understand the risks to commercial aircraft in the region.

➤ Within 90 minutes, the assembled team had established a site that provided the Malaysian Armed Forces with access to a common operational picture that included detailed Ukrainian mapping and demographics.



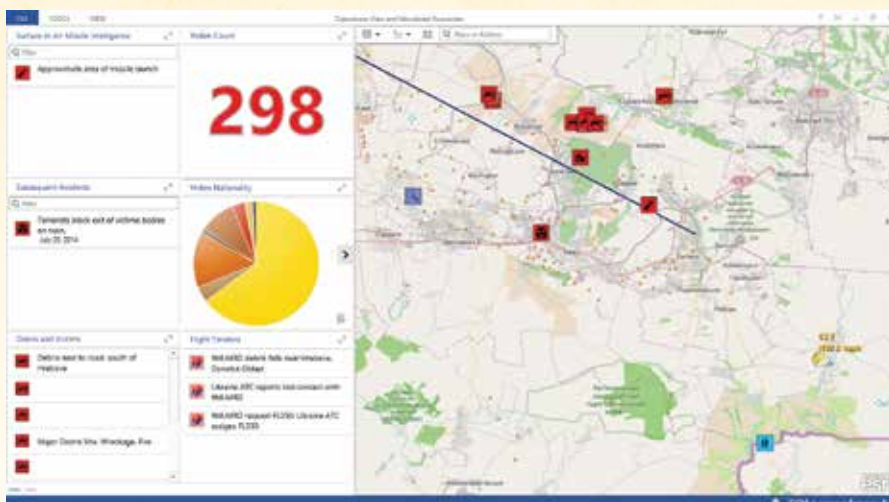
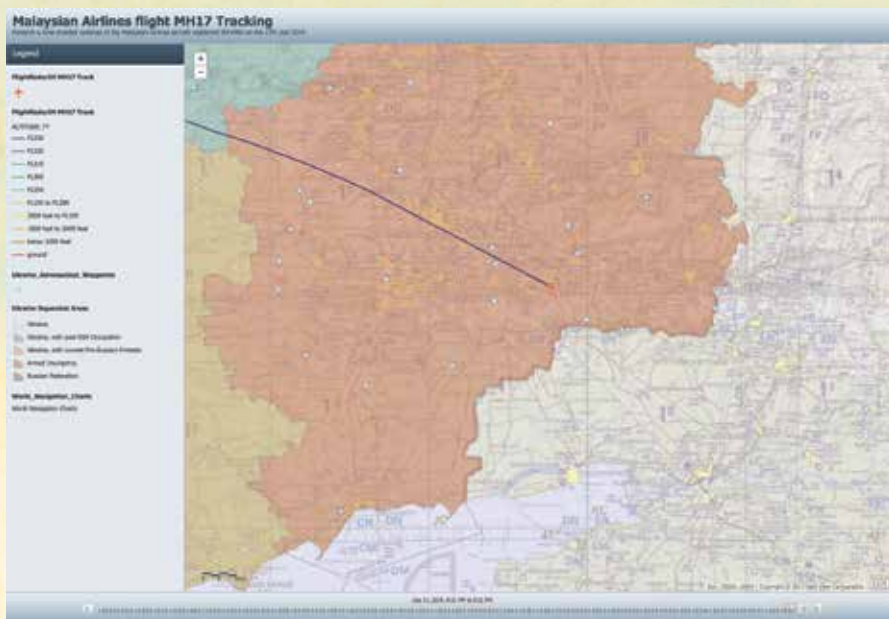
Forces. They were asked to quickly deliver information products and briefings for response and recovery efforts.

“Because of the severity of the incident and the many unknown factors related to it, it was critical to immediately contact Brigadier General Sufian bin Ahmad and Col. Dr. Mohd Zambri to inform them of the situation and request their help,” said Brigadier General Ahmad Nasir Bin Abd Rahman, who is the director of BGSP.

Malaysia had to deal with this national security incident, which had occurred in a war zone on the other side of the world where a complex political situation existed involving multiple nations. At the same time, Malaysian agencies were actively working on the MH370 incident that occurred March 8, 2014, when a Malaysian Airlines plane disappeared on a flight from Kuala Lumpur to Beijing.

In addition, the government was involved in ongoing counter insurgency operations in East Malaysia. The magnitude and complexity of these operations would test the capacity of any government. Fortunately, Malaysian authorities were able to call on the technical resources and expertise of GIS professionals who were attending the Esri UC.

Esri and Esri Malaysia staff began assembling the materials needed to better understand the MH17 incident. Almost immediately, Brigadier General Sufian bin Ahmad and Col. Dr. Mohd Zambri joined Esri specialists and key partners, forming a team of multidisciplinary geospatial experts. They set up a temporary operations center at the Hilton Bayfront hotel in San Diego.



→ As Airbus Defence and Space tasked a satellite to perform imagery collection, the team quickly provided the raw imagery to analysts for comparison and to locate potential debris and infrastructure to support the response and investigation.

↳ By loading the nationalities of passengers, the team could locate and present the relevant embassies and consular services with information to assist families and government officials.

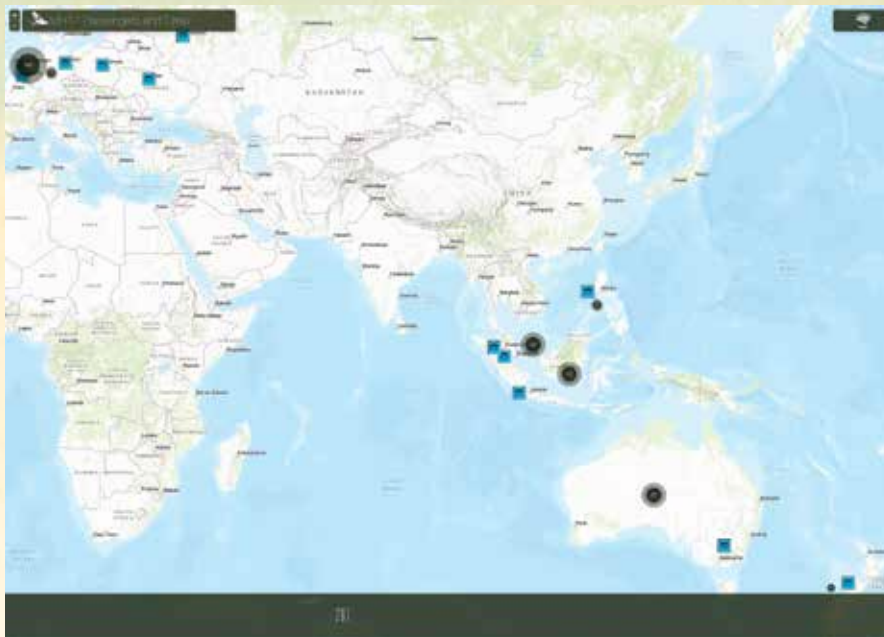
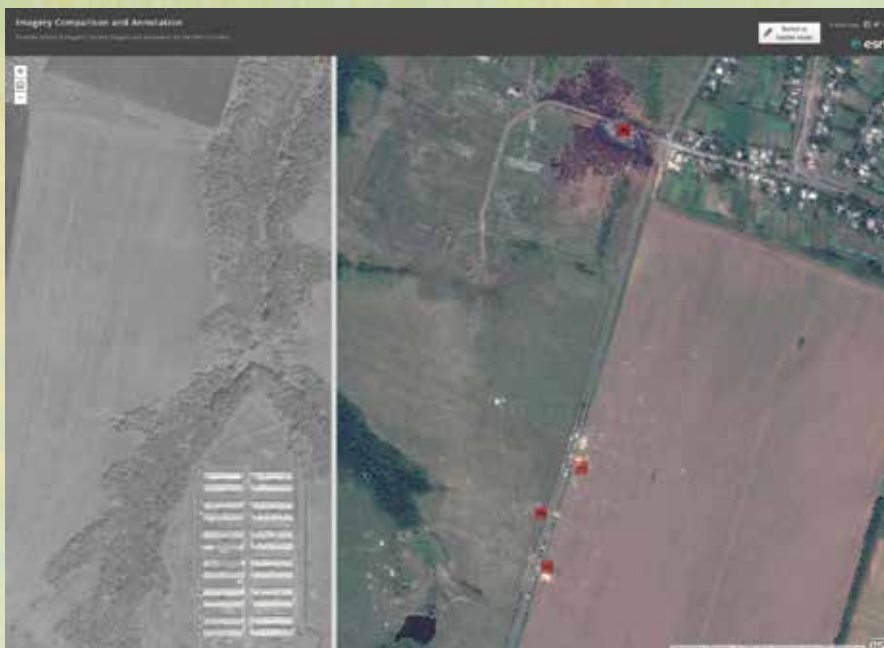
Over the next few hours in the operations center and in the following weeks in Malaysia, multiagency geospatial capability evolved. The central geospatial operations center was established in San Diego with an in-country support center at BGSP in Kuala Lumpur to support multiple stakeholders in the Malaysian government. Although this effort required coordination spanning the world, roles and responsibilities were rapidly assigned and senior users identified across the entire group.

Using ArcGIS Online, the group was quickly able to stand up the required response requested by the Malaysian government and provide useful information products from publicly accessible data. Esri business partners, such as Airbus Defence and Space, helped with data collection. All this was accomplished using only a web browser with an Internet connection. No other IT infrastructure was needed.

With this cloud-based system, the team could share work instantaneously. Existing data could be fused with current data to create new mapping layers to support the information products required. Because authoritative data sources were initially unable to provide up-to-date information, the team created a web application that accessed social media feeds from Instagram, Flickr, Twitter, and YouTube.

At first uncertain about the value of social media data, the team found that other users had published web maps and apps on the crisis. These provided the geographic context and the data that was needed. Searching ArcGIS Online using the keyword “Ukraine” produced useful information including the separatist regions of Ukraine and the languages spoken in those regions.

Within 90 minutes, the assembled team had established a site that provided the Malaysian Armed Forces with access to



“While we cannot minimize the tragedy of the downing of flight MH17, we are grateful for the support given to us from people throughout the world and particularly those connected with Esri’s efforts to provide us with critical intelligence.”

Brigadier General Ahmad Nasir
Director of Bahagian Geospatial Pertahanan

→ ArcGIS Online provided a capability for the team to build a demographic profile surrounding the impact site, divided into drive-time distances. Social media feeds, the only source of on-the-scene imagery and information available, were fused.

a common operational picture that included detailed Ukrainian mapping and demographics.

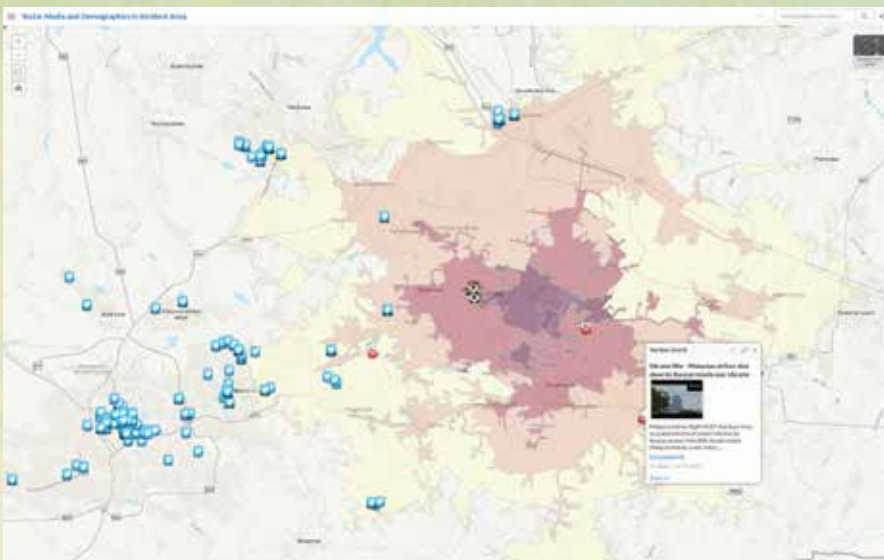
The team adopted an agile workflow to expedite the development process. This consisted of hourly sprints to accomplish simple tasks, a review of the completed work at the end of each hour, discussion and agreement on the next task, and continual user engagement. The team determined that users needed quickly developed special applications rather than data.

One of the first tasks was creating an application for locating the embassies and consulates of the 10 countries that had citizens aboard flight MH17 as well as the embassies of Ukraine and Russia. This application was widely shared with other nations and the Malaysian government so that it could be used to guide families and officials to their respective embassies for updated information.

A few days later, after finalizing the dashboard, uploading imagery data, and clearing up content, the team handed this work to BGSP for inclusion in its MH17 Response Portal. The portal contained historical information, geospatial data, and briefing materials to assist with the response and provide context for a better understanding of the incident.

This experience has influenced BGSP's capability development and how it now trains to support government. In addition, it proved that ArcGIS Online has the agility to aid responders to multiple, concurrent missions.

Brigadier General Ahmad Nasir concluded, "While we cannot minimize the tragedy of the downing of flight MH17, we are grateful for the support given to us from people throughout the world and particularly those connected with Esri's efforts to provide us with critical intelligence. It was surprising to see how quickly the team in San Diego was organized in a collaborative manner to collect the necessary data and provide us with comprehensive situational awareness."



Whether you're in a remote forest or standing on a manhole cover in a busy city, Trimble has powerful, practical ways for getting the highly accurate results you need. That's why Esri® users rely on Trimble products to get the job done.

See how Trimble solutions provide you with enhanced deliverables in ArcGIS®. Visit trimble.com/esriworkflows

TRIMBLE AND ESRI:
For wherever your project takes you

TRANSFORMING THE WAY THE WORLD WORKS





POP-UP WETLAND HABITATS

Benefit Migrating Birds and Farmers

By Christopher J. McColl, Conservation Analyst; Katie Andrews;
Mark Reynolds; and Gregory H. Golet, The Nature Conservancy

In response to the decline of wetland habitats for migrating and wintering water birds in California, The Nature Conservancy (TNC), an international conservation organization, has developed a program called BirdReturns. The program creates “pop-up” wetland habitat where and when birds need them most by enlisting farmers to flood their fields at specific times.



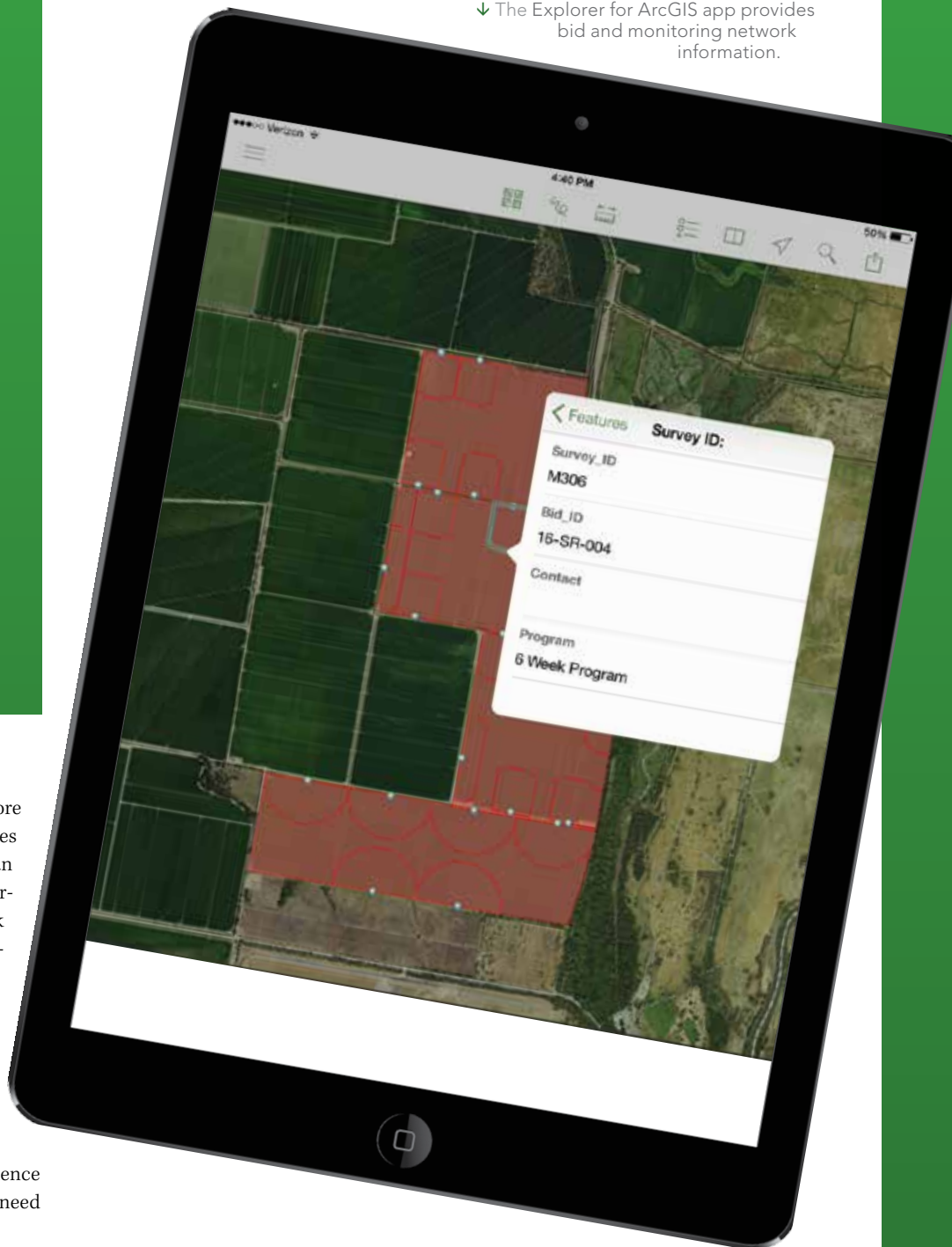
habitat with market tools to pay farmers to generate habitat.

How It Works

Working in partnership with Cornell Lab of Ornithology and Point Blue Conservation Science, TNC uses predictive models of water bird occurrence and abundance and

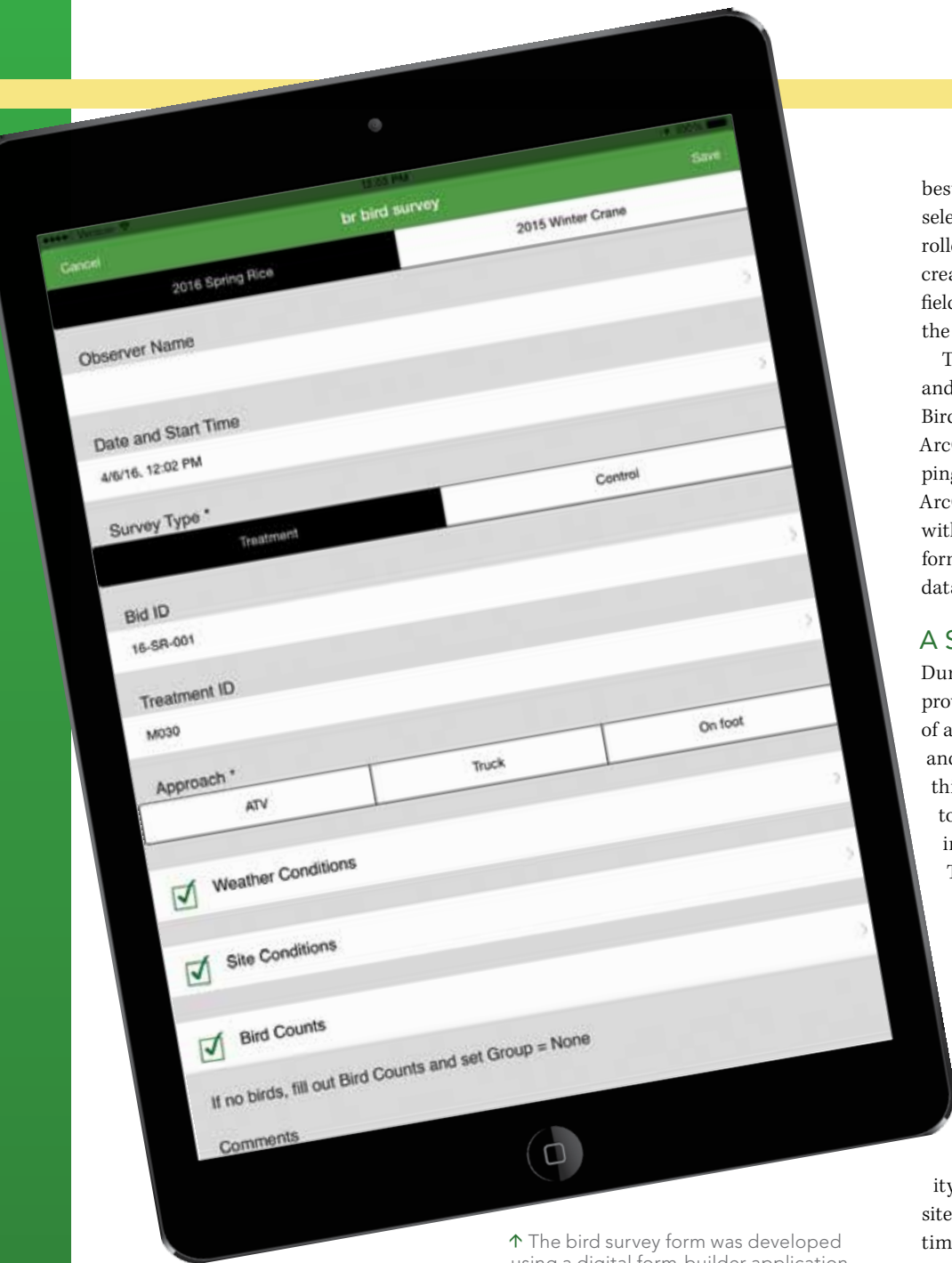
surface water availability to target times and places predicted to have high bird occurrences and abundances but lack habitat availability. Since piloting the program in the spring of 2014, BirdReturns has targeted shallow water habitat for shorebirds from February to March and from mid-August to October. These are time periods when

↓ The Explorer for ArcGIS app provides bid and monitoring network information.



California's Central Valley has lost more than 90 percent of the four million acres of wetlands that at one time supported an estimated 40 million wintering waterfowl. Birds now depend on a patchwork of refuges, protected areas, and farmland for their habitat needs.

Protected area strategies, such as buying land that could be restored to wetlands in perpetuity, can be prohibitively expensive, and the number of willing sellers is limited. BirdReturns is a complementary approach that combines precision science to pinpoint where and when birds need



↑ The bird survey form was developed using a digital form-builder application.

predicted shorebird needs are great but appropriate habitats may be in short supply.

Farmers are invited to participate in a reverse auction. They submit bids for the cost of providing habitat in two-week increments in spring or fall. TNC processes bids by geolocating each field and evaluating bids based on price per acre, predicted bird occurrence model scores, distance from refuges, protected areas and other bids, and other factors. The goal of the evaluation process is to provide the greatest value of high-quality habitat for the least cost. The bids with the

best conservation return on investment are selected. Farmers with winning bids are enrolled in a program that will pay them if they create the proposed habitat by flooding their fields. TNC monitors the habitat created and the number of birds that use the habitat.

TNC relies on a suite of geospatial, cloud, and mobile technologies to implement the BirdReturns program efficiently—from ArcGIS Online for collaborative web mapping and program design to the Explorer for ArcGIS app, which supports the field teams with an interactive mobile map, to digital forms that are used by field teams to collect data on mobile devices.

A Spatially Explicit Auction

During the reverse auction, bidding farmers provide information detailing the number of acres, cost per acre, location of the fields, and how long they would like to provide this habitat. An online web map is used to support the transfer of bid information into a GIS data layer using ArcGIS Online. TNC staff are able to work simultaneously, digitizing bid locations and verifying information provided by BirdReturns auction participants. The selection process is supported by analyzing various ecological metrics to identify the most competitive bids.

Metrics include distance to high-probability surface water, predicted mean abundance of shorebird species, predicted mean probability of shorebird species, probability of bid sites having surface water present during time-specific periods, and distance to airports. The bid GIS data layer is then used as a zonal layer to extract the various ecological metrics reflective of each bid location. The summary statistics are used to generate relative indexes to support the ranking of each bid.

The BirdReturns team reviews the bid locations via an ArcGIS Online web map application in conjunction with the ranked ecological metrics. The ArcGIS Online web map application provides an efficient method for team members, who are located in remote offices, to collaboratively review the data in real time and visually assess the field characteristics using Esri's online

imagery. They can quickly make determinations concerning which bids should be prioritized for further assessment.

Monitoring Response and Compliance

Once auction bids are selected, it is critical to determine the response of the shorebird populations to the newly created habitat. Which species are present, and what are their relative abundances over different temporal periods and site conditions? To answer these questions, avian monitoring technicians must visit each site and collect detailed information on bird use and site conditions.

Drawing meaningful conclusions from this data requires a statistically robust sampling design. TNC generated sample points using a Generalized Random Tessellation Stratified (GRTS) procedure that maximally disperses points to increase the probability that sample points are statistically independent and less likely to be biased. To achieve this, ArcGIS Online provides a mapping environment that supports field monitoring teams and is accessed using the Explorer for ArcGIS mobile app. The mobile web map includes data on bid locations, sampling point locations, associated monitoring zones (monitoring zones extend in a 200-meter radius from each sampling point), and aerial imagery. Armed with iPads, field monitoring teams are able to navigate to each monitoring location using Explorer for ArcGIS, which displays street names. Teams verify program enrollment, landowner, and sampling point information, accessing it from map pop-ups. They also install monitoring stakes and conduct bird surveys and site condition and compliance monitoring at recurring intervals.

Optimizing Bird Surveys

Historically, TNC—as well as most other organizations conducting field research and monitoring—has used paper surveys to record field observations. Once staff returned from the field the data was transferred to computer spreadsheets. However, there was strong interest in having this information recorded in a digital format from the onset of monitoring so that it could be uploaded to a central data location

Four Lessons Learned from the BirdReturns Project

The BirdReturns team learned a number of lessons through implementation that will improve similar efforts in the future.

1 It is critical to gain a thorough understanding of workflows prior to implementation.

When translating paper-based workflows to (primarily) digital format workflows, ensure that the digital versions meet the practical and logistical needs of all teams. This will require a significant amount of time, collaboration, and testing.

Meeting with field staff to clarify the logical progression of data recording steps is vital. These meetings are needed to understand the full range of constraints and conditions staff deal with in the field. This preparation allowed TNC to design mobile digital forms that were intuitive and would efficiently support fieldwork, not impede it. Meeting with managers to understand team information needs and timing was also critical to success.

Thoroughly understanding the teams' requirements in terms of data collection, management, and information flow paid significant dividends in the form of mobile workflows that were robust and easy to use. They required very little alteration during the survey season, thus minimizing disruptions to workflows and inconsistencies in data records.

2 Minimize data disruptions by leveraging systems that can seamlessly synchronize data updates while users continue through their workflow.

Using ArcGIS Online in combination with the Explorer for ArcGIS app allowed office staff to edit layers and web maps based on changing conditions, while field staff could rely on having the latest web maps.

3 Minimize the learning curve where possible.

Deploying apps on iPad minis and iPhones—devices that were already familiar—allowed the team to focus on learning specific apps.

4 Structure the workflow on multiple, independent apps to provide implementation flexibility and durability.

Do this instead of being locked into a single proprietary solution that can limit the ability to adapt to changing end-user needs. Using independent apps to address different data collection and management requirements resulted in a robust suite of tools that efficiently supported the BirdReturns work. Apps were selected based on their suitability for specific tasks as well as their interoperability with other technologies being used. This solution provided the development team with the flexibility to swap apps without destabilizing the overall approach.

accessible by the BirdReturns team.

This reduces time spent on data entry, as well as recording and transfer errors, while improving efficiency in the field and reducing the amount of material that field staff have to carry. To facilitate this, TNC used a form-building application that was cloud based but also allowed for data collection offline. Using this application, existing paper format bird survey documents were transferred into a series of logically linked, cascading digital survey forms.

Field staff verified bid location and sampling point ID numbers using Explorer for ArcGIS and selected this information in the digital survey form app. Once a bid ID is selected, the survey form app incorporates drop-down boxes that provide a list of monitoring IDs relevant to that particular bid ID. This functionality aids staff by improving the efficiency and accuracy of data recording. Field staff are then led through a structured workflow that enables them to quickly enter observations and save them to the iPad.

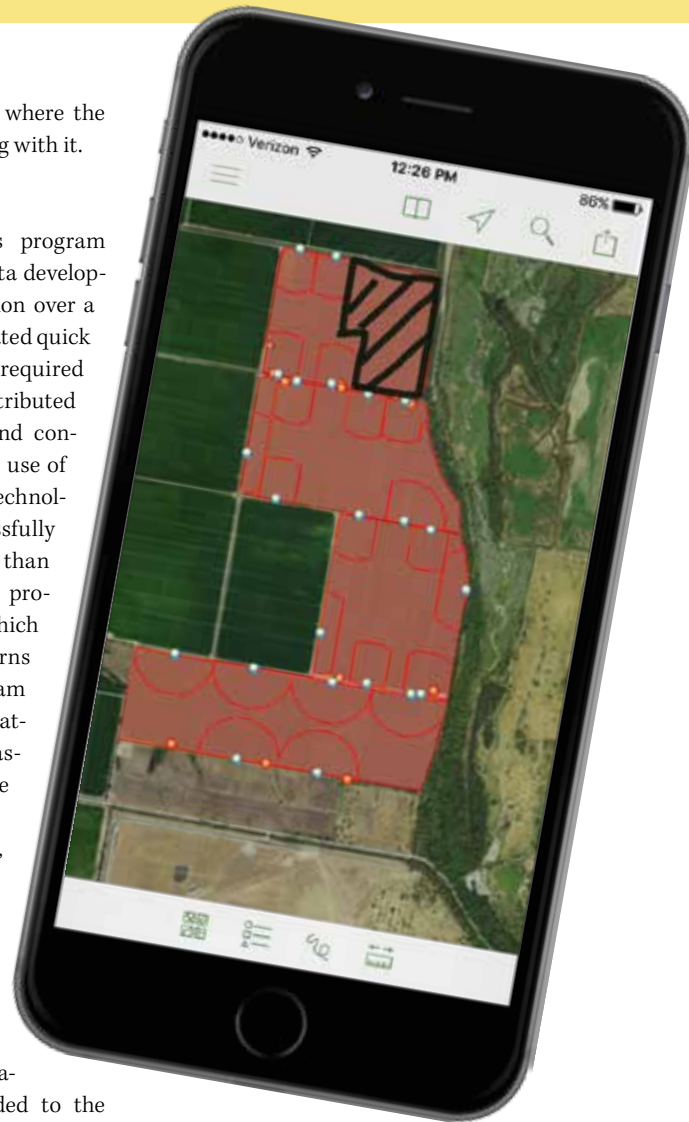
In addition to recording bird observations, monitoring teams review field conditions, such as water depth and the spatial extent of habitat, to determine auction contract compliance. The Explorer for ArcGIS app enables staff to quickly draw regions that were out of compliance, estimate acreage affected, and send screen captures from the devices back project management staff who can bring these fields into compliance. Once observations were recorded, staff members

send the data to cloud storage, where the BirdReturns team begins working with it.

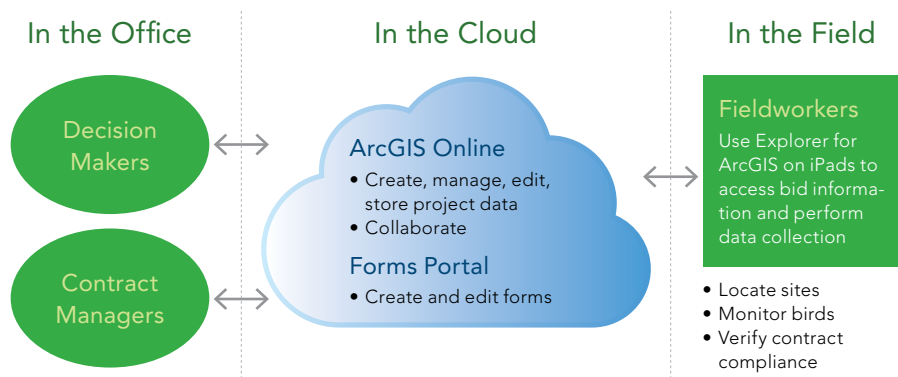
Conclusion

Implementing the BirdReturns program involved significant efforts in data development, management, and collection over a wide geographic area. It necessitated quick response to changes in data and required making the data available to distributed field teams, decision makers, and contract managers in the office. The use of cloud and mobile geospatial technology has allowed TNC to successfully implement five seasons (or more than two years) of BirdReturns. The program has grown each season, which is significant because BirdReturns will need to scale up the program to support the millions of migrating water birds that face increasing challenges in finding suitable forage habitat.

The BirdReturns program, which has completed over two years of implementation, has yielded more than 40,000 acres of temporary shorebird habitat at times that are critical to support migrating shorebird populations. Shorebird populations have significantly responded to the habitat, which has generated increased interest in scaling the program to provide habitat to additional regions within California and beyond. The utilization of a variety of mobile



↑ Field staff collecting information using the Explorer for ArcGIS app and digital form applications.



↑ Diagram of the BirdReturns system components

geospatial and data collection solutions enabled TNC to develop and implement a monitoring program that has improved in-field collection processes, reduced the turnaround time for data to be accessible for analytics, and provided an approach that is durable through time where various platforms can be easily replaced or supplemented with new technologies as they emerge.

For more information, contact Katie Andrews at kandrews@tnc.org

About the Authors

Chris McColl works in the Central Valley and mountain region of California. He has a bachelor's degree in environmental science from the University of Guelph in Ontario, Canada, and a master's degree in natural resources management from Central Washington University. His work focus includes habitat assessment and modeling, online mapping services and mobile applications, and drone technology.

Gregory Golet works in the Central Valley and mountain region of California. He has a bachelor's degree in biology from Bates College in Maine and a master's degree in marine sciences and a doctorate in biology, both from the University of California, Santa Cruz. Golet was a wildlife biologist for the US Fish and Wildlife Service before joining TNC in 2000. His areas of expertise include riparian systems and avian ecology, and he has extensive experience conducting research in marine and terrestrial ecosystems of California and Alaska.

Katie Andrews has a bachelor's degree in environmental studies from the University of Kansas and a master's degree in geography from the University of Utah. Andrews was a GIS specialist for the Bureau of Land Management before joining TNC in 2003 as a GIS manager. Her current areas of focus include designing, developing, and/or managing mobile, cloud, and web solutions for a range of conservation projects.

Mark Reynolds has a bachelor's degree in biology from the University of Iowa; a master's degree in biology from Idaho State University; and a doctorate in zoology

from the University of California, Berkeley. Reynolds has directed field research stations for the University of California, Natural Reserve System, and the California State University System and worked as a wildlife biologist for the US Forest Service before joining TNC in 2001. His research interests and publications have focused on conservation biology and ecology and the behavior of birds. He is adjunct professor of biology at San Francisco State University, where he also serves on the advisory board of the Romberg-Tiburon Center for the Environment.

snhu.edu | See Yourself Succeed

Southern New Hampshire University

GEOSPATIAL TECHNOLOGY IS ALWAYS EVOLVING. ARE YOU?

Advance your career in geospatial technology by learning the latest tools and software, including ArcGIS®, at Southern New Hampshire University. Our innovative online courses are affordable, flexible and designed to give you technical skills demanded by today's employers. **Find out more at snhu.edu/GIS.**

- Remote Sensing and Imagery Analysis
- Intro to Geographic Information Systems
- Geospatial Programming
- Spatial Awareness
- Geostatistics and Data Analysis

The BUSINESS IMPACT of GIS

Case studies from Utah

By Wade Kloos, GIS Director, Utah Department of Natural Resources

This article, the third in a series on GIS return on investment (ROI), provides ROI examples and offers a summary of findings after two years of using this ROI approach at the Utah Department of Natural Resources.

In an article in the Winter 2016 issue of *ArcUser*, I addressed the need for and benefits of documenting GIS results as well as the advantages of adopting the right ROI mind-set. In “Downsizing the ROI Report” in the Spring 2016 issue, I reviewed the target audience for ROI reports, shared a different approach to documenting ROI, and provided a one-page ROI and Benefits Report template that could be downloaded from the online version of the article.

The online version of this article has links to two reports created using the template. They are referenced in case you want to download them. Look at the ROI and Benefits Report for the Wildland Urban Interface (WUI) Project Geodatabase Compilation project carried out by the Division of Forestry, Fire, and State Lands (FFSL). The Executive Summary portion notes that not all the organization’s relevant information could be used to make decisions. The Tangible Benefits section of this same report describes how a repeatable method for producing more timely, higher-quality data is now part of the organization’s decision-support process.

Your leaders need to know the *bad* and the *ugly* of your current information and process limitations so they can accurately assess the *good* your GIS efforts are delivering. This report describes efforts to improve an outdated workflow. This problem is not an uncommon one for organizations, especially those with dispersed offices, multiple data editors, and an absence of data standards. This report also deftly describes the current and proposed workflows by describing

details that the GIS staff in other departments can understand, learn from, and then apply.

The 60 hours required by this project to clean and organize years of data reduced the original 10-hour, unstructured job that had a high risk of error to a 12-minute, easy-to-repeat task that had the added benefit of standardizing the data. The fact that the task was repeated numerous times throughout the year and produced both ROI and tangible benefits made this GIS enhancement a no-brainer.

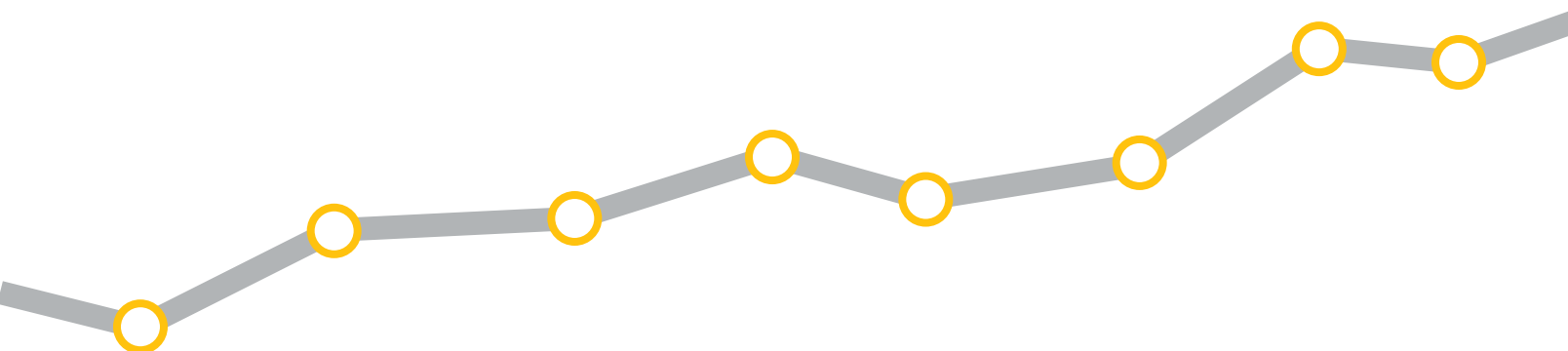
The measures of success at the bottom of this report are critical components of the report because they do two essential things. First, they describe the actions necessary to assess and validate the report’s initial assumptions. Even if leadership doesn’t ask for this information, the GIS professional should be compelled to discover these metrics. Second, the measurements provide expectations for the GIS professional, who should think in terms of business performance and accountability. As I stated in previous articles, ROI studies are not conducted enough in our discipline. If GIS managers don’t start having higher expectations for GIS staff performance, we will keep getting the same results.

The ROI and Benefits Report for the Statewide 3-D Stereo Model Acquisition project describes a project done by the Utah Geological Survey (UGS). I wanted to share this report for a very important reason. Its most notable benefit is cost avoidance, and that is the gift that keeps on giving.

As you can imagine, fieldwork constitutes a core activity of geologic mapping. This fieldwork, along with associated expenses for hotels, per diem, transportation, fuel, and labor, represents a significant cost of doing business for the UGS. By addressing these

Year	Projects	Hours Saved	Labor Cost Savings	Workflow Improvement
2014	19	9,094	\$185,000	75%
2015	12	9,996	\$255,000	76%

↑ Table 1: ROI benefits



costs, this workflow enhancement hits a bulls-eye for the division's bottom line. The streamlined, in-house process for creating highly accurate and standardized geologic data not only reduced the need for fieldwork—and the time and expense it requires—but also helps accelerate the completion of the division's key deliverable: geologic information products. The tangible benefits listed in the report deliver considerable gains to the organization as well as universities and the public.

The UGS example also highlights the fact that even though the ROI calculation may be relatively low, GIS projects like this one can manifest so much positive benefit that an ROI value of some number of dollars can't reveal all of a project's contributions. For example, that \$85,000 of cost avoidance keeps helping the division year after year. Even if the ROI was zero, or initially negative, this project suggests that the workflow improvements are still worth pursuing. Please try not to place too much emphasis on a project's ROI value. Always look deeper into the way business operations can improve and what can come from those improvements. This was the mindset behind naming the report the ROI and Benefits Report.

It should be noted that the ROI calculations in the template include the entire cost of the workflow so as to be reflective of all costs required to perform a given task. This produces more conservative ROI numbers. If only the cost associated with the GIS enhancement was considered in isolation, the ROI would be considerably higher. For example, using the formula *savings* minus *enhancement cost* divided by *enhancement cost* would generate a future annual ROI of 459 percent for the UGS project compared to the 45 percent shown.

I want to thank Sean Edwards of FFSL and Kent Brown of UGS for allowing me to share their ROI and Benefit Reports and for their excellent work in documenting their results. So far, Utah DNR has completed more than 30 ROI and Benefit Reports in the last two years, and the cumulative statistics gathered from tracking GIS ROI and benefits are shown in Table 1.

To convey the business benefits delivered as part of DNR's GIS results documentation effort, I summarized our deliverable benefits (shown in Table 2 on the next page) and distributed this information to our department and division leadership.

"We've asked our GIS staff to document the Return on Investment that has come about from our focused investment in GIS. I am pleased and somewhat surprised by the magnitude of the GIS contribution to our Department of Natural Resources. There is a documented, significant reduction in labor, and a significant increase in cost avoidance in our GIS delivery. We feel rewarded for searching out and embracing new ideas that push our old limits of comfort."

Mike Styler, DNR Executive Director

These examples of ROI and Benefit Reports will help you understand how GIS projects can improve organizational operations and realize the value of those improvements to the organization. I hope you can also appreciate not only the reasonable level of effort required to complete the abbreviated documentation of results required by the ROI and Benefits Report, but also how uniquely positioned GIS is to transform your organization's business processes.

Benefit	Example 1	Example 2
<p>Revenue Growth</p> <p>If information and access to it impact revenue, how can GIS do more to get this information in the hands of others?</p>	¹ (FFSL) Geographically locating leases helped identify and analyze existing and future lease opportunities as well as delinquent leases.	⁵ (DWR) Web maps that convey timely and pertinent hunting and fishing information encourage these activities and the purchase of licenses.
<p>Cost Reduction</p> <p>It may be possible to automate a process or restructure it to take advantage of the superior data organization or analysis capabilities of GIS.</p>	³ (DWR) Labor-intensive planning processes dependent on multiple meetings or public hearings, printed maps, and data editing workflows (like the water budget plan) can be performed with less labor via more efficient interactive web maps.	(DWR) When tasks must be repeated many times a year, GIS can automate certain steps in the workflow, thereby saving time and money not just once but many times.
<p>Cost Avoidance</p> <p>Just because a task has always been done a certain way does not mean that must continue if there is a better way (with GIS or without GIS).</p>	⁶ (UGS) When information from the field must be collected, understood, and recorded, spatial data and aerial imagery (in this case, 3D stereo imagery) can be leveraged in the office to reduce the amount of fieldwork required and its associated cost.	(DWR) When multiple regional offices are required to share up-to-date information on statewide wildlife conditions, interactive and editable web maps can reduce or eliminate travel expenses.
<p>Increase Efficiency and Throughput</p> <p>A faster or more accurate way to do business leads to greater efficiency. If this also increases a critical deliverable of your division, it's a double win.</p>	(DWR) Evaluating water reservoir location options can require significant calculations. GIS can automate spatial analysis functions so that more sites can be studied in less time, thereby supporting the delivery of timely and high-quality engineering throughput.	(FFSL) Sometimes a program's throughput is data-driven decisions, such as a yes/no determination for a lease or change application. GIS can combine operational data with other data, creating a solution that enables faster, more accurate decision making.
<p>Save Time</p> <p>How much faster can a process be carried out with GIS?</p>	⁷ (DOGM) To ensure that actual activity is in compliance with issued permits, GIS can convert documentation of conditions and legal descriptions into spatial features that can be checked against field observations.	(DOGM) A GIS request form creates a standard process that provides non-GIS staff who request maps or analysis with realistic expectations of the process. This reduces need for reworking maps.
<p>Improved Effectiveness</p> <p>To be effective, a division must be both efficient and accurate. Good data that enables interpretation, insight, and communication is at the heart of what GIS staff can do.</p>	(FFSL) GIS can enable better planning and more effective use of resources by tracking project locations in programs that involve the implementation of numerous projects dispersed over large areas (such as FFSL's Wildland Urban Interface projects).	(DWR) When research into other division or department databases is needed, GIS can be used to integrate that data into easy-to-use web maps that can be overlaid with operational data for context. This allows faster research, fewer errors, and greater efficiencies.
<p>Increased Customer Service</p> <p>How can GIS be leveraged to cast your division in a better light to your key stakeholders?</p>	⁴ (DWR) When requiring information from the public concerning location, GIS can validate and provide accurate spatial information, eliminating errors that lead to delays in processing or customer care.	(DWR) Whenever there are several spatially defined activities, such as hunt boundaries, GIS can deliver this information in an easy-to-view web map that allows customers to interact with the data so they can find the information they need.
<p>Lower Risk</p> <p>What's the cost of a wrong or delayed decision? Does your division rely too much on the institutional knowledge held in the heads of a few key people? Examining your risk exposure and methods to leverage data and spatial analysis can be effective ways to lower existing division risk.</p>	(DOGM) Understanding what is permitted is critical to enforcing compliance. Having this information in a GIS rather than paper documents saves time, creates actionable intelligence, and produces greater compliance and lower organizational risk.	(DOGM) Knowing where risks are most prevalent can guide how and when division work gets done. GIS can be used in the office to guide planning activities as well as in the field to make urgent decisions.

↑ Table 2: The business benefits of GIS to individual divisions in Utah DNR

¹Division of Forestry, Fire and State Lands (FFSL); ²Division of Oil, Gas and Mining (DOGM); ³Division of Water Resources (DWR); ⁴Division of Water Right (DWR); ⁵Division of Wildlife Resources (DWR); ⁶Utah Geological Survey (UGS)



TECHNOLOGY TO CONNECT,
INFORM AND PROTECT™

ENVI® Analytics in the Cloud

Quickly access cloud-based analytics
from web and mobile applications

TRANSITION YOUR IMAGE ANALYTICS TO THE CLOUD

Harness the processing power of the cloud to quickly get from data to decisions. ENVI® products work seamlessly within any ArcGIS® environment. When everyone from your organization can access and share geospatial analytics and products, they make quicker, more informed decisions regardless of geographic location.

harrisgeospatial.com/cloudanalytics

©2016 Exelis Visual Information Solutions, Inc., a subsidiary of Harris Corporation.
All rights reserved. All other marks are the property of their respective owners.

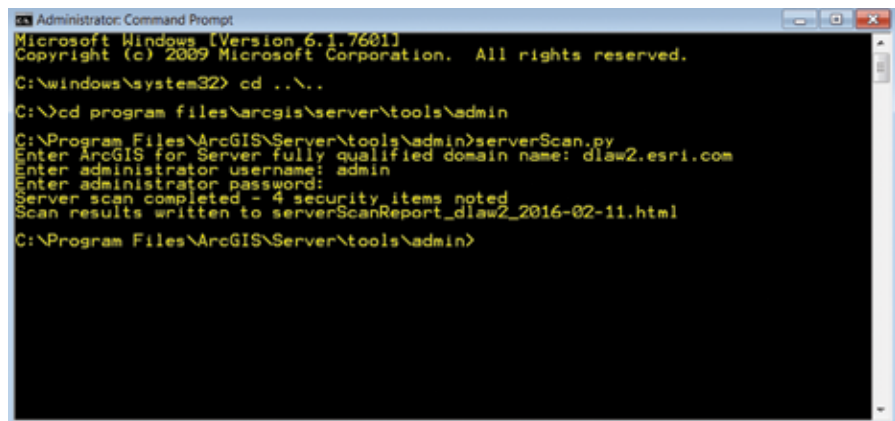


Apply Security Best Practices to an ArcGIS Server Site

By Derek Law, Product Manager, ArcGIS for Server

The new command line tool called `serverScan.py` is one of the many enhancements in ArcGIS 10.4 for Server. It scans your ArcGIS Server site and checks to see whether it has been configured following the security best practices recommended by Esri. After the tool executes, it returns a report that lists all the recommended actions that you can apply to make your ArcGIS Server site more secure so that it will better protect your data and GIS web services. This tip shows you how to run the `serverScan.py` tool and interpret the results in the report it generates.

This tool is written in Python and can be found in the ArcGIS Server installation directory (<installation location>\arcgis\server\tools\admin). In a default ArcGIS Server installation, it is located at C:\Program Files\ArcGIS\Server\tools\admin. (Note: ArcGIS for Server is the product name. This tip only applies to the GIS server [ArcGIS Server] component of ArcGIS for Server. Although it is meant to work with ArcGIS 10.4 for Server, it can be applied to server sites for ArcGIS 10.3 for Server. Portal for ArcGIS 10.4 also includes a new command line tool called `portalScan.py` that performs a similar best practices security check on your Portal.)



```
Administrator: Command Prompt
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\windows\system32> cd ..\..
C:\>cd program files\arcgis\server\tools\admin
C:\Program Files\ArcGIS\Server\tools\admin>serverScan.py
Enter ArcGIS for Server fully qualified domain name: dlaw2.esri.com
Enter administrator username: admin
Enter administrator password:
Server scan completed - 4 security items noted
Scan results written to serverScanReport_dlaw2_2016-02-11.html
C:\Program Files\ArcGIS\Server\tools\admin>
```

↑ A new tool called `serverScan.py` runs from the command line and helps you follow Esri best practices for enabling security.

Step 1

Open a new command prompt window on your server computer. Ensure that you have the appropriate administrator privileges on the computer.

Step 2

In the command prompt window, navigate to the ArcGIS Server installation directory. Then navigate to the admin folder in the Tools directory. For example, in a default ArcGIS Server installation, the tool is located in C:\Program Files\ArcGIS\Server\tools\admin.

Step 3

Run the `serverScan.py` tool. Before it executes, it will prompt you for three input parameters: the ArcGIS server machine fully qualified name, the GIS server site admin login, and the GIS server site admin login password.

For Example

```
<Server_machine_name>.<domain>.com
<Admin login name>
<password>
```

Step 4

After you enter the last parameter, hit Enter, and the serverScan.py tool will run. The serverScan.py tool generates a report written in HTML format. By default, the report will be named verrScanReport_<machine name>_<dategenerated> and will be stored at the same location where the tool executed—in this case, in the admin folder.

Step 5

Open Windows Explorer and navigate to the report's location. In this example, the location is C:\Program Files\ArcGIS\Server\tools\admin.

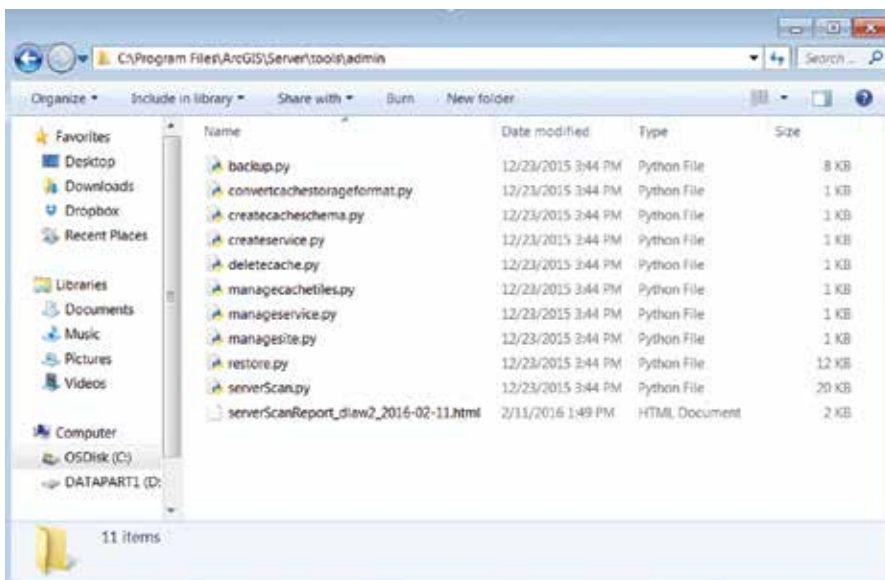
Step 6

Double-click to open the report in a web browser and view its contents. Notice that each reported item has a unique ID, is categorized based on the severity of the issue, and includes a name and description. The report recommends parameter settings you can set and/or adjust in your ArcGIS Server site so that you can make it more secure.

Step 7

Review the report results and check them against the ArcGIS for Server online help topic "Scan ArcGIS Server for security best practices." This help topic describes each of the 12 Esri security best practices for an ArcGIS Server site. You have the option to apply all, some, or none of these to your site. The more best practices you apply, the more secure your ArcGIS Server site will be.

See how easy it was to check that your ArcGIS Server site was properly configured following the Esri best practices for enabling security? For more information on securing your ArcGIS Server site, see the help topics "Configuring a secure environment for ArcGIS Server" and "Best practices for configuring a secure environment."



← The output from serverScan.py will be stored in the same location where the tool executed. In a default installation, that will be the admin folder.

↪ Open the report in a web browser to view descriptions of issues and suggestions for improving security.

Large Format Printing & Laminating

We Ship
Anywhere!

Mapping Specialists®

Phone 608.274.4004 Toll Free 866.525.2298
info@mappingspecialists.com
www.mappingspecialists.com

ArcGIS for Server Security Scan Report - 2016-02-11

dlaw2.esri.com

Potential security items to review

<u>Id</u>	<u>Severity</u>	<u>Property Tested</u>	<u>Scan Results</u>
S806	Important	Cross-domain requests	Cross-domain requests are unrestricted. To reduce the possibility of an unknown application sending malicious commands to your web services, it is recommended to restrict the use of your services to applications hosted only in domains that you trust.
S807	Important	Rest services directory	The Rest services directory is accessible through a web browser. Unless being actively used to search for and find services by users, this should be disabled to reduce the chance that your services can be browsed, found in a web search, or queried through HTML forms. This also provides further protection against cross-site scripting (XSS) attacks.
S811	Recommended	PSA account status	The primary site administrator account is enabled. It is recommended that you disable this account to ensure that there is not another way to administer ArcGIS Server other than the group or role that has been specified in your identity store.
S810	Recommended	Web adaptor registration	One or more web adaptors are registered over HTTP. To allow Server Manager to successfully redirect to HTTPS, all web adaptors should be registered over HTTPS.

The Top 10 Takeaways from the Esri Developer Summit

If you missed this year's Esri Developer Summit (DevSummit) in Palm Springs, California, Esri development team members have compiled a list of the top technology takeaways from the event.

The Plenary Session and technical sessions were packed with useful information about current projects Esri is working on that will help geospatial app developers, whether they want to use off-the-shelf or configurable apps or create native apps. "We intentionally engineer virtually every aspect of the ArcGIS platform to be accessible to developers," said Jim McKinney, Esri ArcGIS program manager.

1 ArcGIS API 4.0 for JavaScript

ArcGIS API 4.0 for JavaScript gives developers a completely new API that helps them create better apps with less effort. It's a simpler, more consistent API design with tools to create web apps that use modern browser capabilities and provide a great user experience. For example, you will be able to render a map with a 2D or 3D view (or both) with minimal code. Developers can author 3D maps, save them as web scenes, and load them into the app using the web scene ID. *[To learn more about this release of the API, read "Six Reasons You Should Use the ArcGIS API 4.0 for JavaScript" in this issue.]*

2 Quartz Release of the ArcGIS Runtime SDKs

Esri will soon release the final version of the ArcGIS Runtime SDKs, a version called *Quartz*. Use ArcGIS Runtime SDKs to add full GIS capabilities to native apps on any platform and in your development language of choice. With Quartz, you can author and edit maps and share them with your organization. You can use mobile map packages to bring offline capabilities to your apps by packaging maps, layers, and data. The authentication process is smoother with portals, and you will be able to more easily retrieve the content and items. ArcGIS Runtime SDKs are also providing a number of options for cross-platform development using Xamarin, Java, and Qt/QML that will help get your apps to market faster.

3 Vector Tile Maps

The use of vector graphics in basemaps results in excellent display on high-resolution devices. Since drawing is done on the client, vector tile maps can be restyled for different appearances for your mapping applications.

4 ArcGIS Pro SDK 1.2 for the Microsoft .NET Framework

The release of ArcGIS Pro 1.2 in the first quarter of 2016 was accompanied by an update to ArcGIS Pro SDK 1.2 for the Microsoft .NET Framework. ArcGIS Pro is a 64-bit application that comes with ArcGIS for Desktop and can be installed and run on the same machine. ArcGIS Pro SDK 1.2 for Microsoft .NET Framework is a new, modern SDK for extending ArcGIS Pro. It uses the add-in extensibility framework, which will be familiar to developers currently working with ArcGIS for Desktop at 10 or later releases. Unlike ArcGIS for Desktop add-ins, ArcGIS Pro SDK 1.2 for the Microsoft .NET Framework gives developers the ability to write a single add-in that works in both 2D and 3D environments. With ArcGIS Pro SDK 1.2 for the Microsoft .NET Framework, developers can integrate ArcGIS Online and Portal for ArcGIS access into add-ins as well as APIs for the geodatabase, editing, maps, layers, animation, layout, content, and geometry.

5 3D Mapping—Web, Runtime, and ArcGIS Pro

3D capabilities are continually added to the ArcGIS platform. Significant qualitative and quantitative improvements have been made in two areas: visualization and analytics. 3D scenes created in ArcGIS Pro can be shared using the ArcGIS Online web scene. Full support for 3D mapping in apps built using Web AppBuilder for ArcGIS will be available later this year.

- A 3D web app created using Web AppBuilder for ArcGIS.
- Insights for ArcGIS displays crime statistics via a heat map, a graph, and a chart.

6 Python in ArcGIS

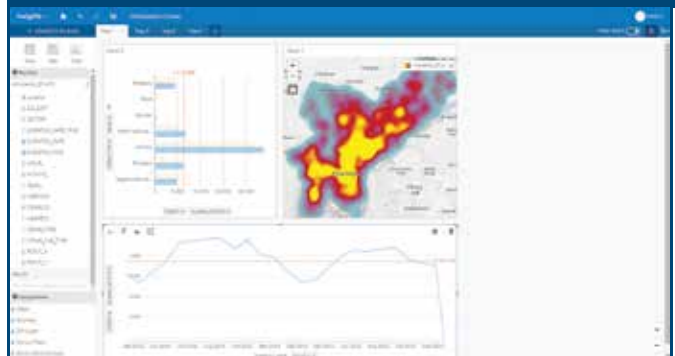
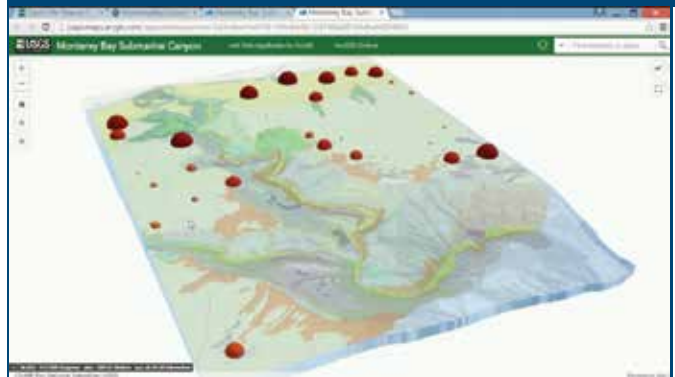
Continuing support for Python and the scientific community, Esri is adding a number of Python libraries, including the netCDF4 library for using multidimensional data, SciPy to perform scientific computation, and pandas to make it easier to conduct data analysis. Esri plans to also make it easier for Python users to find and use compatible Python libraries within ArcGIS by using Conda, an industry-standard build and distribution framework. This will ensure that Esri's libraries and the standard scientific libraries are always compatible.

7 Create Web and Native Applications Using Builders

Want to get the apps you build into users' hands more quickly? Esri offers a variety of web and native app builders that will help you meet that goal. Web AppBuilder for ArcGIS is an intuitive what-you-see-is-what-you-get (WYSIWYG) application that lets you build responsive web apps that run on any device. You can also use an extensible framework for creating custom widgets and themes. Fully functional, cross-platform native apps can also be built with AppStudio for ArcGIS. You can convert your web maps into beautiful, consumer-friendly mobile apps that are ready for Android, iOS, Windows, Mac OS X, and Linux and then publish them—using your own brand—in all the popular app stores. Esri also announced the release of the source code for Esri's Survey123 for ArcGIS app, which was built using AppStudio for ArcGIS.

8 Big Data Analytics

Analytics will be a major focus in 2016. Esri will release powerful analytic capabilities in Insights for ArcGIS. Based on a new paradigm, Insights for ArcGIS will give users new ways to explore, interact with, and analyze data. Big data analytics is a new generation of analytic engines available in the ArcGIS platform for working with big data that will have feature and raster analysis capabilities, exposed via tools that can work against big data that might be spatial or spatiotemporal in nature. Using high-performance distributed computing technology and a new Spatiotemporal Big Data Store, GeoAnalytics will present results more quickly. Look for improved real-time GIS capabilities, such as the ability to ingest large volumes of observation data, perform data stream analytics, visualize observations, and archive spatiotemporal data for further batch analytics. ArcGIS also makes these capabilities available for automation through Python scripting.



9 Open Data Initiative

ArcGIS Open Data was launched to easily allow organizations to share their authoritative data and give developers a way to find data to build awesome and useful apps. Currently, the site contains more than 40,000 datasets related to everything from air quality to water use. New, simplified tools and powerful capabilities are being added to ArcGIS Open Data to make it easier for developers to discover content and build apps with that content.

10 A New ArcGIS Subscription for Developers

A new, more flexible way to obtain developer tools for the ArcGIS platform will soon be available. A restructured subscription will simplify how developers use ArcGIS to build apps and extend the platform. Currently, developers can choose between two separate subscriptions: Esri Developer Network, an annual subscription for developer licenses for ArcGIS for Server, ArcGIS Engine, and ArcGIS for Desktop, and the ArcGIS for Developers subscription, for use with ArcGIS Online. A new, single-developer subscription model will merge those two into one. This model offers different plans so you can tailor your subscription to the technologies that you use rather than a one-size-fits-all approach that charges you for products you don't need. Details about this new subscription model will be shared later this year.

A Force for Good

Geospatial app developers are “Great, bright lights” for positive change

By Carla Wheeler, ArcWatch Editor

Esri president Jack Dangermond told an audience of app developers that the geospatial solutions they are building today are a “positive force” for solving the problems faced by society and their organizations.

“The world is not in a good place right now, don’t you agree?” Dangermond said in his opening remarks to attendees of the

2016 Esri Developer Summit (DevSummit) in Palm Springs, California. “If you look at the challenges that we are facing—from climate change to social conflict to the need to be more efficient in our organizations to overpopulation—it’s daunting. One of the great, bright lights for me is actually you and your creativity and your ability to

take this technology—GIS—and leverage it into solutions that address these kinds of challenges.”

Dangermond also touched on the swift technological advances that will drive geospatial app creation in the future.

“This is an amazing year for Esri, and I hope it’s an amazing year for you,”



“You can count on me, and you can count on everybody at Esri to support you and what you do.”



Dangermond said. “The platform—from my experience and my 50 years of doing this kind of work—there’s never been anything like it. The opportunity to extend and expand and be creative with the kinds of tools that are coming down the pathway and are already here is unparalleled.”

As a 2006 *ArcUser* article noted, Esri launched the DevSummit with three goals in mind: to gather feedback from developers so that Esri could better support them, to share information, and to build a GIS development community. The DevSummit has stayed true to those goals over the past decade, helping thousands of developers create their own apps for their organizations by using Esri technology.

“This is an extendable and open architecture by design for developers,” Dangermond said. “We design it as a platform that’s extendable and interoperable and standards based for our own use and, at the same time, document it and make it available for developers like yourselves to extend and leverage.”

Dangermond also told developers to do more than drink from the fire hose of “awesome technology” during the summit. He encouraged them to meet new people and bounce ideas off each other.

“I don’t know how you learn, but the way I learn is through friendship,” he said. “How do you interpret [new information]? It’s really through other people’s experiences and sharing. I want you to build and reinforce this as a community, a friendship network that you can count on. You can count on me, and you can count on everybody at Esri to support you and what you do.”

Esri® Hardware and Data Offerings

For all your ArcGIS® needs, Esri has the solution for you.

Take advantage of our cost-effective solutions to configure or upgrade your geographic information system (GIS). Esri works with leading hardware vendors to provide server, desktop, mobile, and data products that are prepackaged with ArcGIS software. Custom hardware-only configurations are also available for existing Esri customers.



For more information, visit esri.com/hardware.

Copyright © 2015 Esri. All rights reserved.

SIX REASONS

You Should Use ArcGIS API 4.0 for JavaScript

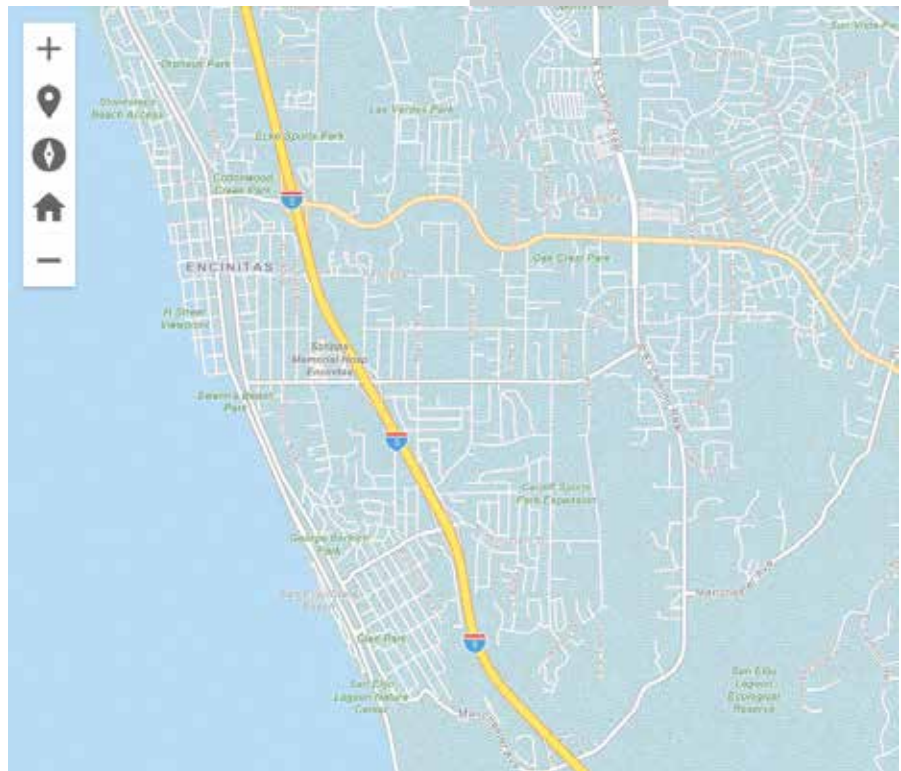
By Julie Powell, Esri Product Management

Since 2008, developers have used ArcGIS API for JavaScript to build powerful web mapping applications. With the release of version 4.0 of the API, you now have a completely new API that has been rearchitected so that you can visualize your data in 3D, easily integrate with your web GIS, and build a great user experience—all using a simple and consistent API.

Its clean design and cutting-edge capabilities bring forward the most useful aspects of the 3.x API but also enables you to build compelling web apps with 3D visualization. Not all the 2D capabilities of the 3.x API will be available with the initial release. For example, time-enabled layers and Open Geospatial Consortium, Inc. (OGC), layers and editing will be available in later releases of the 4.0 API. Esri will be rapidly evolving the new API so that it not only achieves parity in terms of features with the 3.x API but introduces new capabilities.

Here are six aspects of ArcGIS API 4.0 for JavaScript that you can use today to help you build better apps with less effort.

→ You can more easily create new widgets and repurpose existing widgets with any third-party framework such as Bootstrap, React, or jQuery. (React shown here.)



1 Make a 3D map as easily as a 2D map.

With the introduction of map views, developers can render a map with a 2D view or a 3D view (or both) with just a few lines of code. Working with a 3D view is much like working with a 2D view. For example, both views have a unified approach for working layers, renderers, tasks, geometry, symbology, pop-ups, and navigation, but 3D adds 3D-specific concepts such as environment (atmosphere and lighting) and the camera. Compare the code for creating a 2D view and a 3D view shown in Listing 1.

Create a 2D view

```
var map = new Map({
  basemap: "streets"
});

var view = new MapView({
  container: "viewDiv",
  map: map,
  zoom: 4,
  center: [15, 65]
});
```

Create a 3D view

```
var map = new Map({
  basemap: "streets"
});

var view = new SceneView({
  container: "viewDiv",
  map: map,
  zoom: 4,
  center: [15, 65]
});
```

↑ Listing 1: Creating a 2D view and a 3D view

Many developers have adopted the pattern of authoring a web map in ArcGIS Online and Portal for ArcGIS and consuming it in an app. They create beautiful visualizations of their data, configure pop-ups, and set up bookmarks, then load the map into their app by simply referencing the web map's ID. This is a huge time saver.

With the 4.0 API, you can follow the same pattern with 3D maps using web scenes. This is accomplished by styling your map in ArcGIS Online or Portal for ArcGIS, saving it as a web scene, and then loading it in your app using the web scene's ID.

```
/* *****
 * Create the scene using the web scene's item ID
 * ***** */
var scene = new WebScene({
  portalItem: {
    id: "affa021c51944b5694132b2d61fe1057"
  }
});

/* *****
 * Create the 3D view using the web scene.
 * ***** */
var view = new SceneView({
  map: scene,
  container: "viewDiv"
});
```

↑ Listing 2: Loading a web scene using its ID

2 Author, manage, and mash up layers using layer items ... all with minimal code.

Layer items are similar to web maps in that they allow developers to set up initial extent, rendering, filtering, pop-ups, and other settings. In contrast to web maps, which consist of the entire map, layer items represent individual map layers. This allows you to choose the individual layers needed for each application. If you are developing in a team environment, others can also consume your layers, which are represented in a meaningful and consistent way. The 4.0 API lets you load layers by referencing the layer item's ID. Listing 3 shows an example of how a layer can be loaded using the layer item.

Note: Not all 2D layer capabilities are supported in the initial 4.0 release.

```
// Creates a layer from a Portal layer item id
Layer.fromPortalItem({
  portalItem: {
    id: "af1ad38816814b7eba3fe74a3b84412d"
  }
}).then(function(lyr) {
  // Adds layer to the map
  map.add(lyr);
});
```

↑ Listing 3: Loading a layer item



→ With the 4.0 release, pop-ups are responsive and adapt to the screen size used. Pop-ups are also dockable and can have action buttons such as the mail button shown,

3 Build a great user experience.

The API was designed to give you the tools to build an app that has a polished user interface and responsive design. Widgets, flexible UI placement, and control over the map view are a few of the capabilities in this new API that will help you build a user-friendly app suitable for any device.

Widgets are the UI building blocks. API widgets have been built from the ground up with a clean user experience adaptable for any screen resolution. Widgets can be easily placed in one of the corners as shown in Listing 4 or offset from the edge. Relative placement of UI elements helps accommodate multiple screen resolutions.

```
// Add the home widget to the top left corner of the view
view.ui.add(homeButton, "top-left");
```

↑ Listing 4: Placing a widget

You can use API widgets as-is or style them using CSS to change specific aspects of the widget such as button color as shown in Listing 5.

```
.esri-widget-button {
  color: #DD8888;
  background-color: #000000;
}
```

↑ Listing 5: Styling a widget button using CSS

Controlling the map view is important. If you need the map to fill only a portion of the screen so that a menu or other UI element occupies the rest of the space, you will want to keep a particular extent centered on the screen. Using view padding, you can make the map center or extent work off a subsection of the full view. As the screen size changes, your map will be centered relative to the location you specified.

4 Benefit from a simple and consistent API.

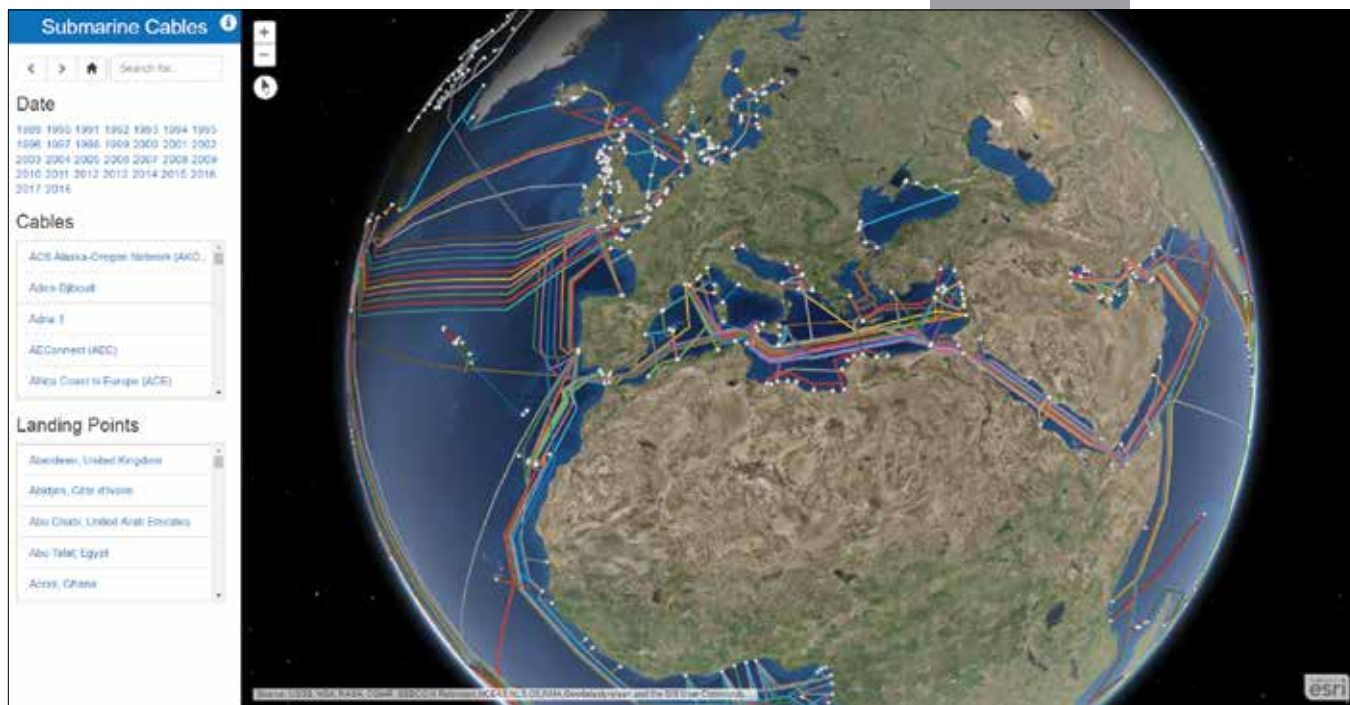
The 4.0 version of the API introduces an improved developer experience with a cleaner implementation. For example, working with properties is more straightforward. In the past, you often had to use methods to get or set property values. Only sometimes could you set property values directly. In the 4.0 version, you can consistently set all properties within the constructor or directly in the property itself. Because the API is more consistent in this way, the documentation can focus on describing the purpose of each property rather than on how to get and set it.

In the example in Listing 6, the `SimpleMarkerSymbol`'s properties are simply set in the constructor. The 4.0 API also introduces a new concept called autocasting, which takes the values passed in these properties and instantiates the typed objects internally within the API. The example illustrates how you don't have to explicitly create a new `SimpleLineSymbol` for the `SimpleMarkerSymbol`'s outline. Thanks to autocasting, the `require` statement for the `esri/symbols/SimpleLineSymbol` module is not needed.

```
require([
  "esri/symbols/SimpleMarkerSymbol"
], function(
  SimpleMarkerSymbol
) {
  var symbol = new SimpleMarkerSymbol({
    style: "diamond",
    color: [255, 128, 45], // No need to write new Color()
    outline: { // No need for new SimpleLineSymbol()
      style: "dash-dot",
      color: [255, 128, 45] // Again, no need for new Color()
    }
  });
});
```

↑ Listing 6: Setting properties in the constructor

There is also a consistent approach for watching for property changes. In previous versions of the API, property changes were handled with events. Using the documentation, developers had to figure out which event to listen to determine when a particular property changed. With the 4.0 API, monitoring for property changes has become much easier because all properties can be watched via the `.watch` method (property, callback). The callback is called each time the property changes and allows you to work with the property's new value, old value, and name along with the watched object. You only have to learn and remember the essential classes and properties to work with the API.



↑ With map views, developers can render a map with a 3D view using just a few lines of code, such as this map showing submarine cables.

5 Have it your way with tooling.

All widgets in this new version of ArcGIS API for JavaScript have been reengineered to enhance their extensibility and customization. Each widget's presentation is now separate from its properties, methods, and data. You can use widgets as-is, style them with CSS, or completely customize the UI. While the API is built on Dojo, its widgets are not entirely dependent on Dojo's Dijit framework. The separation of core logic and presentation lets you more easily create new widgets and repurpose existing widgets with any third-party framework such as Bootstrap, React, or jQuery.

When working on complex solutions—such as enterprise apps—you may want to integrate the JavaScript API into a third-party framework such as Ember. This can make code more maintainable and facilitate development when you are collaborating with other developers. Because 4.0 is a more consistent API, it is much easier for you to integrate it with other development frameworks.

The Map Object and Web Map Synergy

The new architecture of ArcGIS API 4.0 for JavaScript mirrors the web map structure. This means you get the same structure—operational layers, basemaps (with reference layers) and map properties such as bookmarks and presentations—that you would expect in a web map.

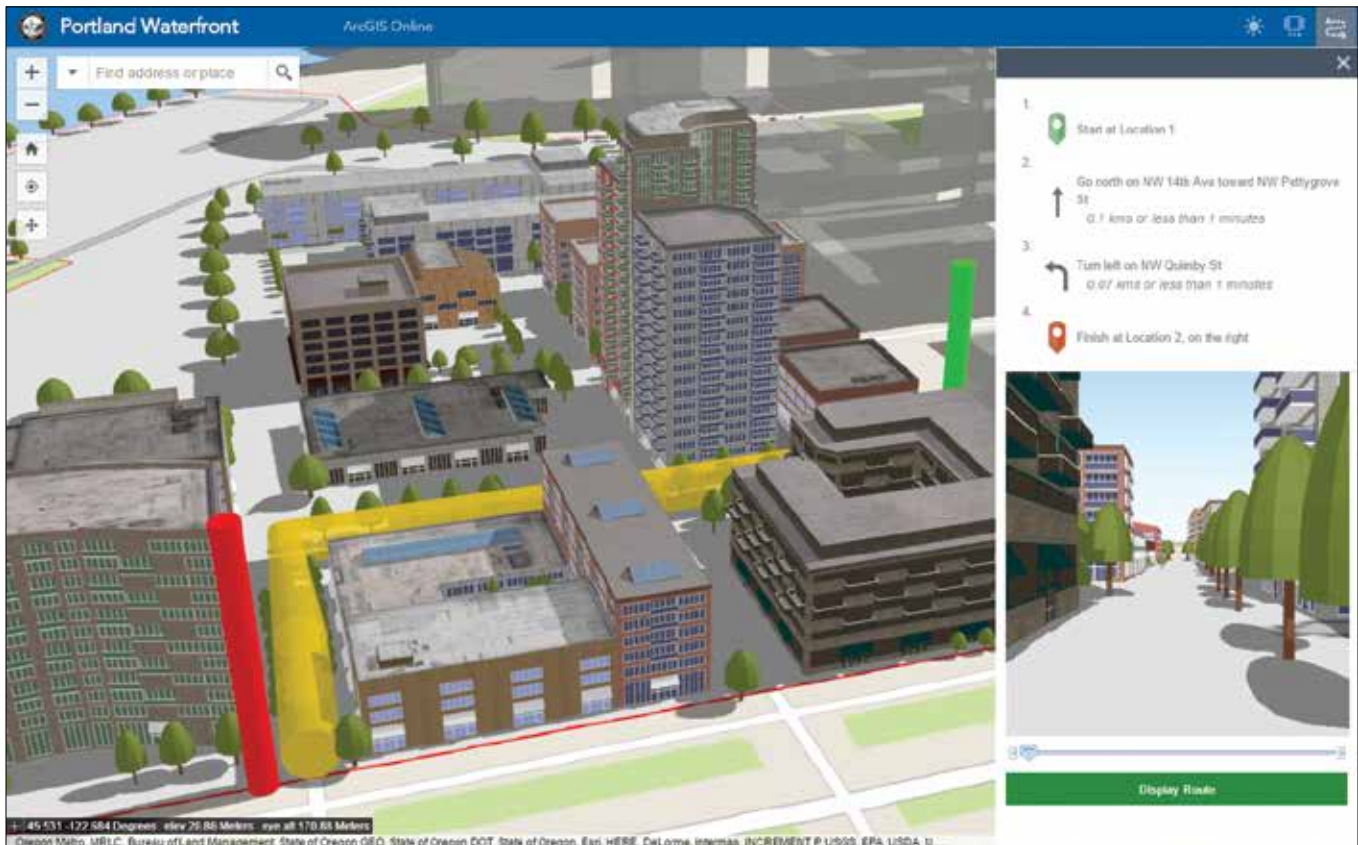
In 3.x, a basemap layer, reference layer (consisting of boundaries and labels), and an operational layer are represented in the API as three individual layers. In the 4.0 API, a map is represented as a basemap and operational layer so you can easily identify and work with just the operational layers to build out workflows. You can also instantiate maps, basemaps, and layers directly from portal items because the Portal Information model is incorporated into the API.

This map API structure remains the same whether you build the map yourself using code or open the map from a portal item. The 4.0 API adds the concept of a Group layer so that you can turn on/off a set of layers in your map. Having this consistent architecture will enable not only reading but also (eventually) writing web maps and web scenes. Writing web maps and scenes is expected in a subsequent release in 2016. In addition, the entire ArcGIS Portal REST API will be covered by ArcGIS API 4.0 for JavaScript. So rather than having to write direct REST requests for some calls like AddItem, you can simply implement it using the API.

6 Don't do it all. Let configurable apps or Web AppBuilder for ArcGIS help.

This API lets you use workflows that eliminate the need to code everything from scratch and help you get apps into your users' hands faster. You can take advantage of a variety of configurable apps and Web AppBuilder for ArcGIS to increase your development productivity. Choose from a comprehensive set of configurable 2D and 3D apps in ArcGIS Online or Portal for ArcGIS to quickly create a focused app for performing a specific function such as parcel editing. Using Web AppBuilder for ArcGIS, you can create HTML/JavaScript apps—including 3D apps—with ready-to-use widgets and customizable themes that run on any device. You can also build custom widgets for Web AppBuilder for ArcGIS.

ArcGIS API 4.0 for JavaScript makes it easier for you to work more efficiently and provide polished and responsive apps that meet the needs of your users. Visit developers.arcgis.com/javascript to interact with samples, read the guide, and access the API reference.



↑ Using Web AppBuilder for ArcGIS, you can create HTML/JavaScript apps—including 3D apps—with ready-to-use widgets and customizable themes that run on any device.



*"The secret to great facility management is **location, location, location!**"*

That's why InVision software uses location as the organizing principle to create order out of complex, disparate FM data. Now you can better see, plan, manage, and protect property and assets, whether they are indoors, outdoors, or underground.

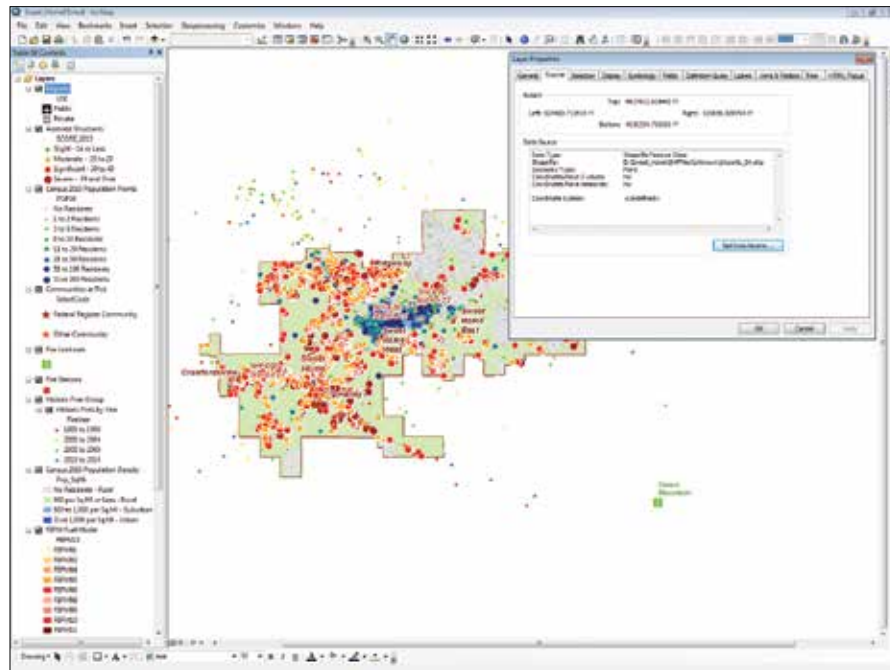
Get more out of your GIS investment.
Visit penbaysolutions.com/GISFMvideo today!



Attacking Coordinate Systems and Datums

Tips and Tricks to Recognize Problems and Resolve Issues

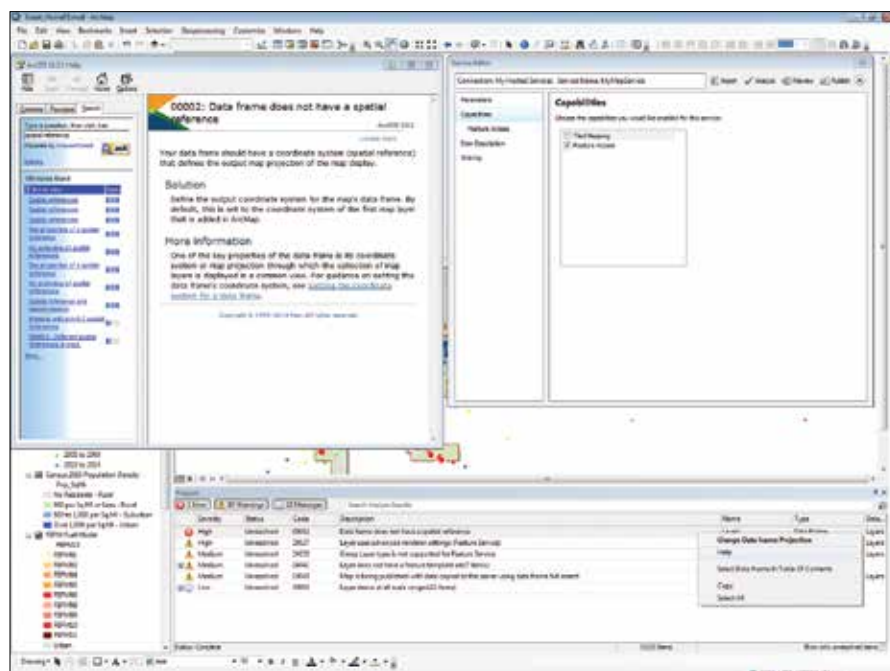
By Mike Price, Entrada/San Juan, Inc.



Late last month, I was asked to consider a best practices article discussing the status of geographic and projected coordinate systems, especially as they related to datums and GPS field data collection. This article fulfills that request. It is not intended to be used as a tutorial, although it provides concepts regarding coordinate system issues that might keep you out of trouble.

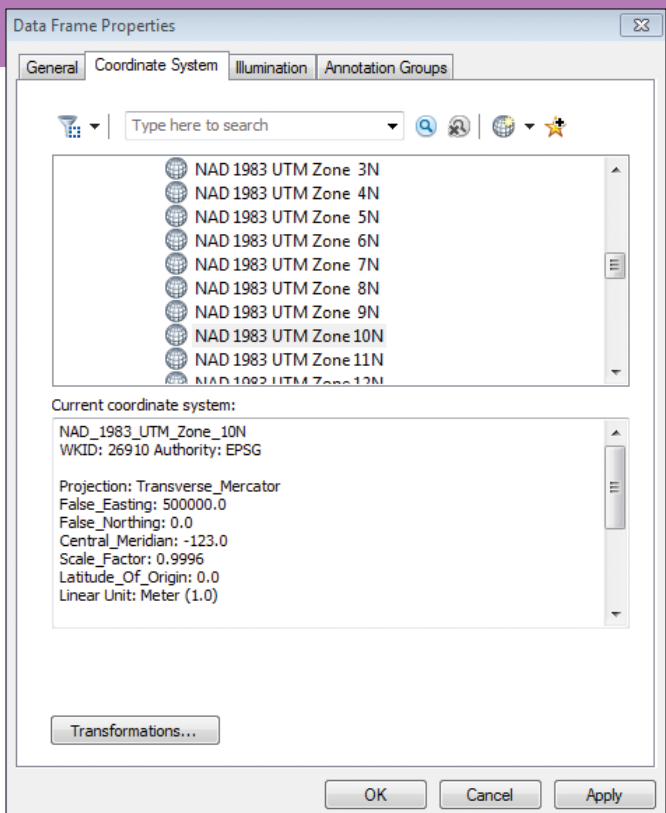
Recently, I experimented with data publishing on ArcGIS Online and on Portal for ArcGIS. I tested correct, incorrect, and missing coordinate system information in datasets, map documents, and services. I also built a public safety dataset in the Pacific Northwest that required me to merge or append different polygon datasets. I almost fell into a huge trap when the assigned coordinate systems clashed with one another. Fortunately, I recognized problems in time to fix them and create the required composite layers.

This article summarizes some current coordinate system and datum issues and lists additional helpful references. It demonstrates what happens when data is published as an online service without sufficient coordinate system documentation. It also shows what can happen when geoprocessing tasks



⦿ After removing all coordinate system information, the map looked reasonable, but the map's data frame properties did not list any coordinate system.

⦿ After publishing the map that lacked coordinate system information, I analyzed it and received several major (high) errors, including one spatial reference fatal error.



← Using Service Editor, I interactively defined the data frame's coordinate system as UTM NAD 1983 Zone 10N, US Feet based on information supplied by the data provider.

↓ After fixing the spatial reference error and updating several minor issues, I reanalyzed the map and received several warnings but no fatal errors, so I published the map.

high and medium error messages were generated, but no fatal errors. See “Using Web GIS to Build Consensus and Combat Wildland Fire Threats” in the winter 2016 issue for a discussion on resolving these warnings.

If I right-clicked the spatial reference error, ArcGIS Online prompted me to consider changing the data frame projection. Also, I found that context-sensitive help encouraged me to set a coordinate system for the data frame.

With Service Editor opened, I found that I could interactively define the data frame's coordinate system. I contacted the data provider and learned that the map and its data should be projected in UTM NAD 1983 Zone 10N, US Feet. I was able to assign the proper data frame coordinate system without closing the Service Editor. I also opened the transformation tab and found that no transformations were needed. I hoped my data provider was correct. After fixing the spatial reference error and updating several minor issues, I reanalyzed my map and received several warnings but no fatal errors, so I published it.

are performed on improperly defined coordinate systems and datums.

Publishing without Preparation

“Using Web GIS to Build Consensus and Combat Wildland Fire Threats,” published in the winter 2016 issue of *ArcUser* magazine, described how a wildland hazards map of Linn County, Oregon, was published to ArcGIS Online. The ArcMap document and its data were properly designed and included full metadata that consisted of coordinate system information for Universal Transverse Mercator (UTM) North American Datum of 1983 (NAD83).

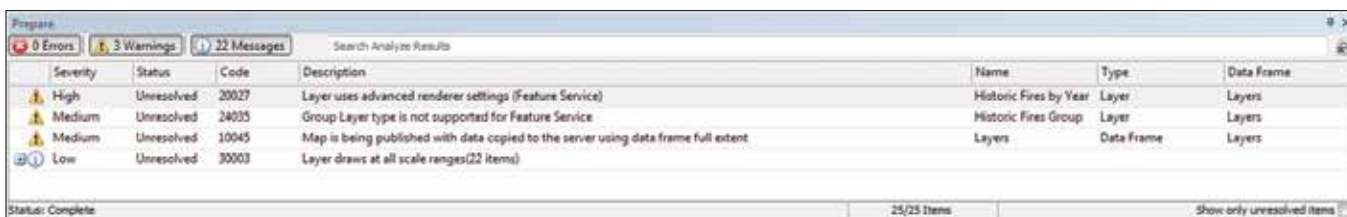
With just a little coaxing, the map was published. But what would have happened if the same map was published without any coordinate system information for the data layers and the map? To test these conditions,

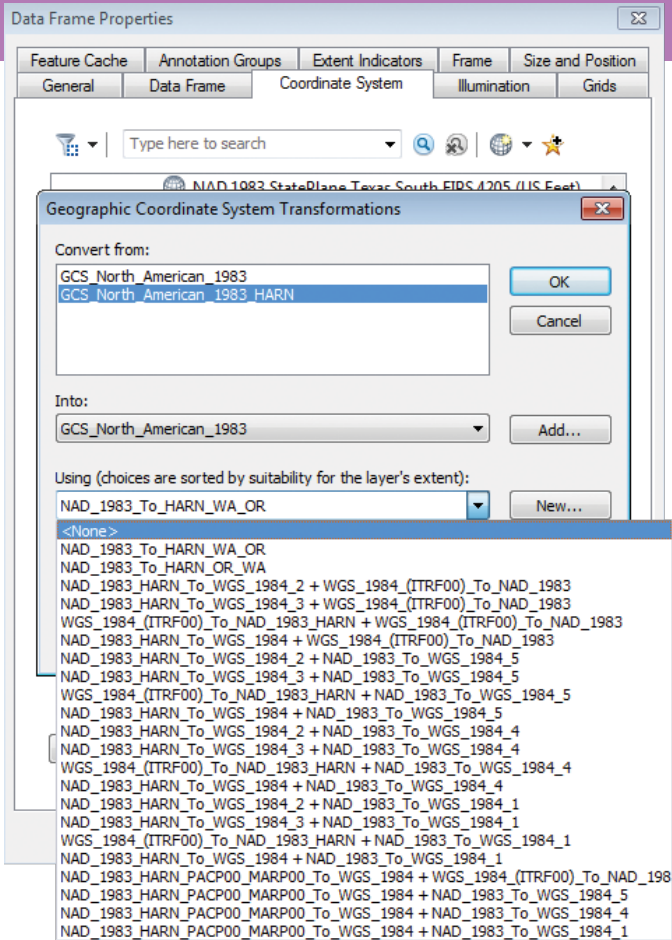
I copied the original dataset into a new geodatabase and removed all coordinate system information from both the feature classes and the ArcMap document. When I reopened it, the modified map looked reasonable, and the data seemed to be in relational space. However, the map's data frame properties did not list any coordinate system, the map units were unknown, and my proportional map scale window was disabled.

Next I inspected all layer properties and found that the coordinate system was undefined but the data looked fine, so I decided to publish the map. I logged into ArcGIS Online and proceeded to share the map as a feature service. When I analyzed the map, I received several major (high) errors, including one spatial reference fatal error, flagged by a red and white *x*. In the previous exercise, several

Checking the Published Results

I was quite curious to see the published map, so I opened it in ArcGIS Online. I found that the data frame coordinate system was properly defined, the map units were correct, and my map scale worked fine. Next, I opened the properties of the Airports layer and checked the source coordinate system. The coordinate system for the ArcGIS Online layer was also set to UTM NAD 1983 Zone 10 North, although the coordinate system for the original Airports layer was still undefined. I now realized that I should return to my original map and define coordinate systems for all layers in ArcMap. The moral of this story is that more data preparation and documentation is better, and it is better to do it earlier rather than later.





← One important layer, Fire District boundaries, was projected in Washington State Plane NAD 1983 HARN (High Accuracy Reference Network) North US Feet.

↓ Before opening it, I received a coordinate system warning error that suggested I set a transformation to NAD_1983_To_HARN_WA_OR.

data frame's coordinate system. Next, I loaded the Cities layer, followed by the Fire Districts layer. Before the Fire Districts layer opened, I received a coordinate system warning error suggesting I set a transformation. I selected the appropriate NAD_1983_To_HARN_WA_OR transformation.

When I zoomed to one city completely surrounded by fire districts, I noticed some possible irregularities along the city's western boundary. As I zoomed in, I confirmed that yes, there are some small valid Fire Districts layer polygons extending into the city. As I zoomed way in, I also noticed that the Cities and Fire Districts boundaries layers were not coincident. Although the difference was less than one foot, that is certainly enough to create errors when the two datasets are combined through a union. I decided to troubleshoot the issue by experimenting with the HARN transformation and reset the transformation to None.

After removing the transformation, I zoomed in to the same corner that I previously measured and observed that the untransformed Fire Districts layer boundaries were now coincident with the Cities layer boundaries. I checked boundary relationships through the area and found that

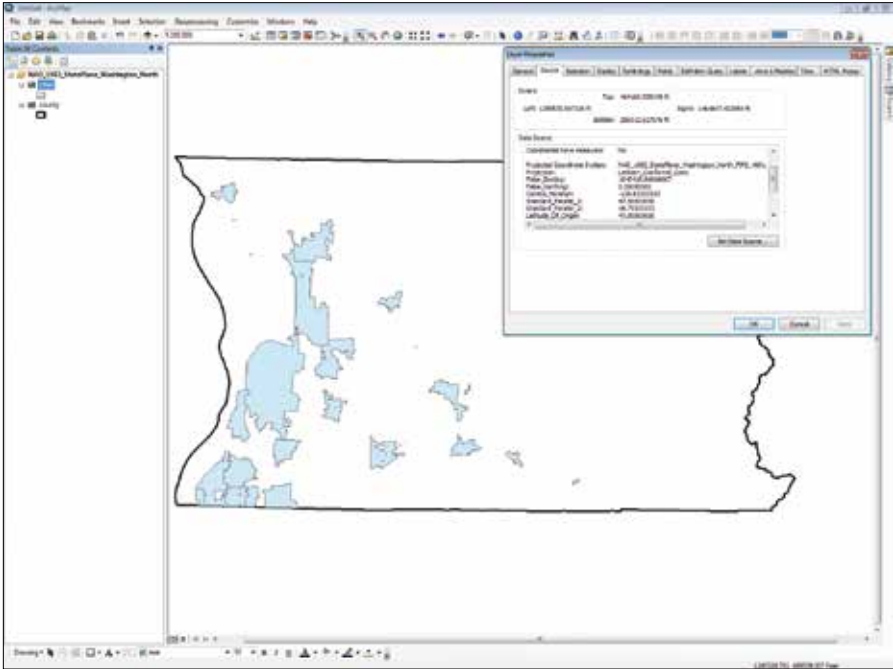
A Real-World Coordinate System Challenge

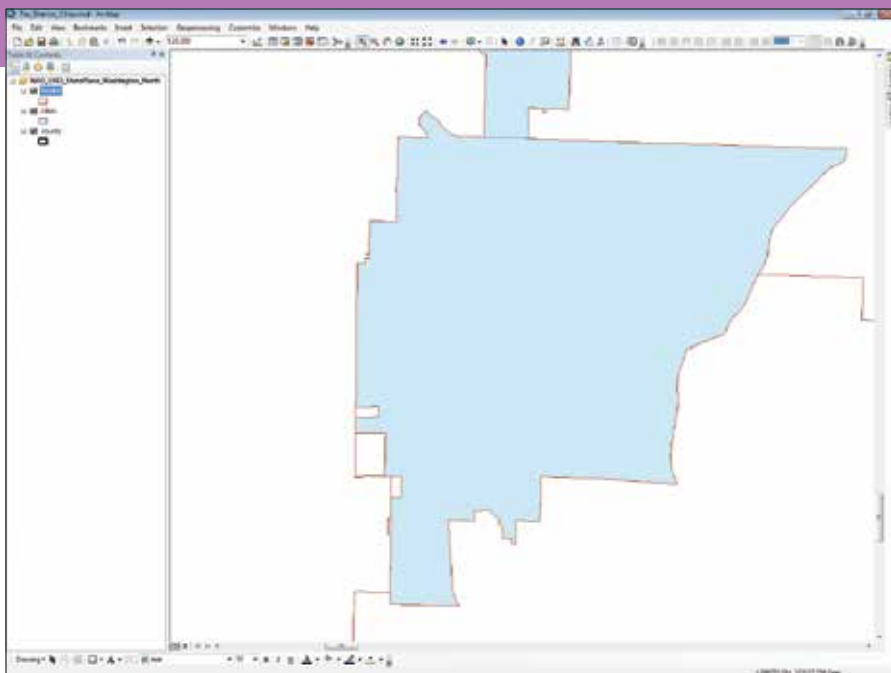
Next I began preparing basemap datasets to support a public safety study for a Pacific Northwest Fire Protection District. Much of my data was obtained from a county GIS portal. Most of the available data was projected in a Washington State Plane NAD 1983 North US Feet coordinate system. However, one very important layer—Fire Districts boundaries—was described in the projection file and the metadata as projected in the Washington State Plane NAD 1983 HARN (High Accuracy Reference Network) North US Feet. When I used the union geoprocessing function to combine Fire Districts (NAD83 HARN) and Cities (NAD83) layers, many small boundary slivers and gaps formed. This made me question the Fire Districts HARN adjustment, so I decided to test it.

Testing Transformations

In a test model, I first loaded the County boundary layer, which was properly

projected in WA State Plane NAD 1983 North US Feet. This dataset properly defines the





← When I zoomed to one city completely surrounded by fire districts, I noticed some possible irregularities along the city's western boundary.

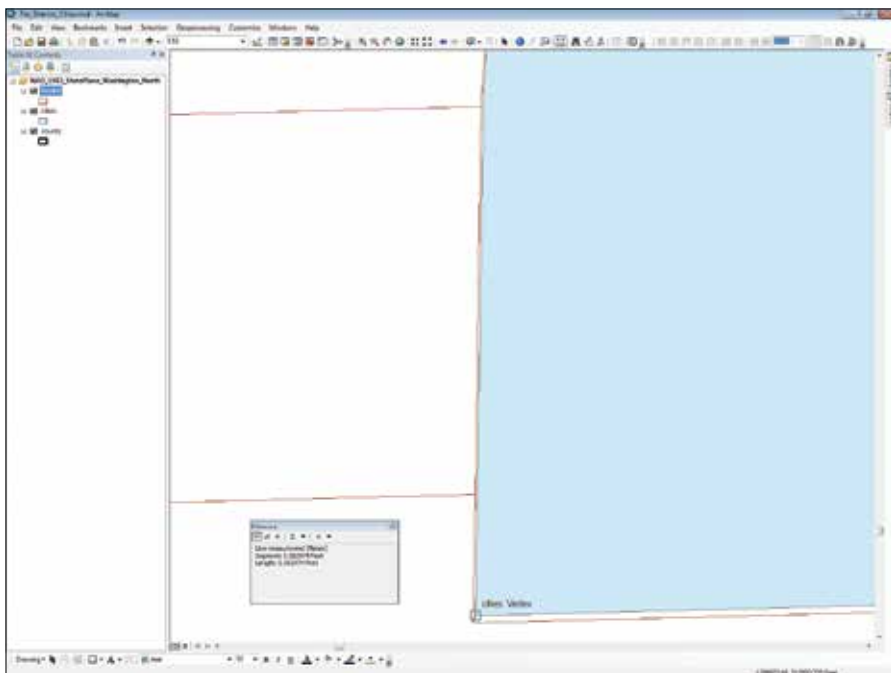
↙ As I zoomed in, I noticed that the Cities and Fire Districts boundaries layers were not coincident. The difference was certainly enough to create errors when the two datasets were combined through a union.

coordinate systems and datums.

A workshop on this topic given by Dennis was summarized by Eric Gakstatter in his article "What really matters to GIS professionals," available online at geospatial-solutions.com/what-really-matters-to-gis-professionals/. Gakstatter is the editor of *Geospatial Solutions Monthly* and a contributing editor to *GPS World* magazine and the Geospatial Solutions website.

Acknowledgments

I'm thankful for the many coordinate system experts in the surveying and GIS world and truly appreciate their diligence and shared expertise. I also thank all the agency, private, and other GIS data developers who strive so hard to provide the best data possible.



untransformed Fire Districts layer boundaries match Cities layer limits exactly. When I reran the Union tool, the slivers and gaps were gone. In this real-world example, I discussed my observations with the data provider, who promised to resolve any issues.

Who Needs Datums?

It turns out that anyone who creates maps and spatial models in our modern world needs to be aware of datums and understand

them. To gain a better understanding of the relationship between datums and coordinate systems, you can review the slides from an excellent presentation given at the 2015 Esri User Conference by Michael Dennis, president and owner of Geodetic Analysis, LLC. Entitled "Space, Time, and Datum Forensics—Aligning GIS Data on a Dynamic Earth," it is available online at proceedings.esri.com/library/userconf/proc15/papers/935_537.pdf. It provides a comprehensive review of



Connect
your existing
GPS device to
iOS devices.

Overrides iOS device's native location - so all apps using location service benefit from the accuracy.

- Supports VRS over internet from your iOS device.
- Fine grained access to incoming GPS data available via our Apple approved SDK.
- Apple Certified "Made For iPod" accessory, No Jailbreak needed
- Supports Connectivity over Bluetooth.

AmanEnterprises.com

707-722-7430

support@amanenterprises.com

Six Easy Ways to Improve Your Online Maps

By Lisa Berry, Esri Cartographic Product Engineer

1 Think about Color

ArcGIS contains many basemap-specific color ramps to help showcase your data. Many of these ramps are friendly to color-blind readers. When you switch the basemap, smart mapping automatically suggests a color ramp suitable for the basemap you select. The Light and Dark Gray Canvas basemaps are designed to draw focus to your data and are a good place to start. To enhance your story, choose an alternative color ramp that matches the context of your data. For example, the map in Figure 1 shows change in water usage in Atascadero, California, after the California governor proclaimed a 25 percent mandatory reduction in water usage. Areas in blue used more water after a year, while the areas in brown used less water. These colors are directly associated with the story being told.

Tip

When mapping thematically, try changing the theme to see your data in a new way. Try using Above and Below or Centered On options. Mapping something with important high or low values? Try High to Low or Extremes. Each theme has color ramps designed for use with that theme and the current basemap on your screen. Click a color ramp to see how it looks. Then think about your audience—do the map's colors give the first impression you want them to give?

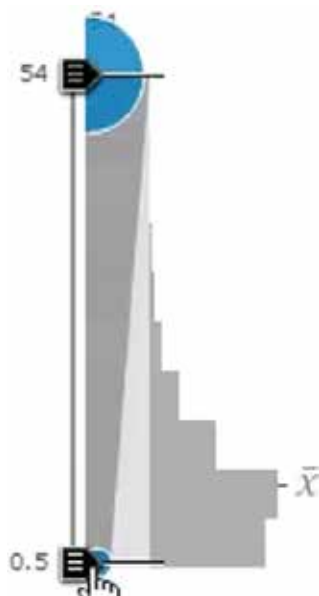


↑ Try using Above and Below or Centered On options or the High to Low or Extremes to see your data in a new way.

2 Find Signal within the Noise

The patterns within your data need to be revealed. Whether you classify your data or use an unclassified approach, be deliberate in how you assign color or symbol size to the data. Choose values that make your message clear. To find patterns in your data, use the handles within the histogram to adjust the map quickly. If you want to use size to represent values in your data, an easy way to discover and show patterns is to drag the lower handle to the average value (as shown in Figure 2). This will emphasize any values that are above average. To get the average value, hover over the x-bar value to the right of the histogram. You can also type the exact value into the lower handle by clicking on the number near the handle.

The maps in Figure 3 show the average household income for Atlanta, Georgia. The first map uses a continuous ramp through all values of the data, while the second map starts showing larger circles only once a value is above average (the technique just described). In comparison, the second map shows a more definitive pattern of above-average incomes in the Druid Hills area.



↑ Figure 2: If you want to use size to represent values in your data, an easy way to discover and show patterns is to drag the lower handle to the average value.

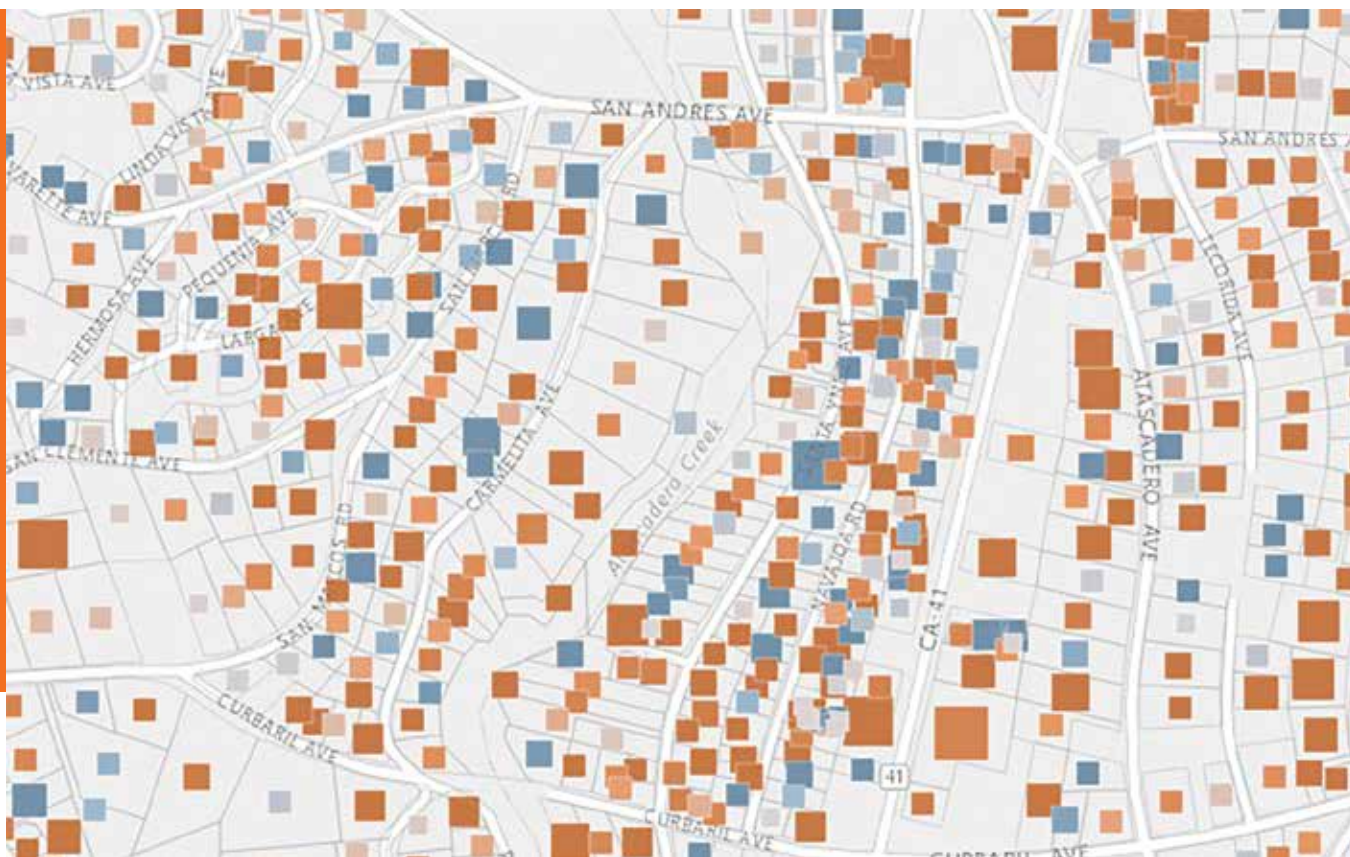
Tip

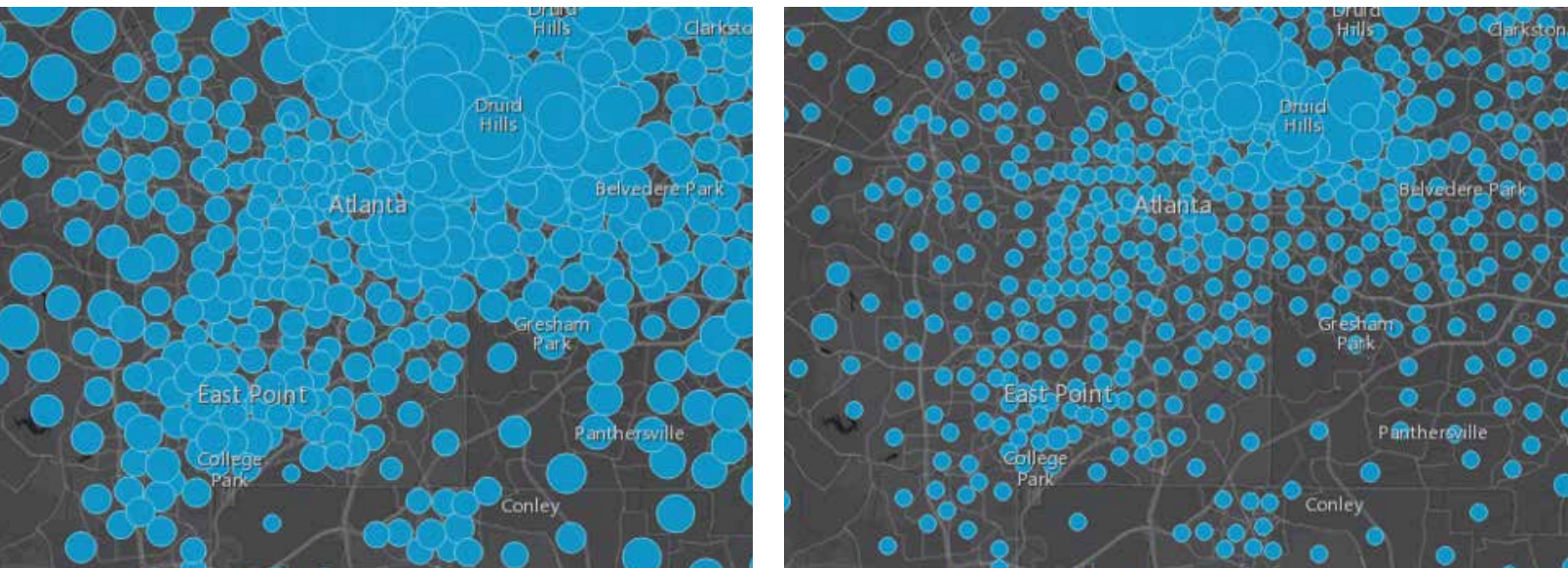
Have an outlier in your data? Zoom in to see the values closest to the mean in the histogram. Pull the handle away from the outlier value to see how it affects your map.



↑ Pull the handle on the histogram away from the outlier value to see how it affects your map.

↓ Figure 1: This map of water usage in Atascadero, California, shows areas that used more water in blue and areas that used less water in brown.





↑ Figure 3: These maps show the average household income for Atlanta, Georgia. The map on the left uses a continuous ramp through all values of the data. The map on the right shows large circles once a value is above average.

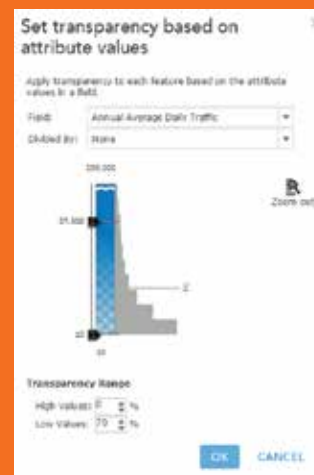
3 Adjust Outlines

Outlines on points and polygons sometimes become distracting and tear your audience away from the focus of your map. An easy way to maintain their importance while drawing attention to the map topic is to play around with color and transparency on boundaries or outlines. For example, change your boundaries or circle outlines to a slightly transparent value or a color similar to your basemap. You can even try full transparency if the boundaries or outlines don't help support your story.

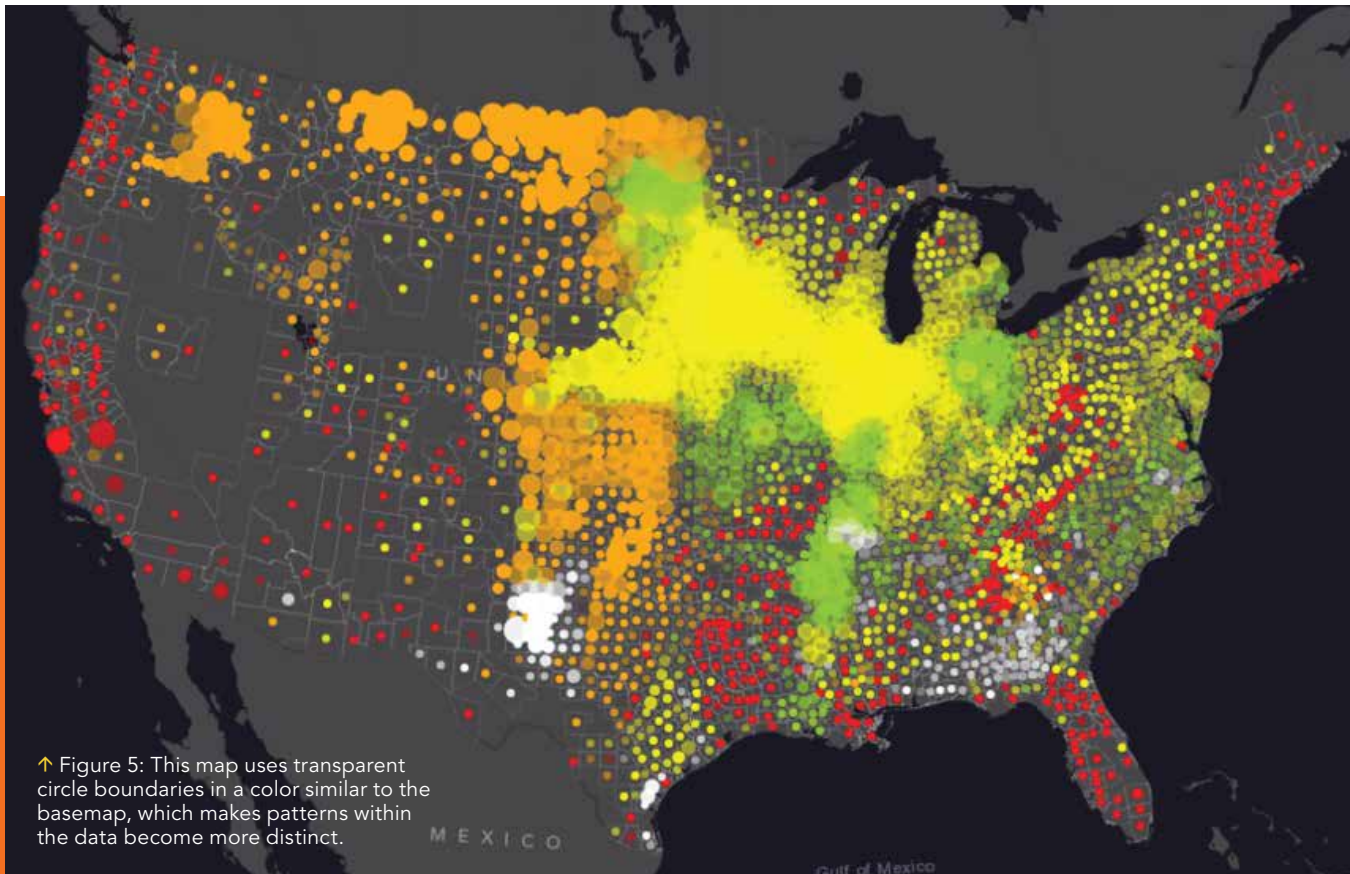
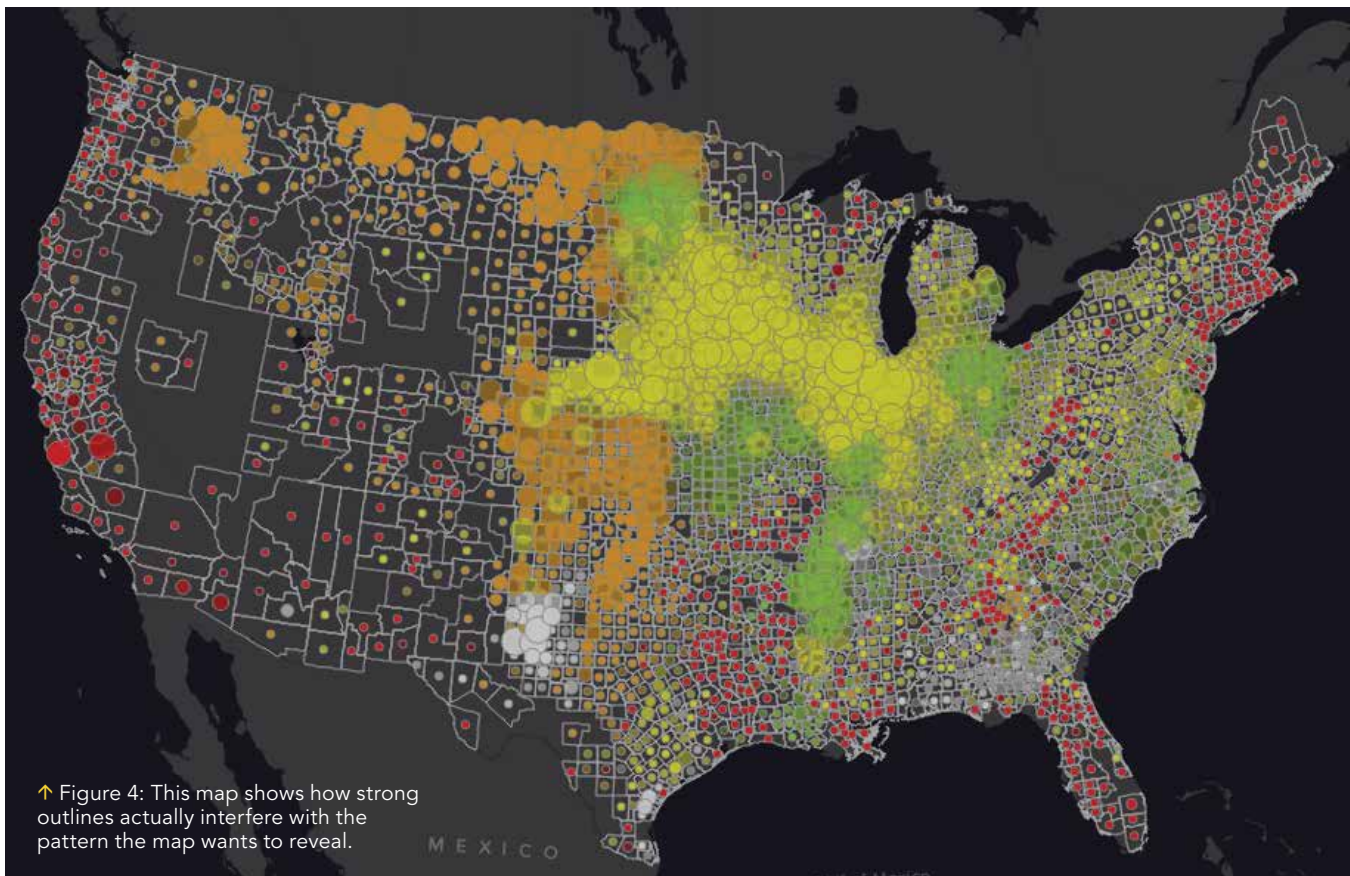
The map in Figure 4 shows an example of overbearing boundaries, while the map in Figure 5 uses transparent circle boundaries using a color similar to the basemap. The patterns within the data become more distinct and comprehensive. You can see how strong outlines actually interfere with the pattern the map wants to reveal.

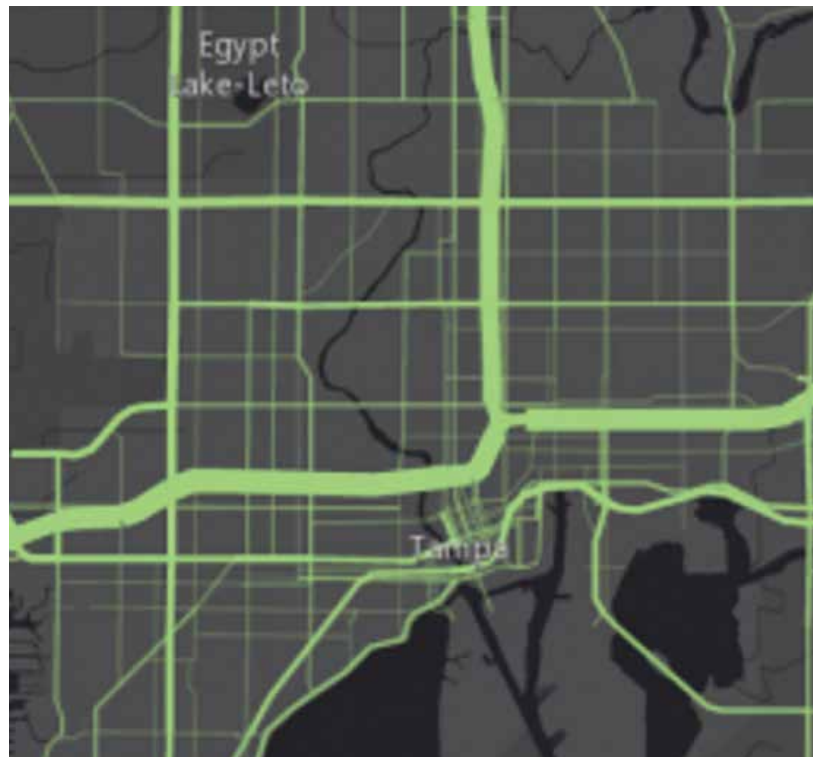
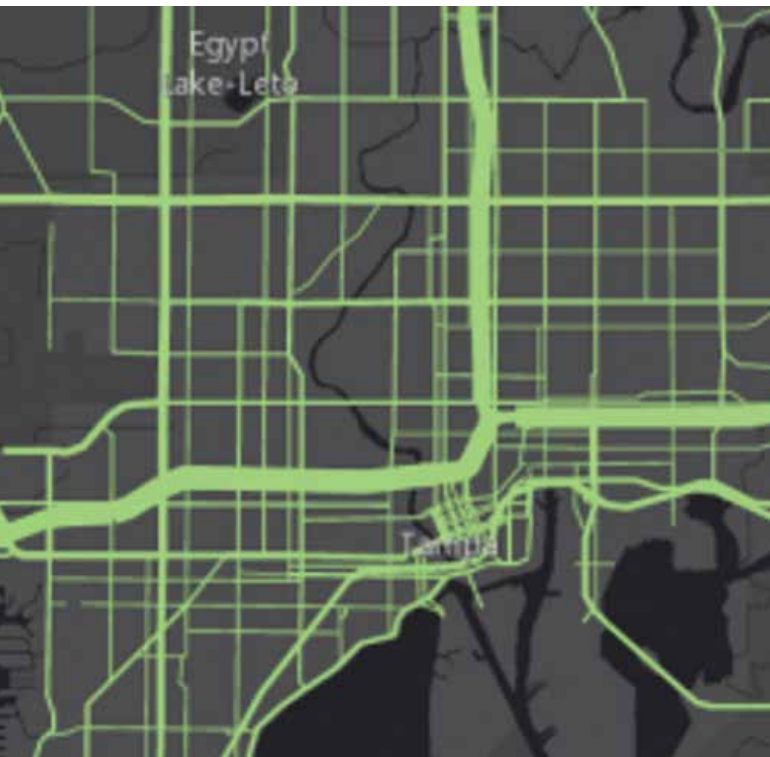
Tip

Widen the gap between the highest and lowest value to get a more intense transparent effect. The maps in Figure 6 show the subtle difference achieved by using transparency. The maps in Figure 6 show the subtle difference achieved by using transparency. The second map uses the same attribute for size and transparency, revealing the busiest highways in Tampa, Florida, by letting less busy roads recede visually into the map (due to data-driven transparency).



↑ To get a more intense transparent effect, widen the gap between the highest and lowest values.





↑ Figure 6: Subtle differences can be achieved using transparency. The map on the right employs attributes for size and transparency to make the busiest highways stand out and the roads with less traffic recede visually into the map.

4 Utilize Transparency

Transparency can add emphasis to the patterns in your data. Whether you want to highlight a pattern or a statistically significant value, transparency makes patterns more understandable. Choose an attribute field from your data to control the transparency, then adjust the transparency range as shown in Figure 6. Using size and transparency highlights the busiest highways on the right-hand map.

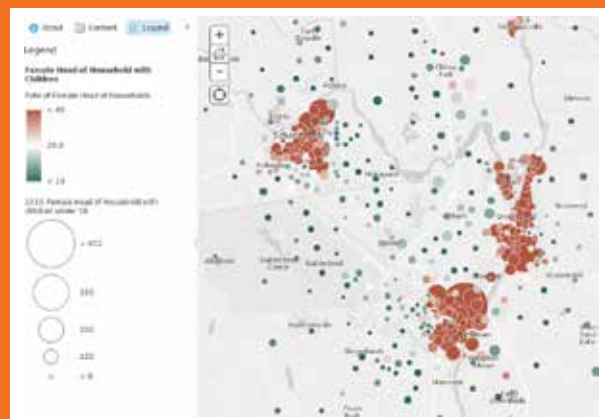
5 Use Size and Color

In the past, showing two topics in the same map could be a challenging task. With smart mapping in ArcGIS, now you can easily show patterns using both color and size. Simply select the variables you want to view, and smart mapping will provide an option to show color and size.

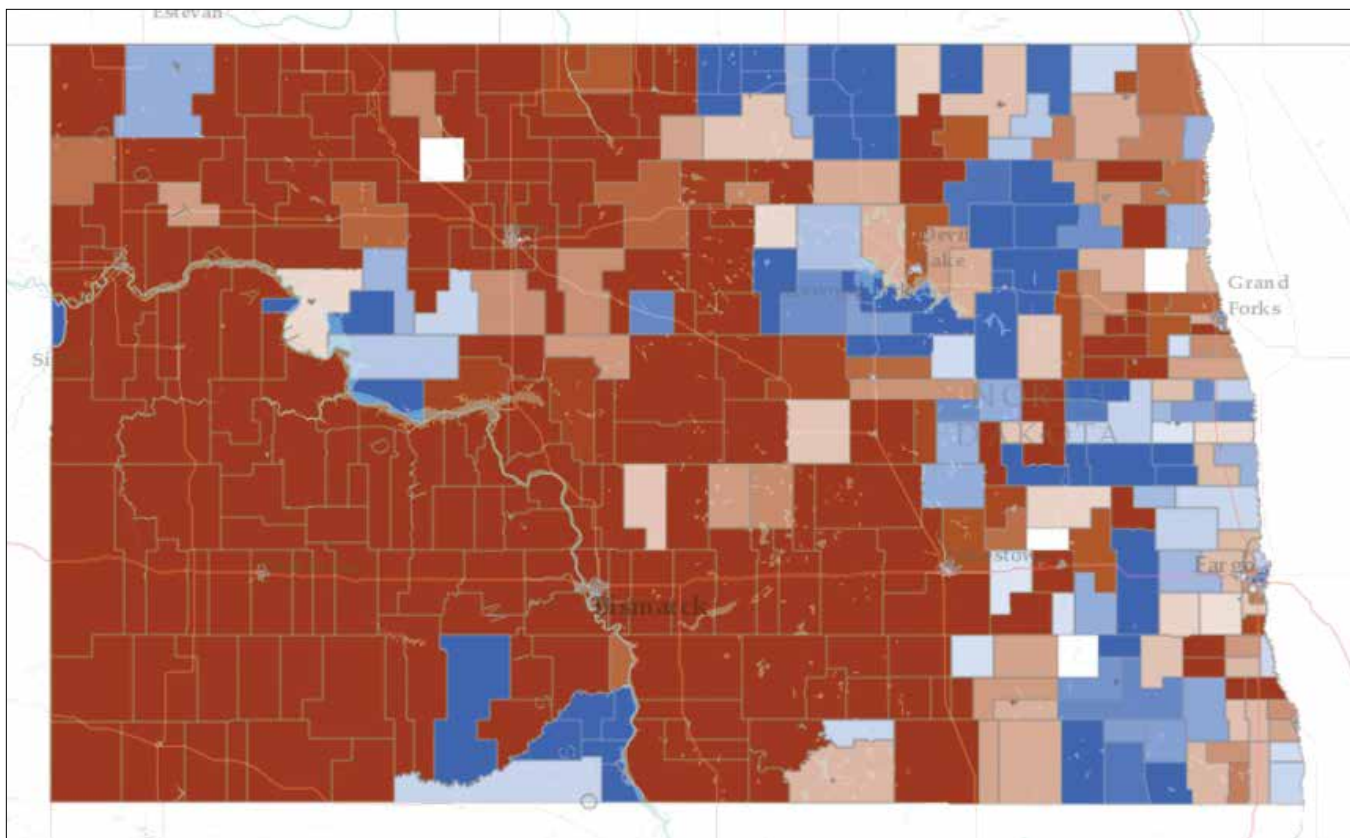
For example, if you want to explore the pattern of single-parent households, size can show the total numbers, while the color can highlight where the highest percentage exists. This technique pinpoints areas that have a high count and percentage of single-parent households.

Tip

When starting a multivariate map, use a count attribute for the size and a normalized attribute for the color. This will help you see patterns more quickly. An example of a normalized field would be a ratio, average, or percentage. You can select a field to normalize your data from the options interface.



↑ When starting a multivariate map, use a count attribute for the size and a normalized attribute for the color.



↑ Figure 7: This election map shows the predominant count of votes in North Dakota voting precincts from the 2008 presidential election, with darker colors indicating a higher predominant vote for that party.

6 Find the Largest Value

Smart mapping has a built-in interface to help you pinpoint the largest value between multiple attributes. This predominance option allows you to quickly visualize predominant values without needing to calculate any fields in your dataset. In the interface, choose up to five numeric attributes that share a common subject of measurement.

An election map is an example of a predominance map. An election map simply tells you which—of two or more candidates—has the highest total vote count. The map in Figure 7 does more. It shows the predominant count of votes in North Dakota voting precincts from the 2008 presidential election. Darker colors indicate a higher predominant vote for that party. Lighter colors indicate that party barely won the precinct. White represents a tie. With this map, a campaign manager can instantly see which precincts have a strong base for each party and which precincts were more contested.

For help getting started with smart mapping in ArcGIS, visit the ArcGIS Online help.

Be Credible!

Spell check your maps with...

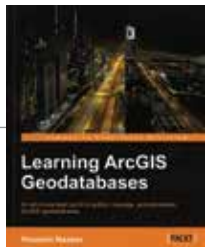


888-334-3832

www.Edgetech-US.com
Edgetech America, Inc.

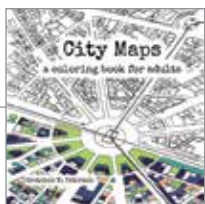
An Esri partner since 1995

GIS Bookshelf



Learning ArcGIS Geodatabase

This book provides practical instruction on authoring, managing, administering, and optimizing ArcGIS geodatabases. It is suitable for geospatial developers new to the geodatabase architecture or those who want to migrate legacy geospatial data to the geodatabase. The book also covers the use of Python to author a geodatabase programmatically and how to configure a networked enterprise geodatabase. The author, Hussein Nasser, is a senior GIS solution architect at the Electricity and Water Authority in Bahrain and has been in the field since 2006. In 2007, he won the annual ArcGIS for Server Code Challenge at the Esri Developer Summit. Previously he worked for Khatib & Alami, the leading Middle Eastern engineering company. He has authored other GIS books including *Administering ArcGIS for Server*. Packt Publishing, 2014, 150 pp., ISBN-13: 978-1783988648



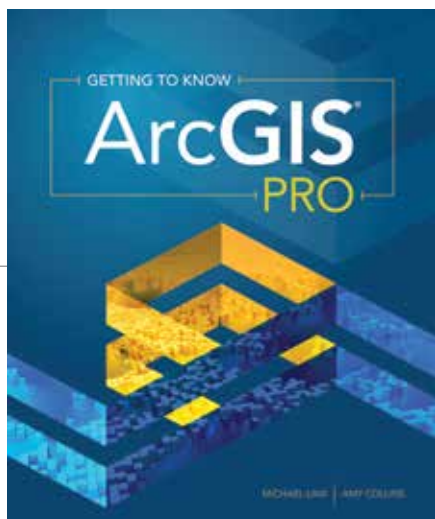
City Maps: A coloring book for adults

By Gretchen N. Peterson

Gretchen N. Peterson, author of *Cartographer's Toolkit* and *GIS Cartography*, provides an antidote for stressed geogeeks in her newest book, *City Maps: A coloring book for adults*. As you color 40 bird's-eye view maps of the largest metropolitan areas in the world, you will likely realize the therapeutic benefits of relaxation and mindfulness that have made adult coloring books all the rage since 2013. These intricate maps of London, Dhaka, Istanbul, Los Angeles, Tokyo, and other cities have real building footprints and road outlines depicted at scale. PetersonGIS, 2016, 94 pp., ISBN-13: 978-0692670934



Start Making 2D and 3D Web Maps with ArcGIS Pro



The new workbook *Getting to Know ArcGIS Pro* teaches the fundamentals of working with the next generation of GIS software, ArcGIS Pro.

Designed so users can quickly author maps and create, edit, query, visualize, and analyze geospatial data in both 2D and 3D environments, ArcGIS Pro is an application that comes with ArcGIS for Desktop. It is a 64-bit, project-based, professional GIS desktop.

This is Esri's first workbook for ArcGIS Pro. Its 10 chapters teach the basic functions and capabilities of ArcGIS Pro and show how it can be used with ArcGIS Online. Working these exercises, readers can learn how to do basic tasks in ArcGIS Pro, create a web map in ArcGIS Online, convert a 2D

map into a 3D map, create and edit spatial data, create a geoprocessing model, use the Python command line and run Python script tools, prepare a geodatabase and a map for data collection, geocode location data, perform hot spot analysis, apply symbology and label features, create a page layout, and share a project. Data for all exercises can be downloaded from esripress.esri.com/bookresources.

This workbook was designed to give readers a broad overview of ArcGIS Pro by providing a diverse sampling of industries, scenarios, and workflows that highlight the many core functions of the application.

Michael Law and Amy Collins, the book's authors, also wrote the popular Esri workbook *Getting to Know ArcGIS*, fourth edition, which was published in 2015. Law is a cartographer with more than 12 years of professional GIS experience. He worked for Rand McNally Canada before coming to Esri, where he has developed cartography for books in addition to editing and testing GIS workbooks. Collins is a writer and editor who has worked with GIS for 14 years.

As a former technical editor at Esri, she honed her knowledge of GIS and designed instructional materials for budding GIS professionals.

Getting to Know ArcGIS Pro is available in print (ISBN: 9781589484573) or as an e-book (ISBN: 9781589484580) that can be purchased at esri.com/esripress or by calling 1-800-447-9778. Outside the United States, visit esri.com/esripressorders for complete ordering options.

Share Your Story in ArcUser

Write an article for *ArcUser* magazine. Tell the GIS world how your organization saved money and time or acquired new capabilities using GIS. Share your GIS management insights or your expertise in extending the GIS functionality of Esri software.

esri.com/ausubmission

Copyright © 2015 Esri. All rights reserved.

An Exceptional “Normal” Person Changing the World

By Citabria Stevens, ArcNews Editor



From her couch in Ohio, Katherine Wright (who goes by Kelly) created a web GIS app as part of a class that she hopes will help curtail tungiasis, an epidermal parasitic skin disease that is widespread throughout sub-Saharan Africa and South America.

Initially, Wright didn't know anything about this neglected tropical disease. Her friend's boyfriend had some itchy bumps that she thought looked like chiggers, the juvenile mites that cause temporary discomfort to their short-term hosts. When she gave him her diagnosis, he exclaimed that he did not have jiggers—using a “j” to begin the word. Wright looked up jiggers

and found out that they were not the same as chiggers, but rather were equivalent to chigoe fleas.

These parasites can permanently disfigure and cause physical disabilities to their hosts, though they are not normally fatal. There is no concrete data on how many people have tungiasis. While it may be endemic in almost 90 countries worldwide, the disease could be at epidemic levels in many sub-Saharan African countries.

An infestation occurs when female chigoe fleas burrow just underneath the surface of a host's skin. Animals as well as humans can be infested. Humans likely contract the fleas when they walk barefoot

or without sufficient footwear on warm, dry soil and sand. Tungiasis, which disproportionately affects the world's most impoverished people, has flourished over the last 50 years because of growing rural populations and increasing construction of dirt roads in those areas.

“I started thinking, why isn't anyone doing anything about this, and why hasn't anyone applied GIS to this?” Wright recalled. She knew the Carter Center has almost eradicated Guinea worm disease, a parasitic infection that affected 3.5 million people in 1986 but in 2015 only infected an estimated 22 people. “They were using GIS in order to target areas that they knew



← In December 2015, Wright volunteered with the Kentucky Karst Conservancy to use lidar to map a side entrance to the Big Bat Cave, near Custer, Kentucky. The purpose of the alternative tunnel entrance is to make cave entry safer. Photo courtesy of Justin Chodyniecki, In The Shade Photography

↓ Wright has created an app to try to help eradicate chigoe fleas in Kenya.

would be having this problem,” Wright said. She started thinking how she wanted to use GIS as a management strategy for the eradication of tungiasis.

A Meandering Road to GIS

Wright’s path to GIS has been long and winding. But when she finishes her master’s degree in geographic information science and technology (GIST) at the University of Southern California (USC) in December 2016, she knows that she will be able to make a difference.

“I really believe that GIS has the power to effect change,” she said. “I want to try and do that.”

And by all accounts, this young, enterprising woman will be able to do just that.

“She is absolutely among the very best students I’ve known in 20 years,” said Jordan Hastings, one of Wright’s professors at USC who is now a research associate at the University of California, Santa Barbara’s Center for Spatial Studies. “She is both engaged and engaging. She has a rare interest combination in...environmental topics, technical skills, and social commitments.”

Wright has always been interested in maps. She started out—as so many GIS professionals do—being the navigator on road trips when she was a kid. She decided to study molecular genetics in college at Ohio State University. She ended up

transferring to the University of Texas (UT) at Austin because it had a large budget dedicated to biological sciences research.

While carrying a full course load, Wright also worked full time at Dell in tech support. Because Dell is located outside Austin’s city limits, Wright needed a class that didn’t require her to be at UT’s downtown Austin campus. The online course offerings were slim, so she decided to take a class in urban geography.

She quickly found the subject matter exciting. She got an A in the class. It was the best she’d done academically in a while.

“I was hooked,” she recalled. “Taking that class really made things click. I really got it, and I really understood the world I was seeing around me all the time.”

So Wright switched majors. She excelled at geography, though she felt that GIS was still pretty heavy on computer science at the time, so she didn’t think it could be her focus. Wright graduated with distinction from UT with a bachelor’s degree in geography, specializing in urban and regional planning and natural resources.

From there, she bounced around the United States and tried a slew of different jobs. She worked with a butcher for a little while, then headed to New Orleans after Hurricane Katrina to help with the rebuilding effort.

After that, Wright moved to the Florida Keys, where she spent two years as an interpretive park ranger at Long Key State Park. She took visitors on guided walks and explained the flora and fauna, focusing on birds—her specialty—since the area is a major migratory path. She also documented all the native plants in the park, redesigned trail maps, and trained other rangers on how to do interpretive programming.

She moved back to Austin in 2008, where she became a park ranger at McKinney Falls State Park. But when the financial crisis hit, she lost her state-funded job. So Wright headed back to Ohio, where she was from originally, and did a stint with the Columbus Zoo before getting a job at Time Warner Cable in tech support and data analysis. While there, she monitored the health of the network’s lines and data for more than 2 million people.

When her grandmother needed care,



Wright took time to do that. Her grandmother said she'd be happy to help Wright out with graduate school. Shortly thereafter, Wright was on LinkedIn when she saw a targeted advertisement for USC's GIST online master's program. She signed up to learn more about it and just two weeks later she was in class.

Around the same time, Wright began an internship with the Ohio Department of Transportation (DOT). She started in the aggregate geology division, then moved to the technical services department. She currently holds an internship in the CADD and mapping department, where she's working to increase interoperability between ArcGIS and MicroStation. Wright is also helping to archive historical aerial photos taken from the 1940s through today and make them available to the public through ArcGIS.

According to Mark McCloud, the CADD manager at the Ohio DOT, Wright is essentially leading the project to archive aerial imagery. "She's really been kind of the key person to this project," he said. "She's already started building the Python scripts to geolocate our imagery." This is quite a feat, considering Wright has only just started learning Python in her master's program.

"Our office is kind of a learning point for her," McCloud continued. "When she sees something and she knows she wants to learn something...she takes it and gets right on it."

↓ Kelly Wright, a master's student in geographic information science and technology at the University of Southern California, wants to use GIS to change the world.



A Dataset to Battle Tungiasis

And that is exactly what Wright did when she started researching chigoe fleas. At the time, she was taking a web GIS class. As an assignment, she had to design and implement a distributed web mapping service for a specific purpose. She chose to focus her project on tungiasis in Kenya because Kenya is an English-speaking country that has available GIS data and reportedly has almost 50 charitable organizations working to combat the disease.

However, most of the research on tungiasis comes from Brazil. There was no data about chigoe fleas in Kenya. She wanted to get an idea of the distribution of the disease in the country and pinpoint some of its causes.

"My goal is to try to create a dataset that is functional," said Wright. And she wants other people—especially charitable organizations—to be able to use her dataset to curb the disease.

For her project, Wright first created a prototype app that would allow citizens and aid workers to overlay different datasets to explore the underlying causes of tungiasis. She used open data from sources such as the International Livestock Research Institute, Open Data for Kenya, and Kenya Open Data. Because Kenya's borders have changed dramatically over the last 30 years (at times, as many as 100 new administrative units were added in a year, Wright said), it was exceedingly difficult for her to find shapefiles with the correct administrative boundaries. But once she got them, she used USC's organizational account to put all the data together in ArcGIS for Desktop and then upload it to ArcGIS Online. Wright then used Web AppBuilder for ArcGIS to create an app that allowed users to explore the data.

After the course was over, Wright spent her winter break developing three editable feature services for the app using ArcGIS for Server. The idea is to have users contribute information on the charities working in an area, identify the pesticides being used, and record the characteristics of the people who are being helped by aid workers. Drop-down menus would be used to retain standardized data. A charity, for example, could register its boundaries and list its contact information. Workers spraying pesticides or conducting indoor residual spraying (coating indoor surfaces

with lingering insecticide) could report where they're spraying, how long the treatment will last, and the condition of housing. Aid workers could capture the demographics of the people they assist. Wright is still figuring out how to deal with the privacy issues that go with health care and humanitarian work. Currently, users can input data, but the app is not displayed publicly.

"I'm in the process right now of contacting organizations to see if this is something they'd be interested in either adopting or trying out," Wright said. She would also like to get some feedback from them to see how she can make this meet their needs.

A Way to Change the World

Wright has created a website with information about the chigoe flea in Kenya and an extensive help file on how to use her app. She plans to turn this into her master's thesis project. She also thinks that other organizations—such as the Bill and Melinda Gates Foundation, the Carter Center, or the World Health Organization—could use the app to help eradicate the chigoe flea or other neglected tropical diseases. And, given her experience in the park service, she wonders if the app could be used to track and quash invasive species.

"Here in the United States, we have countless invasive species—whether they be plants, reptiles, fish, mammals, or even viruses," Wright said. "For me, this is also an application that can be segued into invasive species control."

She envisions having citizen scientists collect and record information on invasive species in their areas, since they often have better access to hard-to-reach places where they live than do scientists who parachute in and out of an area.

"We all have the power now to help these problems," stressed Wright. "You can take disparate data—just numbers—and give them meaning by providing them with a spatial context. You turn data into information, and people get it when they see it that way."

Because of advances in GIS technology, such as web GIS and app building tools, she truly believes that "normal people can take part in changing the world." Wright is anything but "normal"—though she is certainly already taking part in changing the world.



"I have been able to apply my new expertise to projects back home in Nigeria, and I am working on my Ph.D. in hydrology, looking at more water management issues."

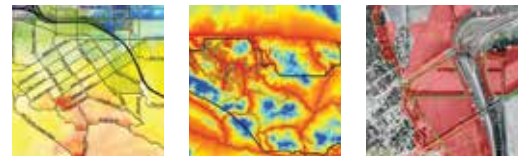
– Damilola Eyelade '12

Master of Science in GIS

Apply now for the new "GIS Leader" scholarship

Located at the epicenter of GIS—Redlands, California, home to the world's leading GIS company, Esri.[®]

Our MS GIS students gain the knowledge and tools to apply GIS to real world global problems. Studying and living together, our cohorts become proficient in the latest GIS technology, theory and applications in close partnership with a supportive faculty.



UNIVERSITY OF
R Redlands

Program Highlights

- **Immersive one-year residential program**
- **Small class size with one-on-one faculty attention**
- **Access to extensive Esri resources**
(Esri instructor-led courses, weekly colloquia, in-depth seminars)
- **Hands-on individual projects that tackle real problems**

909-748-8128
msgis@redlands.edu
msgis.redlands.edu

A Good Map Teaches You to Ask a Better Question

By Joseph Kerski, Esri Education Manager

My colleague, Esri cartographer Charlie Frye, has said that “a good map teaches you to ask a better question.”

I love this statement.

It fits well with the mission of the GIS education community, don't you think? Isn't one of our main goals in teaching and learning with GIS to use maps and data to investigate our communities, our regions, our countries, and our world?

A question is the first step in an investigation. It is the first step in the geographic inquiry process. Questions form the foundation of our investigations, whether the question is What is the relationship between birth rate and life expectancy around the globe? or How did the construction of the breakwater change the rate of coastal erosion along this stretch of beach?

Good questions inevitably get refined and modified along the way and usually lead to other questions. They may not be fully answered, and oftentimes have no single correct answer. This may be puzzling at first to students but

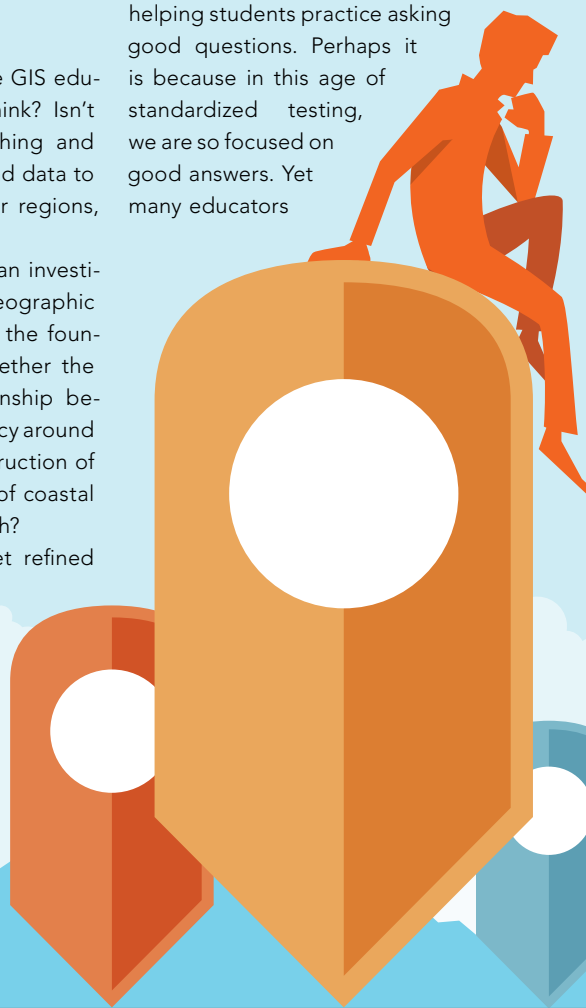
emulates real-world decision making.

As important as good questions are, it is sometimes amazing how little time we spend in our educational system helping students practice asking good questions. Perhaps it is because in this age of standardized testing, we are so focused on good answers. Yet many educators

are indeed helping students ask questions, and not just any questions, but thoughtful questions that can lead to increased understanding, skill building, and critical thinking.

Teaching with and about GIS fosters good questioning. One of the core functions of a GIS is to allow real-world issues to be examined, questioned, and probed with real data. Maps in a GIS environment allow the many spatial and temporal dimensions of our world to be examined at multiple scales. Not only are the questions able to be grappled with using rich sets of maps and data, but they are tied to real-world events, past and present. They are interesting, but they are also important and relevant for our future, including such issues as sustainable agriculture, natural hazard management, and smart city planning.

Maps inside a GIS environment help students of all ages ask better questions, in part because during the inquiry, they allow the scale and symbology to be changed, additional layers to be added, and powerful queries and statistics to be run on the data. What-if questions can be explored, such as





What if I changed the scale?

What if I added this variable?

What if I ran a different query?

What if I examined a different area with the same variables?

What if I classified the data differently?

ArcGIS provides a platform for asking and analyzing questions.

About the Author

Joseph Kerski is a geographer who believes that spatial analysis through digital mapping can transform education and society through better decision making using the geographic perspective. He serves on the Esri education team, is active in GIS communication and outreach, creates GIS-based curriculum, conducts research in the effectiveness of GIS in education, teaches online and face-to-face courses on spatial thinking and analysis, and fosters partnerships to

support GIS in formal and informal education at all levels internationally. Kerski was recently honored by the Department of Geography at Texas State University with the Outstanding Support from the

Business Community Award. He is the coauthor of *Spatial Mathematics*, *The Essentials of the Environment* and *The GIS Guide to Public Domain Data*. Follow him on Twitter @josephkerski.



The University of Maine School of Computing & Information Science is offering two MS degrees online

Spatial Informatics • Information Systems

Graduate certificates also available
Geographic Information Systems • Information Systems

Get started today! 207.581.5858 • umaineonline@maine.edu

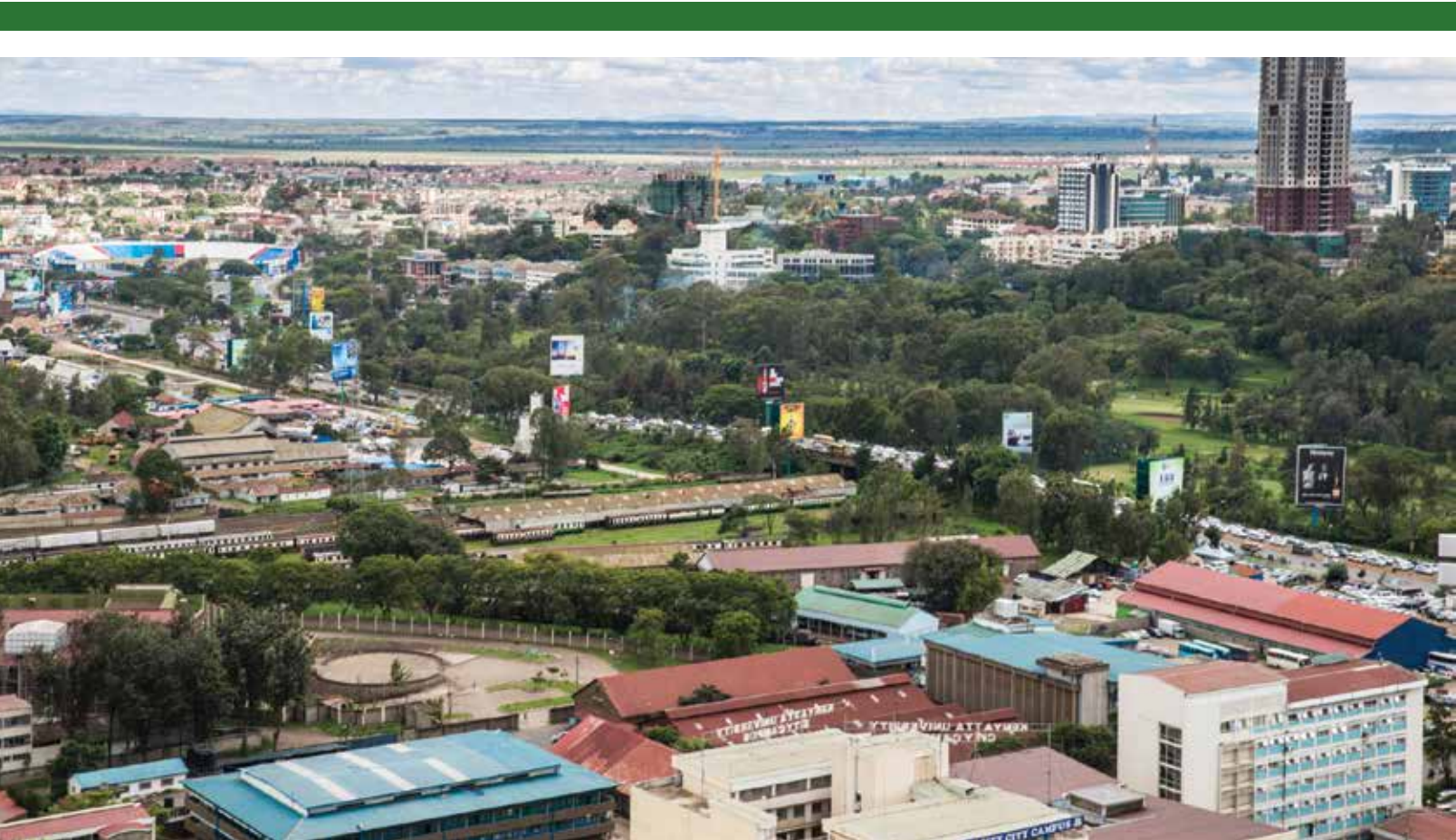
online.umaine.edu/scis



Online access to world-class professors at Maine's premiere public university

The University of Maine is an equal opportunity/affirmative action institution





Kenyatta University Quickly Becomes a Center of GIS Excellence in Eastern Africa

By Jim Baumann, Esri Writer

After implementing an Esri enterprise license agreement under the 100 African Universities program, it took Kenyatta University in Nairobi, Kenya, less than two years to expand its use of GIS technology from a research tool limited to a few professors and graduate students to a multicampus ArcGIS implementation that is a respected center of excellence throughout Eastern Africa.

Kenyatta College, established in 1965 in a former military barracks, became Kenyatta University in 1985. The university takes its name from Jomo Kenyatta, Kenya's first president after it gained independence from Britain in 1963. Kenyatta University currently has 12 campuses that serve more than 88,000 students.

An Opportunity for Transformation

Simon M. Onywere, associate professor and lecturer in Kenyatta University's School of Environmental Studies, first discovered GIS as an undergraduate student in the late 1980s. Later he was instrumental in implementing GIS in his department, but he long believed the technology held great potential for enhancing studies across the entire university.

In 2011, a colleague told Onywere about the new 100 African Universities program announced by Esri at the AfricaGIS conference in Abuja, Nigeria. "Our goal is to foster sustainable GIS curriculums in universities throughout Africa," said Esri president Jack Dangermond.

The program provides a free enterprise license agreement for three years to each participating university. The full complement of ArcGIS software is made available through the agreement. After that agreement expires, licensing costs are determined by the university's ability to pay.

Esri's 100 African Universities Program a Game Changer

"The benefit of the 100 African Universities program is very clear," said Onywere. "It provides the opportunity for students and faculty throughout our university to use ArcGIS in their coursework and research. However, Esri is specific in its requirements for universities to obtain the enterprise license, particularly for computer infrastructure, which, I think is very important for the success of a campus-wide GIS implementation."

Onywere began the application process for the enterprise license for Kenyatta University in 2012. He soon determined that the existing server space at the university was not adequate to support the anticipated use of ArcGIS and had to convince the vice chancellor of the university to buy additional space. By September 2013, GIS was fully available across the entire campus.

"At that point, I felt a great sense of relief and satisfaction," said Onywere. "The university had put in place the required server infrastructure and provided the necessary network access and other computing resources needed to enable our staff and students to use ArcGIS software in their research."

To support the educational needs of students and faculty learning geospatial technology, Esri provides a wealth of online materials, including books, courses, and related course materials as part of the 100 African Universities program.

↓ Introductory courses in ArcGIS aided the adoption of the software across the campus.



Adapting to the Local Learning Environment

"After we explained the benefits of using ArcGIS in their work, the students seemed very enthusiastic about learning this new and powerful technology," said Onywere. "My assumption was that because the students are Internet savvy and Esri provided a wide variety of online educational materials, they would quickly begin studying the available self-tutorials."

Much to Onywere's surprise, this was not the case. "When I noticed that the students who were initially enthusiastic about the opportunity to learn ArcGIS were not using it, I started to ask some questions. Basically, I found they needed introductory training to make them more familiar with the ArcGIS software."

Concerned about this stumbling block and the possibility of the enterprise license remaining underused after the efforts required to have it fully implemented across campus, Onywere began developing

Esri's 100 African Universities Program

Esri's 100 African Universities program has quietly been providing software and learning resources to universities and colleges across the continent. The program is about halfway to the symbolic goal of 100 universities. (One of its notable successes has been Kenyatta University. See the accompanying article, "Kenyatta University Quickly Becomes a Center of GIS Excellence in Eastern Africa.")

Who can apply?

Any African university with a desire to implement GIS at the enterprise or university-wide level can apply. *University-wide* means more than just a GIS laboratory. It means that ArcGIS is used not only in multiple departments but also in libraries and public spaces where all students and researchers can access the software. The IT department must be involved as well to provide needed technical support for servers and online resources. High-level administration support is also critical because enterprise GIS serves its needs as well.

How to apply?

A qualifying university can apply simply by contacting the local Esri office and expressing an interest in joining. That office will work with the Esri Education Outreach team to formalize the application process. The program creates long-term relationships and support structures that can help guarantee the successful use of GIS for teaching, research, and administrative uses across the university.



↑ Kenyatta University School of Environmental Studies faculty pose with visiting Esri staff members Joseph Kerski and Michael Gould.

an introductory ArcGIS training course that was modeled on the university's existing curricula.

"Creating a customized introduction to ArcGIS based on materials the students had some knowledge of was the key," said Onywere. "Though I really did not anticipate personally teaching GIS when I first began this project, I found that it was necessary, and this little boost provided the incentive and confidence the students needed to pursue learning the technology on their own. The pretraining became fundamental to the growing success of geospatial literacy at Kenyatta University."

To expand his teaching efforts, Onywere approached the university's former Institute for Research, Science & Technology, which had partnered with the International Centre of Insect Physiology and Ecology (ICIPE) in Nairobi.

The Institute was working with ICIPE on its Community of Excellence for Research in Neglected Vector-Borne & Zoonotic Diseases (CERNVec) initiative. Using GIS, the research group was trying to better understand the spread of these diseases to control them. Because CERNVec had a well-established GIS capability, Onywere was able to convince them to provide two staff members on an internship basis to assist with his training at the university. This assistance helped the university expedite training. By the end of the first year, more than 1,000 Kenyatta University students had learned how to use ArcGIS.

Today, GIS is used in more than 15 areas of study throughout

the university including the School of Hospitality and Tourism Management, which is mapping tourism resources in Kenya for easier planning, marketing, and research. In addition, the University Geographical Data Portal has been implemented to provide easy access to university mapping projects and other initiatives.

Looking into the Future

An overarching objective of the Esri enterprise license agreement for Onywere is to prepare Kenyatta University students to support the government and its people in achieving the goals outlined in Kenya Vision 2030.

This is a national redevelopment program launched by former President Mwai Kibaki in 2008. The program is founded on three pillars: economic, social, and political, with the intention of increasing the quality of life, social well-being, and democratic voice of all its citizens.

"I am certain that the breadth of GIS applications can play a significant part in helping our country realize the goals of Vision 2030," said Onywere. "Whether it is environmental management, land reform, increasing agriculture yields, urban planning, infrastructure development, and so on—geospatial technology can help with analyzing the problem and providing fact-based solutions. These are the very fields of study our students are pursuing, and their newly acquired GIS skills can be applied directly to achieving the goals outlined by our government."

Arizona State's MAS-GIS Program Prepares Grads for the Real World

By Jim Baumann, Esri Writer



↑ Stephanie Deitrick, program director for the Masters of Advanced Study in Geographic Information Systems (MAS-GIS) program at Arizona State University (ASU) and the enterprise GIS manager for Tempe, Arizona

Students in the Masters of Advanced Study in Geographic Information Systems (MAS-GIS) program at Arizona State University (ASU) have a unique opportunity to gain insights into the practical application of GIS in city government.

They have this opportunity because MAS-GIS program director Stephanie Deitrick, in addition to her responsibilities at the university, is the City of Tempe's enterprise GIS manager.

Deitrick has set up a program with the city that allows students to attend some planning meetings and work on some city projects. This gives them a sense of what to expect in the real world. Students also propose their capstone projects to the city to fulfill an MIS-GIS graduation requirement.

The program, now in its 12th year, has earned a strong reputation for both its academic success and the career paths it opens for its graduates. Between 30 and 50 students are selected annually for the yearlong MAS-GIS program, which provides advanced study in the management and use of GIS technology. The program uses ArcGIS as its instructional platform.

Students accepted into the program come from a variety of academic disciplines. "I find that students have a greater

opportunity for success in this program if they have already developed a discipline-specific background, either by profession or education," said Deitrick.

"I think this real-world experience is very important. The classwork will always appear abstract to them until they actually see how GIS is used in a practical sense," said Deitrick. "Understanding the interaction between the city council and various departments to get agreement on a project and then developing the needs assessment document, as well as defining the workflow and processes required to complete the project, are very important lessons. It allows the students to better understand the importance of working with other stakeholders to successfully implement a GIS-based project."

Part of Deitrick's job with the city is to visit each department, evaluate its current map production workflows, and make recommendations for improvement if necessary. She found that the Tempe fire department regularly issues a large printed map book containing nearly 200 street maps to crews on each of its fire trucks. The background color of the maps is bright yellow, and the details are drawn in red. As a cartographer, her initial reaction was to change the color scheme.

However, Deitrick learned that when it was dark or when the smoke is thick, firefighters need oversized maps drawn in colors that are easy to see. In addition, they needed maps that can be easily shared without relying on a digital display.

"This really struck me," said Deitrick. "I realized how important it was to clearly understand and meet the needs of the user regardless of what I knew, or thought I knew, as a cartographer, and that is something that I teach in my classes."

Deitrick's solution for the fire department will be to create printed maps using ArcGIS that are identical in appearance to those

being used by the department. The added benefit is that they can be easily edited with ArcGIS and viewed in ArcGIS Online.

"My work with the city can be quite varied," concluded Deitrick. "This is something else that I like to emphasize to my students. There is always a new and interesting project when you are working with GIS. That's why it's important to develop your problem-solving capabilities using the technology."

Deitrick is currently working to put into production an interactive map to enhance the capabilities of the Access Tempe website for the city's Americans with Disabilities Act initiatives. This was originally a capstone project started by her students last year.

To learn more about the MAS-GIS program at ASU, visit geoplan.asu.edu/academics/graduate-studies/masters-advanced-study-gis.

LANDinfo
WORLDWIDE MAPPING LLC

SATELLITE & AERIAL IMAGERY
Aerial Photography, UAS & all leading satellite sensors:
Pleiades, GeoEye, WorldView, TripleSat, SPOT Image,
RapidEye, ASTER & Landsat

Image Processing, Vector Feature Extraction,
Spectral Classification & Object-Based Image Analysis

TOPO MAPS & NAUTICAL CHARTS
Global Archive of Digital Map Data

DIGITAL ELEVATION MODELS
UAS, LiDAR, Optical Stereo Satellite & Radar

Contact Us For New Iran 1:25,000 Mapping

AIRBUS DEFENCE & SPACE Image Partner, DigitalGlobe Distribution Partner,
USGS Business Partner, Esri Business Partner, Authorized Vector Reseller,
RapidEye Authorized Reseller, Authorized Interchange Data Distributor

tel +1.303.790.9730 • fax +1.303.790.9734
sales@landinfo.com • www.landinfo.com

Youth Mappers Unite for a Good Cause

By Carla Wheeler, ArcWatch Editor



Youth Mappers is a movement that is galvanizing university students to change the world for the better by mapping it. The fledgling network of university-based mapping chapters is creating maps that will help United States Agency for International Development (USAID) projects that focus on increasing food security; preventing diseases such as malaria; and responding to natural disasters in Asia, Africa, the Middle East, Eastern Europe, Latin America, and the Caribbean.

Youth Mappers project director Patricia Solis at Texas Tech University calls it the Geospatial Revolution 2.0. "It's more than a technical revolution—it's something of a social revolution too," said Solis. She described how students often pitch in and work on volunteered geographic information (VGI) projects aimed at helping developing countries respond to natural disasters or fight problems such as poverty, disease, and hunger. In the process, they learn about other places in the world and



↪ Youth Mappers in a chapter at Khulna University digitize field notes onto the map. They collaborated with two other chapters in the United States on this project. Photo/Chad Blevins

↪ George Washington University students worked on the same rural area near Khulna, Bangladesh. The map will be used to support the US government's Feed the Future initiative there. Photo/Heather Blevins

get the opportunity to connect to students from these areas.

Last year, a chapter at Khulna University in Bangladesh and chapters in the United States at George Washington University and Texas Tech University collaborated to make a basemap of a rural community near Khulna, Bangladesh, where the US government's Feed the Future initiative operates. Once the basemap was finished, the Bangladeshi students visited the area to collect detailed information such as the locations of bodies of water where high-protein fish and prawns are farmed. As part of efforts to improve food security, the map will help USAID better understand who has access to enough nutritious food to live healthy lives.

Students in developing countries know their communities and the land surrounding them well. They can add important information and a local perspective to maps, according to Carrie Stokes, director of GeoCenter, a USAID resource for expanding and institutionalizing the use of geospatial tools and analysis. (See "Mapping a Better World" on this page.)

"Many people in poverty feel they don't have a voice in their own governance," she said. "Give them a skill to define their world by mapping it [and] they feel empowered."

Youth Mappers was formed under the auspices of the new Mapping for Resilience University Consortium. Julia Kleine, the Youth Mappers chapter president at Texas Tech University, said the group has great potential to help people in developing nations because of its international inclusiveness. "Youth Mappers gives people the opportunity to collaborate with students and youth from all over the world, ultimately creating a strong network of leaders in developed and developing nations that can face world issues together and be equipped with the tools to do so," she said.

Most of the students who are drawn to Youth Mappers are those who have a drive for change and desire to give back to the world, said Kleine. This includes members who are international students from developing nations who are studying in the United States. Their reasons for getting involved are personal. They have

experienced firsthand the struggles in the developing world and the lack of access to geographic data.

"If you can visualize the problems and visualize the solutions [*with maps*], that can bring us together to address development issues," said Solis, who is also a research associate professor of geography at Texas Tech University.

Universities in the United States and in countries where USAID works are welcome to join the consortium. Students worldwide can participate in Youth Mappers chapters, mapathons, and research fellowships to

create geospatial data for USAID projects in parts of the world where few maps exist. USAID awarded a \$1 million grant in 2015 to the consortium.

The GeoCenter works with the consortium's founding members, Texas Tech University, George Washington University, and West Virginia University, to build what Stokes calls a "virtual partnership" between students in the United States and students in developing countries. The cadre of international student mappers will then collaborate on making maps using OpenStreetMap (OSM).

Mapping a Better World

Development experts need maps for everything from finding their way around communities after a natural disaster to strategically planning their next project.

The United States Agency for International Development (USAID) is a US government agency that works to end global poverty and foster democratic societies. GeoCenter, an agency resource created four years ago and headquartered in Washington, DC, has a staff of 20 experts who conduct analysis to improve USAID's international development programs.

In addition to conducting their own analyses, GeoCenter team members also work to build geospatial capacity within USAID. The team provides training to USAID staff and has created a global network of GIS specialists in USAID field offices around the world. Most of the specialists are Foreign Service Nationals (FSNs), who bring with them a valuable cultural understanding of the countries in which USAID works.

Much of the GeoCenter's work is focused on analysis to help USAID better target the places where its limited resources can have the greatest impact. GeoCenter analysts use ArcGIS and other statistical tools for conducting analyses, said GeoCenter director Carrie Stokes.

"In the United States, we are so used to having basic maps. That is not always the case in countries where USAID works," said Stokes. "Many parts of the world remain unmapped," Stokes said.

Youth Mappers, a network of university students established under the Mapping for Resilience University Consortium, works on USAID projects. (See "Youth Mappers Unite for a Good Cause" in this issue.)

Students create foundational basemaps that are vital for a variety of international development projects. USAID also anticipates that the Mapping for Resilience University Consortium will cultivate professionals with mapping skills, especially women from developing countries. The consortium plans to foster leadership roles for women.

The word *resilience* in the name Mapping for Resilience University Consortium underscores the importance of the consortium's mission to help the people in the nearly 100 countries where USAID works. "We are trying to end extreme poverty and to help communities be more resilient to the many challenges they face, whether it is a drought, a change in government, an earthquake, or the changing climate," Stokes said.

→ An OpenStreetMap basemap of a rural area of Khulna District in Bangladesh before detailed information was captured by local students. © OpenStreetMap contributors.

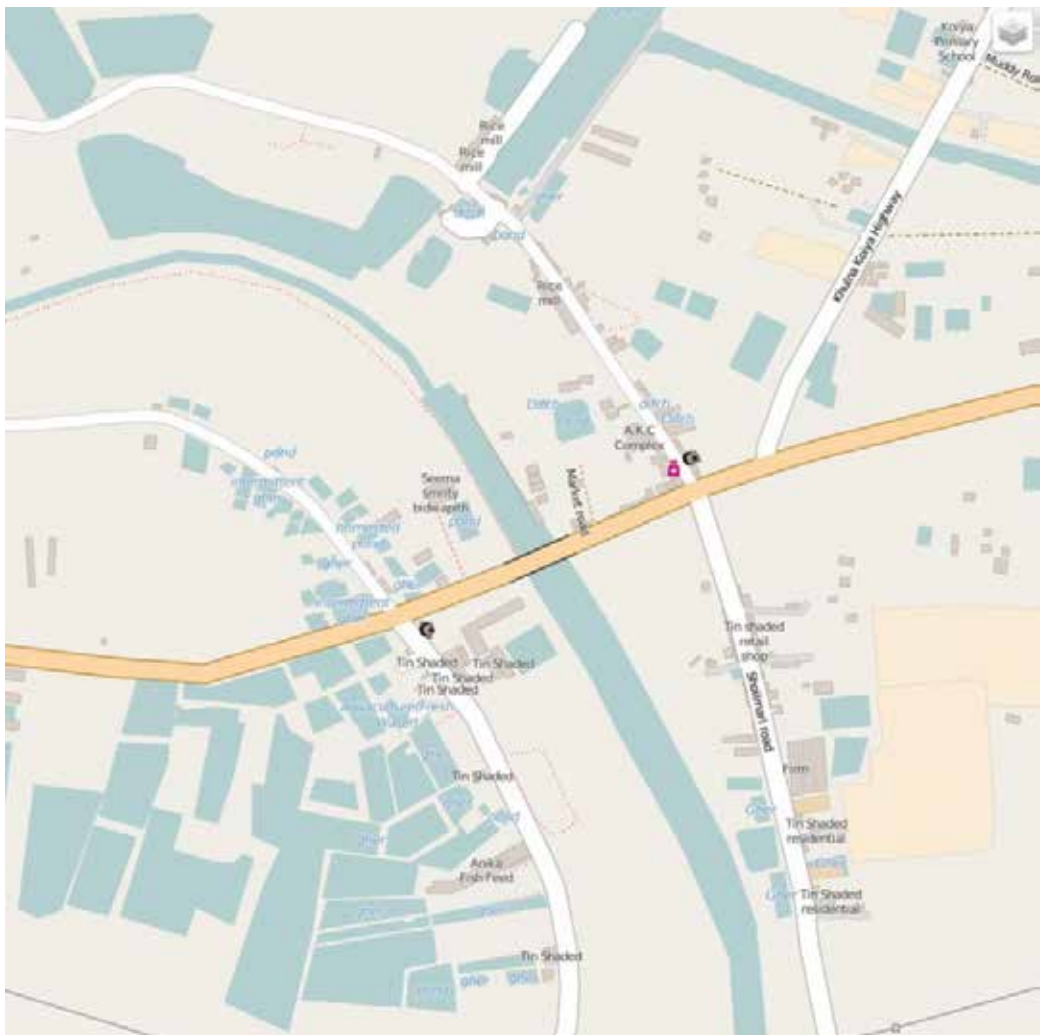
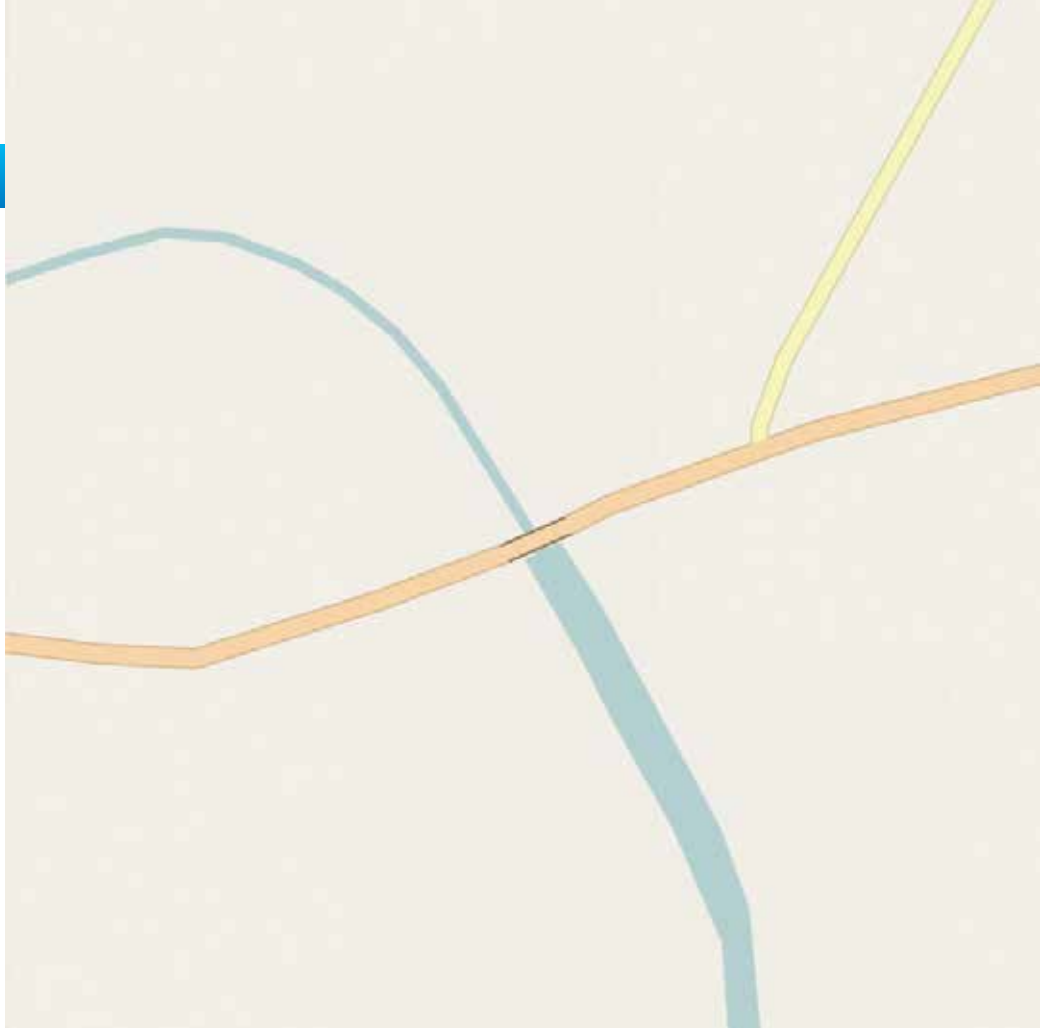
↳ The same map after Khulna University students spent two days walking through this rural area of the Khulna District and added detailed information such as building types, the names of roads, and the location of fish ponds. © OpenStreetMap contributors

Students use high-resolution satellite imagery to map features such as roads, bodies of water, houses, and schools. Using OSM tools such as Field Papers or OpenMapKit, students who live in or near the cities or villages being mapped will go into the field to collect more detailed information to add to the maps, such as road names, the number of students at area schools, or the types of building materials used in houses. The information created by these projects is made available through OSM.

Texas Tech, George Washington University, and West Virginia University chapters have hosted several mapathons to build maps requested by USAID. The events, which offer free pizza and training, attract a diverse crowd that includes students from outside the GIS and geography realms.

In November 2015, these three chapters held a lively mapathon to create a basemap of the African seaport city of Quelimane, Mozambique. Using high-resolution imagery from USAID, the students competed to see which school could map the most features, including houses and roads. An estimated 26,000 buildings and more than 1,000 roads were put into OSM during that mapping effort. The map, now populated with roads and houses, will be used to plan an anti-malaria campaign there. It will help malaria prevention workers plan where and how much insecticide to spray. "If you short-change yourself by not having enough insecticide," said Stokes, "it affects the efficacy of the entire effort."

Stokes points to a successful collaboration in 2013 between students at George Washington University and students from Kathmandu Living Labs. The GeoCenter and the World Bank's Disaster





↑↑ Chad Blevins from the USAID GeoCenter traveled to Bangladesh, where he provided instruction to Khulna University students as they prepared for a day of field mapping. Photo/Michael Crino

↑ Texas Tech University's Youth Mappers chapter president Julia Kleine helped create a map of the city of Quelimane, Mozambique.

Risk Reduction team mapped the city of Kathmandu in earthquake-prone Nepal.

George Washington University used satellite imagery to trace roads, buildings, and other infrastructure. The map features were subsequently validated on the ground by Kathmandu Living Labs students who collected attribute data for those features.

When a magnitude 7.8 earthquake struck Nepal in April 2015, the George Washington University students enhanced the Nepal map on OSM, Stokes said. The GeoCenter downloaded the new map data onto GPS units that American search-and-rescue teams took to Kathmandu.

"It's not just about tech. It's really about

making a difference in the world," said Solis, who witnesses the enthusiasm among the students for these projects. "People care about people around the world when they know something about them," she said.

And do they have fun? "We are talking about a gaming culture," said Solis. "[Students] are motivated. They love the challenge of doing this. But most importantly, the learning potential for making real connections to other places and other students is profound. Youth Mappers not only builds maps, we also build mappers."

Stokes knows that, in the years ahead, the work the GeoCenter does with the consortium to train and mentor the young mappers will be critically important. "We are not only creating the next generation of maps for USAID, but the next generation of mappers for the world," she said.

For more information about the Mapping for Resilience University Consortium, contact mappers.vpr@ttu.edu. For more information about the Youth Mappers chapters, visit youthmappers.org.

Reach GIS Professionals, Managers, and Developers

Advertise in *ArcUser* and reach more than 450,000 people who are actively using GIS and Esri technology in their organizations.

esri.com/arcuser
or ads@esri.com

Copyright © 2016 Esri. All rights reserved.

Esri Corporate Headquarters

380 New York Street
Redlands, CA 92373-8100 USA
T 909 793 2853
F 909 793 5953
info@esri.com
esri.com

Esri Store
esri.com/store

Esri Customer Service
Toll Free
T 888 377 4575
F 909 307 3082
service@esri.com
esri.com/customerservice

Esri Developer Network
edn.esri.com

Esri Technical Support
T 888 377 4575
F 909 792 0960
support@esri.com
esri.com/support

Product Information
ArcGIS Resources
resources.arcgis.com

**Esri Desktop Order Center
and Software Information**
T 800 447 9778 (USA only)
F 909 307 3049
info@esri.com

Esri US Regional Offices

Boston
Middleton, MA
T 978 777 4543
F 978 777 8476

Charlotte
Charlotte, NC
T 704 541 9810
F 704 541 7620

Denver
Broomfield, CO
T 303 449 7779
F 303 449 8830

Minneapolis
St. Paul, MN
T 651 454 0600
F 651 454 0705

Olympia
Olympia, WA
T 360 754 4727
F 360 943 6910

Philadelphia
Chesterbrook, PA
T 610 644 3374
F 610 644 3379

Redlands
Redlands, CA
T 909 793 2853 x1906
F 909 307 3025

San Antonio
San Antonio, TX
T 210 499 1044
F 210 499 4112

St. Louis
St. Charles, MO
T 636 949 6620
F 636 949 6735

Washington, DC
Vienna, VA
T 703 506 9515
F 703 506 9514

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

Esri Distributors Worldwide

Esri Australia Pty. Ltd.
esriaustralia.com.au

Esri BeLux N.V.
esribelux.com

**Esri Bilgi Sistemleri
Muhendislik ve Egitim, Ltd.**
esriturkey.com.tr

Esri Bulgaria Ltd.
esribulgaria.com

Esri Canada Limited
esri.ca

Esri Chile S.A.
esri.cl

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

Esri China (Hong Kong) Limited
esrichina.hk

Esri CIS Limited
esri-cis.ru

Esri Colombia SAS
esri.co

Esri Deutschland GmbH
esri.de

Esri Eastern Africa Limited
esriea.co.ke

**Esri España Soluciones
Geospaciales SL**
esri.es

Esri Finland Oy
esri.fi

Esri France S.A.
esrifrance.fr

Esri Italia Sp.A.
www.esriitalia.it

Esri Japan Corporation
esrij.com

Esri Korea, Inc.
esrikr.com

Esri Lebanon sal
esrilebanon.com

Esri Muscat Co LLC
esrimuscat.com

Esri Nederland B.V.
esri.nl

Esri Northeast Africa
www.esrinea.com

Esri Panama, S.A.
esri.pa

Esri Polska sp. z o.o.
esri.pl

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

Esri Romania S.R.L.
esriro.ro

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

Esri Southern Africa
esri-southernafrica.com

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

Esri Sverige AB
esri.se

Esri (Thailand) Co. Ltd.
esrith.com

Esri (UK) Ltd.
esriuk.com

Esri Ukraine Ltd.
esri.ua

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

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

Esri also has distributors in other
countries around the world. For
more information, contact Esri.
T 909 793 2853 x1235
F 909 307 3070



Copyright © 2016 Esri.
All rights reserved.
Printed in the United States of America.

@esri.com, 3D Analyst, ACORN, Address Coder, ADF, AML, ArcAtlas, ArcCAD, ArcCatalog, ArcCOGO, ArcData, ArcDoc, ArcEdit, ArcEditor, ArcEurope, ArcExplorer, ArcExpress, ArcGIS, arcgis.com, ArcGlobe, ArcGrid, ArcIMS, ARC/INFO, ArcInfo, ArcInfo Librarian, ArcLessons, ArcLocation, ArcLogistics, ArcMap, ArcNetwork, ArcNews, ArcObjects, ArcOpen, ArcPad, ArcPlot, ArcPress, ArcPy, ArcQuest, ArcReader, ArcScan, ArcScene, ArcSchool, ArcScripts, ArcSDE, ArcSdl, ArcSketch, ArcStorm, ArcSurvey, ArcTIN, ArcToolbox, ArcTools, ArcUSA, ArcUser, ArcView, ArcVoyager, ArcWatch, ArcWeb, ArcWorld, ArcXML, Atlas GIS, AtlasWare, Avenue, BAO, Business Analyst, Business Analyst Online, BusinessMAP, CityEngine, Community, Community Analyst, CommunityInfo, Community Maps, Database Integrator, DBI Kit, EDN, Esri, esri.com, Esri—Team GIS, Esri—The GIS Company, Esri—The GIS People, Esri—The GIS Software Leader, FormEdit, GeoCollector, GeoEnrichment, GeoEvent, Geographic Design System, Geography Matters, Geography Network, geographynetwork.com, Geoloqi, GeoPlanner, Geoportal, Geotrigger, GIS by Esri, gis.com, GISData Server, GIS Day, gisday.com, GIS for Everyone, Insights, JTX, MapIT, Maplex, MapObjects, MapStudio, ModelBuilder, MOLE, MPS—Atlas, PLTS, Rent-a-Tech, SDE, SML, Sourcebook:America, SpatialLABS, Spatial Database Engine, Story Map Countdown, Story Map Journal, Story Map Playlist, Story Map Shortlist, Story Map Spyglass, Story Map Swipe, Story Map Tabbed, Story Map Tour, StreetMap, Tapestry, the ARC/INFO logo, the ArcGIS Explorer logo, the ArcGIS logo, the ArcPad logo, the Esri globe logo, the Esri Press logo, The Geographic Advantage, The Geographic Approach, the GIS Day logo, the MapIT logo, The World's Leading Desktop GIS, Water Writes, and Your Personal Geographic Information System are trademarks, service marks, or registered marks of Esri in the United States, the European Community, or certain other jurisdictions. CityEngine is a registered trademark of Esri R&D Center Zurich AG and is distributed under license by Esri.

Other companies and products or services mentioned herein may be trademarks, service marks, or other registered marks of their respective mark owners.

For the things that MATTER IN YOUR WORLD

More and more agencies are turning to the one, easy-to-use solution for public asset management.
Unleash the authoritative data in your GIS.



Cityworks[®]

Empowering GIS
FOR PUBLIC ASSET MANAGEMENT



2016 Esri UC
PREMIER SPONSOR

www.cityworks.com | 801.523.2751



esri[®]

380 New York Street
Redlands, California 92373-8100 USA

Presorted
Standard
US Postage
Paid
Esri

152227 QUAD497M6/16dh

Every Community Can Be a Smart Community

At Esri[®], we do more than talk about smart communities. We help create them.

For decades, we have partnered with thousands of governments of all sizes, all around the world. Through these partnerships we built ArcGIS[®] for State Government and ArcGIS for Local Government—a series of application templates for issues related to economy, health, infrastructure, and public safety. You can download these apps and start creating your smart community today.

Smart communities start here.

Learn more at
esri.com/smartcommunities

