

## Briefly Noted

### Esri Launches R&D Center for GeoAI

Esri recently opened its fifteenth research and development (R&D) center, which will focus on data science, deep learning, and geospatial artificial intelligence (GeoAI) solutions. Located in New Delhi, India, the center will also play a significant role in developing the next generation of ArcGIS Enterprise.

### UN Unveils Gender Statistics Story Map on SDG Hub

The United Nations Statistics Division (UNSD), through the Global Gender Statistics Programme, is collaborating with Esri and statistical agencies around the world to gather data that highlights the current state of global progress on the Sustainable Development Goals (SDGs) and targets relevant to gender equality. The results are being presented in the Women and Sustainable Development story map (available at [arcg.is/00jmSj](http://arcg.is/00jmSj)), which highlights women's economic empowerment, women's voices, and women's safety and human rights.

### Government of Oman Expands GIS Use

At Oman's first ever symposium about developing a national spatial data infrastructure (NSDI) in May, Esri launched a government licensing agreement (GLA) with Oman, in partnership with the country's National Centre for Statistics and Information. The agreement will foster the adoption of ArcGIS technology in about 60 government ministries and entities. According to Sohail Elabd, Esri's general manager for the Middle East and Africa, this is one of the largest GLAs in the region.

## For Automated Maritime Charting, Danish Hydrographic Office Turns to GIS

Denmark has challenging seascapes to map and chart. Aside from its 42-mile land border with Germany, the peninsular Northern European country—with its scores of bays, straits, and fjords—is surrounded almost entirely by the North and Baltic Seas. Denmark is also composed of more than 400 islands, including the Faroe Islands, located in the Atlantic Ocean between the United Kingdom and Iceland. And then there's the Danish territory of Greenland, an 836,000-square-mile Arctic island whose mountains descend precipitously to the sea and whose glaciers release icebergs into labyrinthine straits and fjords.

Denmark has a rich history of nautical charting that dates back to the seventeenth century, and many of its navigational products for Greenland were created in the 1960s. The information on those charts was good and sufficient for traditional navigation, but when GPS started to gain prominence in shipping in the 1990s and early 2000s, hydrographic offices around the world had to start producing Electronic Navigational Charts (ENCs). But Denmark's existing data—especially farther north, around Greenland—didn't line up with GPS points or new high-quality multibeam sonar readings.

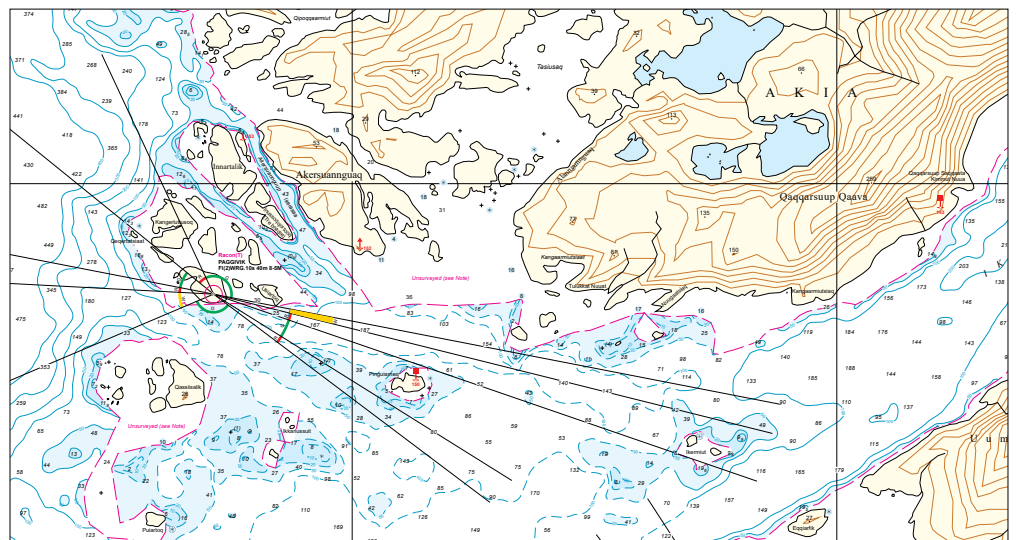
So the hydrographic office at the Danish Geodata Agency (known by its Danish acronym GST) needed to take a different approach.

"Though the charts were accurate for the time, we had to georectify old data with new data to produce

an update," said Rune Carbuhn Andersen, head of the Arctic Division at the Danish Hydrographic Office.

But the division kept all its nautical data in separate files, and that was difficult to update. Within a

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↑ The Danish Geodata Agency (GST) is building an enterprise-wide geodatabase for all its nautical data, which will make it easier to create paper and electronic charts, like this one of Greenland's west coast. (©Danish Geodata Agency—320-0208)

## ArcGIS Urban Transforms City Planning

ArcGIS Urban is a web-based system designed to improve urban planning and decision-making. For planning commissioners and teams, local policymakers, city council members, and the public, it offers a comprehensive overview of development activities along with a suite of tools they can use

to shape the urban development life cycles of their communities.

Regional and local regulations have consistently guided the growth and development of modern cities, but in the last 50 years, the connection between the rules that govern land use and the physical outcome

has broken down. In many cases, this has resulted in urban sprawl that continues to grow, despite demand for mixed-use, walkable communities.

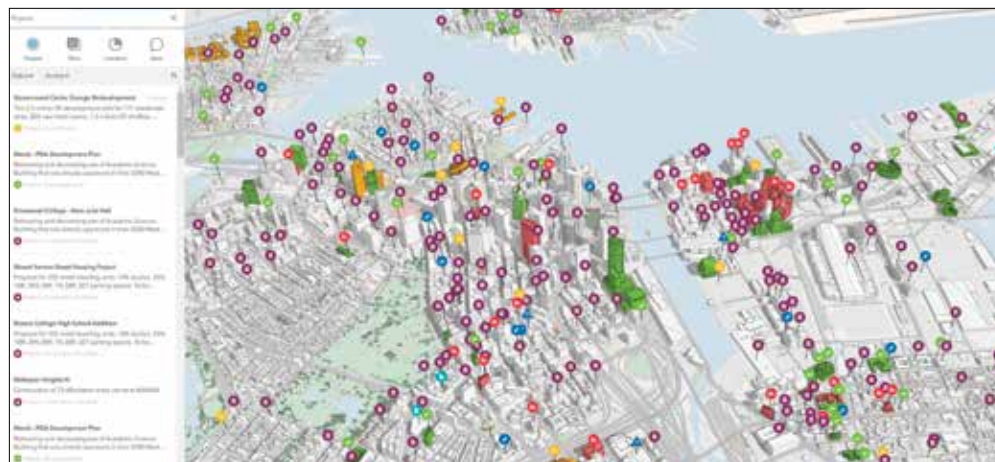
ArcGIS Urban represents an evolutionary step forward in how people interpret and better apply complex land-use regulations to make cities better by fostering a more livable urban form. With an immersive 3D experience, Urban gives organizations the capacity to visualize proposed transformations, enabling planners, local governments, and citizens to formulate a common understanding of what changes could take place in their communities.

### A Complete Planning Support System

ArcGIS Urban, part of Esri Geospatial Cloud, consists of three components: a public-facing Urban Overview web app for standard browsers and/or mobile devices; a back-office Urban Design web app; and Esri CityEngine for desktop workstations.

Urban Overview allows users to search their cities and explore the locations of planned development, as well as their status. Allowing stakeholders

continued on page 3



↑ The Boston Planning & Development Authority (BPDA) facilitates more than 80 large development projects in and around Boston, Massachusetts, every year. With ArcGIS Urban, the public agency can consolidate the development pipeline into a central, shareable view of projects.



In 2024, Tunisia's National Statistical Institute (NSI) will conduct its next census. Thanks to a team of enterprising IT engineers, the census surveys and their related statistical processes will be automated. It all revolves around web, mobile, and enterprise GIS. So far, the team has deployed the technology for smaller surveys, and results are impressive.

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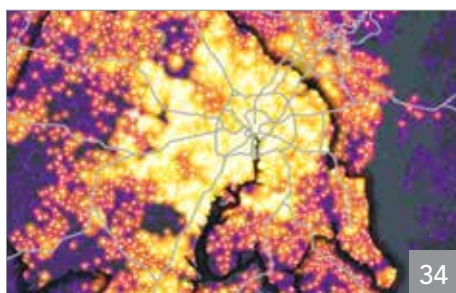
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## Maximum Exposure, Minimum Investment

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to visualize citywide projects in a standard web browser supports the inclusive review of new projects and streamlines the building application process, potentially reducing it from months to weeks. A shared view of the development pipeline also increases public transparency, lessens uncertainty, and promotes greater community involvement in the review process.

The Urban Design tools blend spatial information into a focused set of scenario planning capabilities. Starting with authoritative data on existing conditions provides the basis for future scenario development and reporting on key performance indicators, such as the number of new households and jobs. Users can author specific area plans that incorporate zoning considerations into the design process, which improves productivity and the viability of proposed development patterns.

CityEngine is now integrated with ArcGIS Urban as well. This enables users to access plans and projects directly in CityEngine by connecting to web GIS layers in Urban. Advanced downstream design workflows, such as detailed streetscape and façade modeling in CityEngine, can further leverage cross-platform interoperability with virtual reality (VR) platforms or other modeling software, including Unreal Engine or SketchUp.

With support for projects of varying sizes, Urban can strengthen collaborative planning efforts across teams and organizations. The system is designed to break through the technical barriers that often stand in the way of utilizing spatial information within rigorous scenario development.

#### Achieve Collaboration and Deliver Clarity

Local communities need to address the challenges that are related to affordable housing, walkability, and multimodal mobility, but they can't do that holistically without examining the local

zoning and land-use codes that encourage (or discourage) certain types of development. With ArcGIS Urban, users can get up and running with scenario development quickly, increasing their technical capacity to analyze the economic, social, environmental, and spatial impacts of plans and policies. Whether a community is undergoing a downtown revitalization or attempting to foster better transit-oriented development, Urban builds zoning considerations into the scenario-based process, ensuring the viability of conceptual plan development.

Urban also makes it possible to track progress by incorporating the active development pipeline, which comes in handy when creating plans for entire neighborhoods, since these often take years to implement and, thus, need to remain flexible and responsive to market forces. More importantly, since both planners and developers have a clear view of development guidelines, the review period required for building applications is reduced, and projects that align with the local community's planning objectives are encouraged.

Each project in ArcGIS Urban can have a 3D model that portrays the shape and height of the major massing components of draft building proposals as they undergo revisions. Incorporating building information modeling (BIM) and other types of 3D information through the project submission process can improve spatial accuracy and certainty when evaluating the impacts related to shadow cast and viewshed. This gives planning teams a complete understanding of how proposed projects will affect the built environment and ensures consistency with land-use regulations.

In addition, users can take advantage of shareable web scenes and distributed collaboration in Urban, which can help build



↑ In ArcGIS Urban, users can share proposed projects, like the City of Zurich did when it presented these building candidates in a competition for a new public school in the Allmend neighborhood.

consensus across government, the real estate development community, and the public during the review process. This increases the opportunity to collaborate with local residents beyond the city council room, as all relevant stakeholders have a complete view of proposed projects.

#### Shaping the Future of Your Community

ArcGIS Urban is a new solution designed to respond to the significant challenges that cities face—from upsurges in population to the related development pressures. Planning can be a time-consuming and expensive process that is often reactive to changes in the local real estate market or the broader economy. But by following just three steps, professionals can leverage Urban to proactively increase resilience, expand transparency, and achieve equity in city planning.

First, users translate their local regulations—parameters such as building use, density, and dimensional requirements—into a system of record that they need for a modern zoning code. Many cities today are undergoing multiyear endeavors to rewrite their zoning codes and incorporate improved form-based urban design concepts. With Urban, users can assimilate this work into a framework to support scenario planning.

Second, users establish shared views of plans, projects, and indicators both internally across departments and with community stakeholders. A shared view of what's being built and planned is necessary to make important decisions as a community, which can stimulate private investment and garner more support for long-term economic development goals.

Third, city officials can use Urban to reach elusive populations while also increasing transparency for residents who are unable to attend council meetings. This ameliorates the widespread urban development processes that are prevalent today, wherein developers present their projects to city councils and the council votes on them without much community involvement.

Urban makes it possible to create plans that foster the kind of human-scale communities the public wants while also promoting transparency in the development pipeline and offering new opportunities for public engagement. With a common operating view of plans, projects, and indicators, Urban empowers users to produce an attractive, sustainable, and equitable future for prosperous cities. Learn more at [go.esri.com/smartplanning](http://go.esri.com/smartplanning).

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↑ The master plan for Sabah Al-Salem University City—Kuwait University (SSUC-KU) was developed in conjunction with the university's GIS data model.

# New Kuwait University Campus Incorporates GIS from the Outset

Sabah Al-Salem University City, which will soon contain all the buildings and colleges associated with Kuwait University, is “one of the largest educational campuses in the world,” according to its website. Known as Sabah Al-Salem University City—Kuwait University, or SSUC-KU, the campus is one of Kuwait's main development projects. GIS has been the backbone of SSUC-KU's project life cycle since the beginning and will continue to shape day-to-day activities at the university for years to come.

## Managing All Data and Assets with GIS

Previously, Kuwait University's colleges were scattered in different locations throughout the country. Traffic around those campuses was severe, and the buildings couldn't absorb the growing number of students.

The new, consolidated SSUC-KU campus has all the facilities and amenities needed to offer a modern education. In all, SSUC-KU's two campuses span 6 million square meters (2.3 square miles) and are designed to accommodate 40,000 male and female students, divided equally into male and female buildings to preserve Kuwait's traditions as an Islamic Arabic country. The main campus, which contains the university's 11 humanities and scientific colleges and covers 4 million square meters (1.5 square miles), consists of 22 buildings. The health sciences campus, which is still being designed, will fill 2 million square meters (.75 square miles) and host the university's 5 medical colleges in about 25 buildings.

The intention is to manage all SSUC-KU data—whether spatial or nonspatial—and assets using GIS. To achieve that, the campus's master plan was developed alongside the first version of its GIS data model, built using a combination of Esri's industry-specific data models, which cover all expected services, such as water, electricity, and telecommunications. As the construction process got under way, the data model needed to be extended to absorb new datasets, feature classes, domains, and subtypes. The latest version of the data model contains 29 datasets, 433 feature classes, 58 geodatabase tables, and 21 relationship classes.

As some of the colleges on the main campus were getting ready to receive students, which will happen this September, the team at Openware, Esri's official distributor in Kuwait and the GIS consultant on the project, used ArcMap and ArcGIS Pro intensively to ensure a smooth transition from the old

university to the new campus. In fact, GIS became the primary decision-making tool at this time. Staff in various departments requested hundreds of reports to help them locate their spaces and services on maps. For example, employees in the department of libraries requested maps showing all the library facilities in each building so they could arrange their supplies and revamp their workflows. Staff in the services department, meanwhile, requested maps showing all the electrical rooms, telecommunications pathways and spaces, and more throughout the campus so they could situate their teams appropriately.

## A Portal, Some Apps, and a Dashboard

Once the campuses are in full service, university staff, faculty, students, and visitors will need to be able to find various buildings and rooms, figure out where they need to go, and work out what they need to do on the new campus. Thus, Openware recently developed a bilingual—Arabic and English—mobile portal that contains search apps. The locate subsystem within the portal is built on Elasticsearch technology and utilizes the ArcGIS Indoors Information Model, which draws a route for each search result based on the user's current location. The portal also includes outdoor mapping functionality, which contains a map that shows the campus's street network and basic outdoor infrastructure, taken from the SSUC-KU master plan. The map can even be extended beyond the campus—and throughout the entire state of Kuwait—to make navigation to and from the area seamless.

The mobile portal contains various apps as well. One app allows inspectors with special privileges to generate work orders and assign tasks to field maintenance crews. The app consumes ARCHIBUS database tables inside Survey123 for ArcGIS forms, which together, with their standardized forms and tables, make it easier for inspectors to manage campus assets. For students, there is a study schedule app that provides users with academic information, including the course name, lecturer bio, place, and time; the academic calendar; a list of important dates for students and staff; and even a route map for how to get to specific classes or labs. Additionally, there is a geonotifications app that administrators can use to send alerts to university staff, faculty, students, and visitors

about specific events or emergencies. Users will receive these notifications on their cell phones based on their location, movement, or nearby events.

To get the mobile portal and its apps working perfectly, the Openware team developed a web app to manage the administration web page. This lets users with administrative permissions set roles and privileges for other users and administer and configure push notifications.

Of course, the flow of data through SSUC-KU's GIS, typically called “flow of transmittals,” is massive. Hence, it was necessary to control this process using a dynamic dashboard, which the Openware team built with Operations Dashboard for ArcGIS. The dashboard shows the number of transmittals by month, discipline, project, and business, as well as the review results for submitted packets of data, which are designated as approved, rejected, or accepted with notes. To show these statistics on the dashboard, it was necessary to design an ArcSDE table that specific users can access and edit to keep information up-to-date. Editing and tracking are also enabled so that management can know who is doing what and when.

At the campus level, water and electricity networks are managed and updated using Esri partner Schneider Electric's ArcFM solution, which is installed on top of ArcGIS Desktop. The campus's telecommunications network, however, is managed and updated using GDI Ensemble from Esri's official distributor in Croatia, GDI.

## Planning for the Future

With SSUC-KU's health sciences campus currently under design, the project team is incorporating even more sophisticated enterprise technology. To support the operations and decision-making processes, for example, this campus's building data will be delivered in a building information modeling (BIM) format that is compatible with the university's current GIS schema. This will allow staff at SSUC-KU to simulate all the buildings and their complete services, including water, electricity, and telecommunications. By 2021, when the health campus is fully designed and construction begins, the flow of transmittals in both GIS and BIM formats will be incorporated into SSUC-KU's geodatabase, enriching the campus's GIS content.

For more information, email Eyad Ghattasheh, a GIS consultant at Openware, at e.ghattasheh@openware.com.kw.

# Tracker for ArcGIS

## Streamlines Fieldwork Management

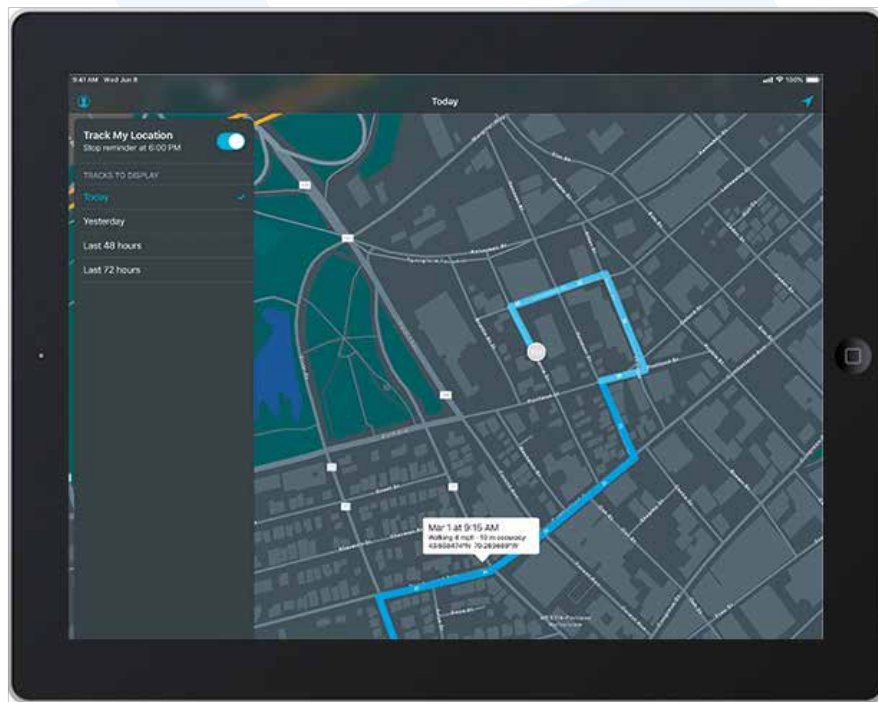
Field operations are a critical component of the work many organizations do. Utilities, law enforcement agencies, public works departments, and outside sales teams all rely on field personnel to provide services and conduct daily business.

There is often a disconnect, however, between what is happening in the field and what is going on in the office, and that can leave managers and supervisors uncertain of where their field resources are at any given time. Historically, fieldwork-heavy organizations have used work tickets, two-way radios, and other tools to help bridge this divide. But getting a real-time understanding of where field personnel are has always been difficult and expensive.

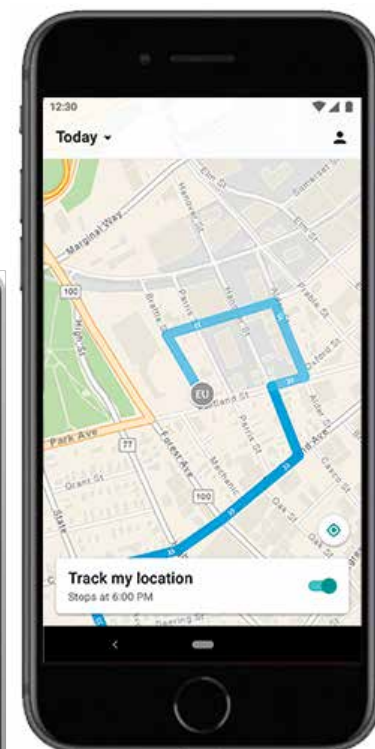
That's not the case anymore, though. Tracker for ArcGIS, a newly introduced app from Esri, allows field personnel to share their real-time locations using a mobile app for iOS and Android devices. The track data enables supervisors and managers to identify a user's last known location and also perform after-action analysis using the new location tracking capability in ArcGIS Online and ArcGIS Enterprise.

Location tracks can be viewed and analyzed by authorized viewers with the Track Viewer web app or other visualization and analysis tools in ArcGIS that leverage the location tracking capability. Managers and supervisors can then get greater insight into the location behavior of field personnel by

- Creating linear heat maps to visualize the density of location tracks over time.
- Aggregating tracks to analyze coverage over an area and identify gaps.
- Using incident detection to uncover abnormalities in track data, such as a significant change in a person's rate of speed.
- Verifying where inspectors were when inspections were carried out.
- Deriving new datasets from locations traveled.



↑ Field personnel can set reminders to prompt them to start and stop sharing their tracks.



↑ With Tracker for ArcGIS, supervisors can see the precise locations of fieldworkers, which aids in verifying work, monitoring safety, and better coordinating field resources.

The following examples show how organizations that employ Tracker can better support supervisors, managers, fieldworkers, and customers:

**Know Where Everyone Is**—Tracker enables field personnel to securely share their locations with supervisors who benefit from seeing where their workers are. Knowing the precise locations of the field workforce helps supervisors verify work, monitor safety, and better coordinate personnel and resources in response to unplanned events.

**Review Where People Have Been**—Tracker stores location tracks so they can be accessed and reviewed later. Stored location tracks can be used to analyze the places workers visited during their shifts. This helps prove that work was conducted at a specific location, measure whether contractors met service-level agreements, and even derive new datasets—on crime patterns or speed limit violations, for example—using the tracks collected.

**Improve Efficiency in the Field**—Analyzing a workforce's location behavior can improve operational insight and boost efficiency. Command chiefs, operations managers, and field supervisors can find patterns that contribute to gains or losses in efficiency, discover areas where compliance requirements aren't being met, identify potential process enhancements or corrections, and better understand the balance of staff resources relative to where needs exist.

**Support Field Personnel**—Using Tracker allows fieldworkers to see where they are and where they have been so it's clear whether the intended territory has been covered. When the day is done, field personnel can easily turn off the Tracker mobile app. They retain complete control over when they share their location and can set reminders to prompt them to start and stop sharing their tracks.

### Empower Your Organization with Tracker

The Tracker mobile app is available for download from the iTunes App Store, Google Play, and the Amazon Appstore. To sign in to the app, users need a premium app license for Tracker for ArcGIS. The Track Viewer web app can be used by ArcGIS administrators to create track views (feature service views), as well as by any authorized supervisor to view tracks.

Tracker is a premium app that can be added to any ArcGIS User Type license. Learn more at [esri.com/tracker](http://esri.com/tracker).



↑ Authorized viewers can see and analyze fieldworkers' location tracks using the Track Viewer web app.

Read how the Pasadena Fire Department used it for the 2019 Tournament of Roses Parade on page 6.

# Pasadena Tournament of Roses Manages Real-Time Situational Awareness

## Fire Department Applies Tracker for ArcGIS

One of the United States' oldest parades is the Tournament of Roses Parade, which started in 1890 in Pasadena, California, and is now held every New Year's Day to showcase the abundance of flowers and greenery that adorn Southern California all winter. The floats in the parade must be completely covered with flowers or other natural materials, making this a unique and eye-catching event.

In 1902, the festivities expanded to include the Rose Bowl, now a very popular collegiate football game that happens later in the day. From the 3,000 spectators who came out for the very first Rose Parade, attendance and interest in the combined events has grown enormously. In 2019, the parade and game attracted more than 800,000 live attendees and 59.3 million television viewers around the world.

The safety of participants and attendees is a critical concern for the city, especially given the high visibility of these events. These responsibilities—which include managing public safety for the Rose Parade, the Rose Bowl, and any associated events before and after New Year's Day—are entrusted to the Pasadena Fire Department and the Pasadena Police Department.

The fire department, which has provided support for the Rose Parade since its inception, is composed of eight fire stations and has a staff of 181 people. Usually, the department serves a population of 142,250 people and, on average, receives 55 calls for service each day.

As Pasadena's New Year's Day festivities have expanded to include eight significant events from December 28 to January 2, so have the demands on

the fire department. In addition to experiencing a 100 percent increase in call volume over those six days, the fire department now has to collaborate with 19 different federal, state, and local agencies in the Multi-Agency Coordination Center (MACC).

To effectively manage the spike in workload that goes along with the influx of hundreds of thousands of people into suburban Pasadena, the fire department depends on a comprehensive situational awareness and response plan. This now includes heavy reliance on ArcGIS Pro, Drone2Map for ArcGIS, Collector for

ArcGIS, ArcGIS Online, Operations Dashboard for ArcGIS, and the new Tracker for ArcGIS.

### Siloed Data and Temporary Assets Present a Challenge

Unifying the various agencies within the MACC can be complicated. Each agency brings its own protocols, technology, and data, which makes it difficult to provide a common operating picture that serves as the authoritative reference for managing logistics and ensuring public safety. But authoritative data sources and systems are

key to ensuring that public safety personnel have a good understanding of the area so they can efficiently and effectively coordinate their response to any incidents.

The five-and-a-half-mile parade route is more complex than it appears on television. The parade itself has a Level 1 Special Event Assessment Rating from the federal government, meaning it is of significant national importance. To help ensure the public's safety, the Tournament of Roses erects temporary fencing and vehicle barricades, which impact the normal flow of traffic. Even



↑ The location tracks exhibited via Operations Dashboard for ArcGIS enabled dispatchers to identify the unit closest to an incident and/or pinpoint the unit that would be able to get to an incident the quickest, taking barricades and traffic jams into consideration.

# EMPOWER GIS INTELLIGENCE

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agency representatives who are familiar with the area find it challenging to negotiate various closures. Additionally, public safety personnel have to monitor the grandstands and broadcast booths that spectators and the media use, but these are also temporary structures, so capturing their precise locations is difficult as well.

#### With Better Technology Comes Better Maps

Prior to 2019, the incident action plan (IAP) for the Rose Parade, the Rose Bowl, and their associated events relied on paper maps. The printed IAP was distributed to each agency and circulated among units on a need-to-know basis.

When a call was received, dispatchers at the area's Verdugo Fire Communications Center had to thumb through the IAP's printed maps to find out which unit was responsible for responding to incidents in the caller's zone. The assigned unit then had to locate the incident on its own IAP map to quickly identify any potential delays due to changes in traffic flow.

For Pasadena Fire Department captain Oscar Sepulveda III, building a comprehensive digital map that pulled data from one authoritative source and made it available to all agencies was an important goal.

"The vast majority of data derived from the fire service is siloed, thereby inhibiting efficient collaboration with other public safety entities," said Sepulveda. "Ensuring that all levels of command are empowered with real-time data increases public safety and overall situational awareness for firefighters."

Sepulveda has been an ArcGIS user since 2015, so he was confident that he could use the geoprocessing tools in ArcGIS Pro to begin creating a common operating picture for all public safety personnel working the New Year's events.

His first task was to digitize the AutoCAD-rendered maps that the largely volunteer-staffed Tournament of Roses organization had. From

these maps, Sepulveda was able to use ArcGIS Pro to produce new layers of information, adding a tremendous amount of detail that had previously not been available—from real-time asset location and incident data that could be consumed in the field to street impact information that could be leveraged against the Waze navigation app.

Next, Sepulveda used Drone2Map to create drone-captured imagery of the parade-ready environment, which he used as web map overlays. These overlays provided details of the as-built parade environment to the point that a user would be able to zoom in on something as finite as an individual grandstand seat.

Using Collector, Sepulveda and his team then gathered accurate location data for important assets, such as the grandstands, the staging areas for parade participants and emergency response vehicles, and the zones to which emergency response personnel were assigned. This data, presented as points, lines, and polygons, was fed into ArcGIS Online as feature layers.

With all this new data, Sepulveda and his team created a comprehensive digital map of the parade route, the Rose Bowl, and all the surrounding areas. For the 2019 events, this map would be used to support the needs of the unified area command and enhance security on New Year's Day.

#### Location, Location, Location—In Real Time

For any incident, being able to identify and mobilize the nearest unit is critical. To that end, Sepulveda wanted to have real-time data of all emergency response assets and ensure that this was visible at the MACC, where situational awareness for Pasadena's New Year's events is managed. The objective was to align the distribution of response units with historical data on previous incident locations, meaning that the concentration of an effective response force would most likely be positioned in an area where it could stop an emergency from escalating.

While preparing for these events, Sepulveda learned from his Esri account manager about the new Tracker app, which lets supervisors and managers track field personnel by capturing their location tracks on a mobile app. Staff at the MACC could then view the captured tracks in a web app or as a feature service in other ArcGIS solutions. With approval from his technology-forward fire chief Bertral Washington, Sepulveda informed the Tournament of Roses' liaison and planning committee about this new capability and obtained the organization's support to use Tracker during the 2019 event to test the technology.

On January 1, 2019, the Rose Parade, Rose Bowl, and postparade events were supported by fire engines; truck companies; ambulances; emergency medical services teams on bikes, in carts and utility vehicles, and on foot; American Red Cross first aid stations; Urban Search and Rescue California Task Force 4; water tenders; a brush patrol firefighting unit; and additional sworn personnel. The rescue carts and bike teams carried iPads equipped with Tracker, which was downloaded for the proof-of-concept project. In addition, multiple parade participants, including band leaders and float drivers, downloaded the Tracker app to their smartphones.

For the duration of the parade, each unit and participant ran Tracker, enabling their location tracks to be collected and fed directly into ArcGIS, where area commanders in the MACC could view them in real time in Operations Dashboard. This enabled dispatchers to identify not only the unit closest to an incident but also which unit would have the fastest response time based on traffic jams, barricades, and other traffic flow changes. What's more, each unit was able to use the digital event map in a dashboard or a web app to zoom in on any area of interest, which could help them quickly navigate impacted and restricted routes to reach an incident in the most efficient way. Additionally, for the first time, fire commanders

were able to monitor assets in real time, via a single source, which allowed them to improve resource management during the live events.

#### The Value of Coordinating Resources

Having access to a single, authoritative digital map of all New Year's Day events in Pasadena enabled the agencies in the MACC to better coordinate their resources. Each agency could easily turn off any data layers that weren't relevant to their work. That eliminated the inefficiencies of having to leaf through the various static maps that used to constitute the IAP.

Furthermore, having the real-time location tracks of field personnel allowed area commanders to continually assess the balance of first responder coverage with areas of activity. By using the map with real-time location data for each available response unit, the dispatchers from the Verdugo Fire Communications Center were able to effectively dispatch the unit closest to each incident. Although there was only one high-visibility incident—a parade float that caught fire but was quickly extinguished—there was no question that the emergency response plan for 2019 was more efficient and effective compared to previous years.

"How do you measure the value of being able to potentially save one life, not to mention the potential to save multiple lives? It's a very real possibility in an event like this," said Sepulveda. "That's the value of Tracker for ArcGIS."

After all the New Year's celebration events, the Pasadena Fire Department conducted a postincident analysis. It concluded that use of the ArcGIS platform contributed to the success of this year's events and is an effective way to provide real-time situational awareness. Modern technology enhanced the strategic and tactical objectives associated with this year's Rose Parade, the Rose Bowl, and all pre- and postevent activities, and it will be used going forward into 2020 and thereafter.

The Tournament of Roses Parade, which requires every float to be completely covered in flowers or other natural materials, is held every New Year's Day in Pasadena, California. (Photo courtesy of Mike's Birds, Flickr, CC.)





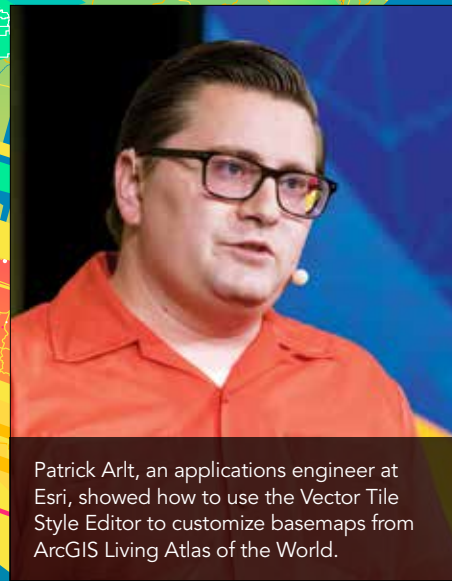
Jim McKinney, chief technology officer (CTO) of desktop development at Esri, lauded the work that developers do to make their organizations better.



Esri's CTO of developer technologies, Euan Cameron, explained that the redesigned ArcGIS Developer Subscription is tailored to the work that developers do.



Esri software development director Sud Menon gave the audience a comprehensive overview of the ArcGIS platform and the Esri Geospatial Cloud.



Patrick Arlt, an applications engineer at Esri, showed how to use the Vector Tile Style Editor to customize basemaps from ArcGIS Living Atlas of the World.

# Where Geospatial Apps GO NEXT

In the geospatial world, location is paramount.

"Location has an aspect in every bit of decision-making and analysis and visualization, and it's just going to become a more powerful tool," Jim McKinney, chief technology officer (CTO) of desktop development at Esri said in a video welcoming 2,100 geospatial app developers to the Esri Developer Summit (DevSummit) in Palm Springs, California, in March.

The developers, who came from around the world, attended technical workshops, met with Esri staff, and—for the athletic minded among them—played in a spirited dodgeball tournament. The technical sessions, however, were the bread and butter of the summit, with about 200 sessions designed to teach developers how to best work with Esri technology, including ArcGIS API for JavaScript, ArcGIS API for Python, ArcGIS GeoEvent Server, ArcGIS Runtime SDKs, AppStudio for ArcGIS, Web AppBuilder for ArcGIS Developer Edition, and many other products.

Attendees also watched about a dozen Plenary Session demonstrations, including one on the new ArcGIS Notebooks for analyzing and visualizing big data, and another on the ArcGIS Vector Tile Style Editor, which can be used to easily create beautiful and well-designed custom styles for Esri vector basemaps.

The theme of this year's DevSummit was GIS—Inspiring What's Next, with the Plenary Session designed to show attendees the latest capabilities in ArcGIS. But before Esri staff dug into the nitty gritty of the technology, McKinney gave a shout-out to the geospatial app developers. These are the people who often work behind the scenes to build the apps their colleagues use to visualize, manage, analyze, and share information so they can make critical decisions.

"Your work, your creativity, your code, the apps that you build, and the systems that you build enable people to make better decisions and make a positive difference for your organizations, for your enterprises, for your customers, for the public, and for our planet," said McKinney. "And that is awesome."

Esri president Jack Dangermond also lauded the developers' work.

"Our sense is that you are doing the system's thinking. You are doing the engineering. You are building the applications

that backdrop so much of what is happening in the geospatial world today," Dangermond told the audience. "Some of you are doing it with lightweight applications, [while] some of you are doing it with machine learning and heavy-duty analytics. Some of you are setting up architectures and making whole organizations come to life [geospatially]."

Dangermond said that despite the negativity in the news, the work that geospatial app developers do is a positive force, and that deserves a big thanks.

"Your work is one of the bright lights of the planet," Dangermond said. "It's literally building that infrastructure that I think will make positive change on an ongoing and sustained basis."

## What's New, What's Next

The building blocks for that infrastructure include Esri technology, plus resources like ArcGIS Developer Subscription. This program offers access to a complete mapping and location analytics platform for developing apps.

Esri has completely redesigned the developer experience to bring the power of mapping and location intelligence to all developers. This includes common capabilities like visualization, routing, and geocoding, as well as sophisticated analytical capabilities, offline workflows, and the ability for developers to host their own data. The experience starts with the ArcGIS for Developers website, where developers get a dashboard tailored to their interests and the type of developer they are.

Developers can sign up for an Essential subscription, which lets them access all of Esri's APIs and SDKs for web, native, and mobile platforms; host, query, and manage content; style basemaps; and benefit from hundreds of tutorials, samples, and open-source projects. They can also use tools like the Vector Tile Style Editor, which gives them the ability to style Esri vector basemaps. Builder subscriptions include everything in the Essentials subscription and add commercial app deployment for an unlimited number of revenue-generating applications, more tools for building and testing, and Esri technical support. All developer subscriptions get up to 1,000,000 free map views per month and a pay-as-you-go model to use Esri's routing and analytical services, which have been substantially reduced in price.

"It's tailored to the work that you do," Euan Cameron, CTO of developer technologies, said about the program. "We present content that's specific to the needs of your development efforts. We've got tools like the new ArcGIS Vector Tile Style Editor...[and] we have lots of open-source projects for you to start doing your development."

Esri software development director Sud Menon gave the audience a comprehensive overview of the ArcGIS platform. "ArcGIS itself is part of Esri Geospatial Cloud," Menon said.

Esri Geospatial Cloud includes geoenabled systems that work with an organization's GIS. One of these is Insights for ArcGIS, which fuses location analytics with open data science and business intelligence workflows to solve spatial problems. Insights was recently made available to non-GIS analysts via the Insights Analyst User Type in ArcGIS Online and ArcGIS Enterprise. This opens up the analytic capabilities of Insights to analysts outside the GIS department who need to evaluate spatial and nonspatial data together using maps, charts, and tables. Another component of Esri Geospatial Cloud is ArcGIS Urban, which will give urban planners a web-based GIS solution to do urban planning and design; create, manage, and share plans; visualize projects and see zoning regulations in 3D; compare design scenarios; analyze the impact of their plans based on a set of built-in indicators; and engage with the public.

Another new addition to the ArcGIS platform is ArcGIS Indoors. As Menon explained, "ArcGIS Indoors is...a complete indoor mapping and location system, allowing users to do things like wayfinding and orienting themselves indoors, and providing organizations with the ability to do performance monitoring [and] space and asset visualization."

Esri staff also gave the audience a taste of some of the new Esri technology they've been working on over the last year.

Patrick Arlt demonstrated how to use the new Vector Tile Style Editor to customize a basemap from ArcGIS Living Atlas of the World. Arlt, an applications engineer at Esri, showed developers how to use quick edit tools to style the basemap's layers. He selected different colors to represent land, water, roads, boundaries, buildings, and nature. He differentiated minor roads from major roads,





Esri's product manager for analytics and data science, Shannon Kalisky, demonstrated how to use ArcGIS Notebooks to analyze and visualize big data.



Esri product engineer Orhun Aydin used ArcGIS Pro to model the movement of plastic debris in the Pacific Ocean and demonstrate its detrimental effects.



Jay Theodore, CTO for the ArcGIS Enterprise group, talked about how important Esri's geospatial infrastructure is for doing data analysis.



Vinay Viswambharan, Esri product manager for imagery, illustrated how ArcGIS can be used to extract detailed information from imagery.

## ESRI DEVELOPER SUMMIT

using different shades of purple. And he made the labels for all the place-names on the map larger by changing the font size. All this work took just minutes.

"With my style looking good, I can save it and start using it in all my maps and apps across the entire platform," Arlt said. "This shows you some of the intelligent defaults and bulk editing tools we've built to help you style your own basemaps."

Shannon Kalisky, product manager for analytics and data science at Esri, demonstrated how to use the new ArcGIS Notebooks for analyzing and visualizing big data to solve complex problems.

"ArcGIS Notebooks puts familiar data science tools directly in Esri Geospatial Cloud, allowing you to use Jupyter to create hosted Python notebooks that are tightly integrated with your portal," she said. "All this is powered by the new ArcGIS Notebook Server that runs within ArcGIS Enterprise."

During her presentation, Kalisky showed how to import data into the notebook and conduct an analysis on watershed health using Superfund and watershed data. She said that ArcGIS Notebooks gives users access to ArcGIS API for Python and ArcPy, plus the standard GeoAnalytics and raster analysis tools in ArcGIS Enterprise for doing analyses.

Advanced spatial analysis can also be done in ArcGIS Pro, as Esri product engineer Orhun Aydin illustrated during his presentation on modeling the movement of plastic debris in the Pacific Ocean and its detrimental effect on marine life and coastal health.

"Plastic pollution in the world's oceans is a global problem that is impacting humans and marine animals alike," Aydin said. "Ocean currents...form areas of swirling movement called gyres, where plastic debris accumulates and creates plastic islands."

Aydin said that plastic debris is hard to detect using imagery from satellites. "Instead, we can simulate how plastics move in the ocean, using an open-source Lagrangian ocean modeling library that I've integrated into a Python toolbox," he explained. "This model uses multiple inputs, such as surface winds and ocean currents."

He went on to show how the movement of plastic debris can be analyzed and mapped as plastic islands.

Aydin then used tools available in ArcGIS Pro, such as the Multivariate Clustering tool and the R-ArcGIS bridge, to evaluate the impact of the plastic islands on marine life—for example, leatherback turtles, who might tend to evade or linger near the plastic islands. In Aydin's analysis, he found that some leatherback sea turtles loitered around plastic islands.

"This might mean that these leatherback turtles are either feeding on plastics, or they might be caught [by] plastics from these plastic islands," he said.

### Data-Driven Analysis and Geospatial Deep Learning

Jay Theodore, CTO for the ArcGIS Enterprise group at Esri, spent a few minutes stressing the importance of the geospatial infrastructure that Esri technology provides for data analysis.

"Analysis starts with your data because that's where all your true information can be extracted from," Theodore said. "ArcGIS works with all types of data, whether it be your raster data from satellite or drone imagery, or your big data stored in S3 buckets. It could be CSV [comma-separated value], ORC [optimized row columnar], or [Apache] Parquet files. It could be a folder of shapefiles, or it could be your utility network contained in an enterprise geodatabase."

In the ArcGIS Enterprise portal, developers can then organize that data into web layers, web assets like web scenes, and web maps, Theodore said. Analysis and data science can be conducted using ArcGIS Enterprise and expanded on, as needed, using servers such as ArcGIS Image Server, ArcGIS GeoEvent Server, and ArcGIS GeoAnalytics Server.

"For real-time streaming analysis, you have ArcGIS GeoEvent Server. You have ArcGIS GeoAnalytics Server if you are working with large volumes of data," Theodore said. "Similarly, for raster analysis, you have ArcGIS Image Server."

Theodore also touched on how raster analytics capabilities, available in ArcGIS Pro and ArcGIS API for Python, can be used to conduct spatial deep learning. His colleagues, Vinay Viswambharan, Esri product manager for imagery, and Rohit Singh, managing director at the Esri R&D Center in New Delhi, India, demonstrated how

ArcGIS can be used to extract detailed information from imagery. In their example, they showed how the Bureau of Land Management (BLM) could search for and find unpermitted oil and gas well pads in southeastern New Mexico using Sentinel-2 imagery mapped with ArcGIS.

"Sentinel-2 imagery is great for change detection, primarily because the refresh rate of the imagery is once every five days," Viswambharan said, using the Swipe Layer tool in ArcGIS to compare two sets of imagery to search for new well pads. "When I compare the two images, clearly you can see at least three new well pads. And when I overlay the well points that are provided by the state, you will see a problem. There are at least two new well pads in here that do not have permits issued."

But how can the BLM find all the unregistered well pads over a large area such as southeastern New Mexico? It's done with deep learning, Viswambharan said. Singh then walked through the workflow using ArcGIS Notebooks. First, he brought in training samples to study and learn from: the locations of the objects—in this case, well pads—and the imagery. Next, he dropped the layer of the known well pad locations into ArcGIS Notebooks, along with the Sentinel-2 imagery for the area of interest. Using various tools such as Detect Objects Using Deep Learning (which are also available in ArcGIS Pro), Singh then deployed a training model to locate all the well pads. Once the results came in, they were added to ArcGIS for visualization and analysis.

"Overlaying the data that is provided by the state [on the map], I can now extract the well pads and identify all the well pads that are unregistered," Viswambharan said. "To summarize, ArcGIS has powerful deep learning capabilities. In addition to ArcGIS Pro and Map Viewer, Python API seamlessly integrates with these deep learning capabilities."

Developers who want to learn more about geospatial app development using the ArcGIS platform can visit [esri.com/developers](https://esri.com/developers).

Esri is also hosting the Esri European Developer Summit, November 4–6, 2019, in Berlin, Germany.

# ArcGIS Online

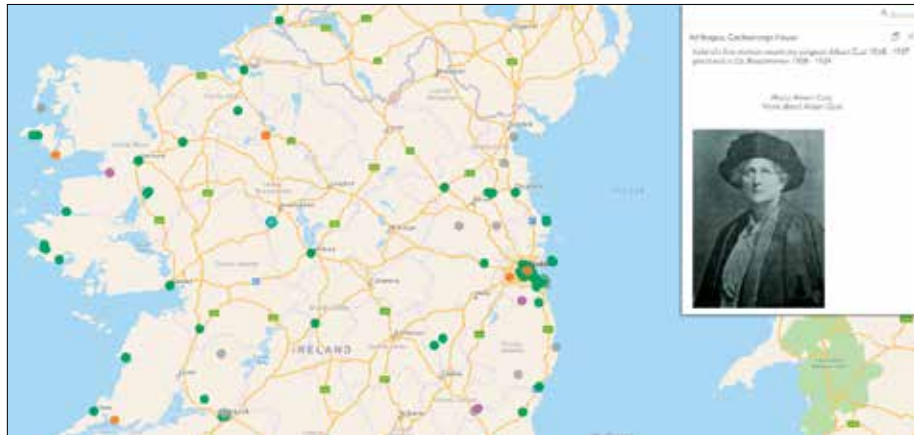
## Transitions to Esri's Next Generation JavaScript API

Big changes are coming to ArcGIS Online this year as the cloud-based platform deepens its use of Esri's next generation JavaScript API, taking advantage of its rich capabilities and improved performance. Version 4.x of ArcGIS API for JavaScript enables fast and dynamic visualization; offers a collection of newly designed tools to build an elegant user experience; and has improved accessibility and 3D visualization. Although Scene Viewer has always used the 4.x API, newer configurable apps are built with the updated JavaScript API, and Map Viewer and Web AppBuilder for ArcGIS will also be rearchitected with version 4.x.

### Improved Pop-Ups

The 4.x API provides additional visualization options for pop-ups. For instance, viewers can choose to dock pop-ups in the corner of the map. Every time a pop-up is clicked, it will appear in the same spot. This can help viewers get pop-ups out of the way when they'd like to interact with the map. This is available in all configurable apps built with the 4.x API.

It is also now possible for users to display pop-ups by simply pointing to a feature. Data can be explored faster, and it simplifies the viewer's experience by eliminating the need to click on a feature to see the pop-up. The pop-ups can be docked in the corner of the map or allowed to float near the feature. These pop-up functions are currently available in the Media Map configurable app.

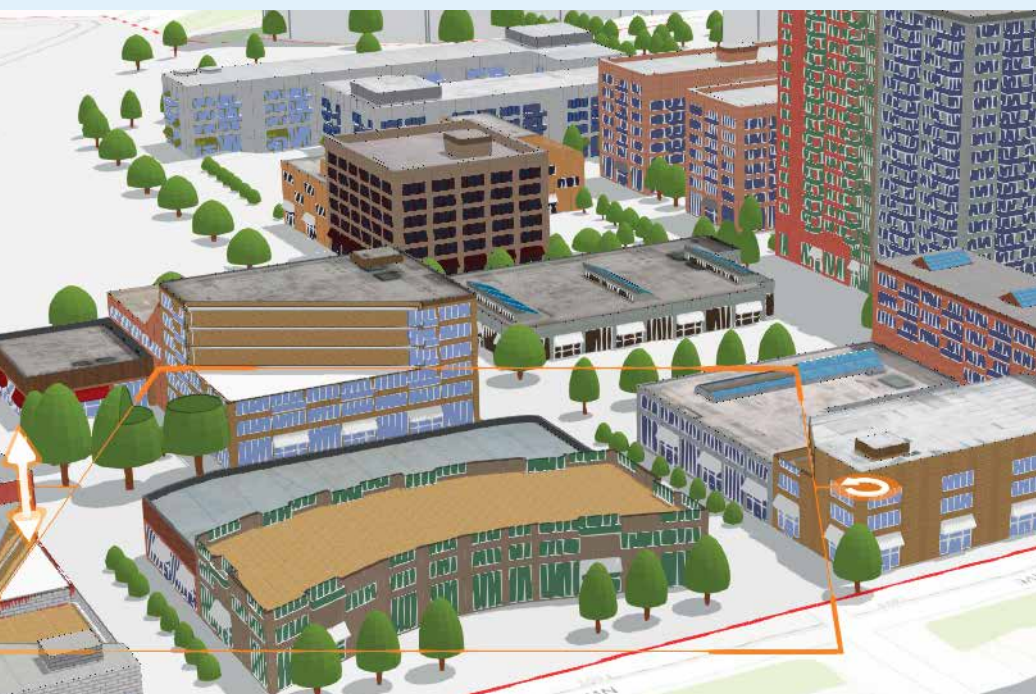


↑ Pop-ups, like this one in the Map Styler configurable app, can be docked in the corner of the map.

### 3D Visualization and Analysis

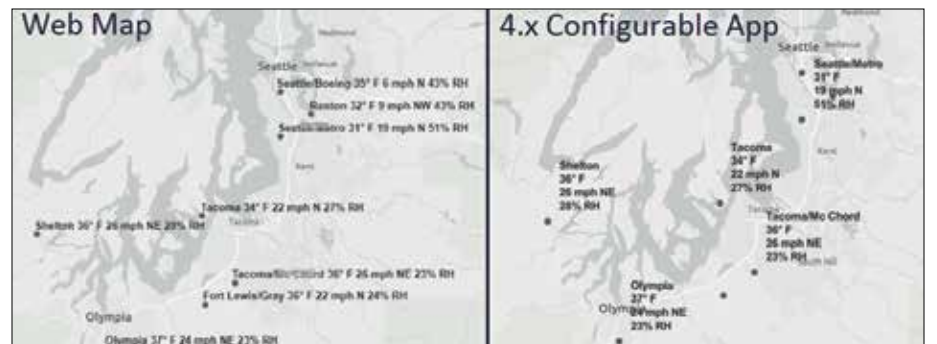
Users can now enable 3D visualization and analysis using the Scene with Inset Map and Compare configurable apps. These apps, built with the 4.x API, include 3D measurement tools that calculate area and length. The Slice tool gives viewers the opportunity to slice 3D objects, which temporarily suppresses portions of the scene to expose hidden content and perspectives.

↓ In the Inset configurable app, viewers can use the Slice tool to temporarily suppress portions of the scene—in this case, a few buildings.



### Support for Arcade

ArcGIS Arcade, the ArcGIS platform expression language, transforms your data on the fly, without leaving the map. Arcade is extremely versatile: it can be used to convert field types; calculate new fields; rotate symbols; and customize pop-ups, labels, symbology, and transparency. For example, users can construct Arcade expressions to concatenate labels, making them display in multiple lines rather than in one long line. All configurable apps built with the 4.x API support Arcade.



↑ Users can construct ArcGIS Arcade expressions to stack labels rather than display them in one long line.

### Customizable Legends

Users can customize legends to meet their visual and interactive preferences. Two legend styles are now possible: card and default. The card style displays items in horizontal bars, and the default style displays items in a vertical list. The card style is more compact, and the information that exceeds the allotted space is moved to the next card and can be accessed by toggling.

Give viewers the opportunity to explore the map's data using an interactive legend. Users can choose which data to display by clicking different items within the legend. This feature is available only in the Interactive Legend configurable app.

#### ACS Travel Time To Work Variables

Predominant Commute Time (Collapsed Categories)

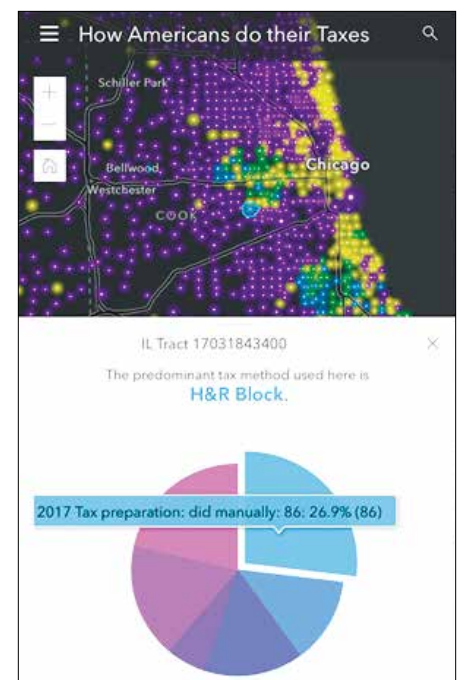


↑ The new card style legend displays items in horizontal bars.

### Mobile Friendly

People frequently use maps and apps on their mobile devices, making responsiveness key. The 4.x API provides an optimal user experience, regardless of screen size or device. For example, when viewing a map on a small screen, the legend automatically docks on the bottom of the screen. This provides a clear view of both the map and the legend. When a user clicks a pop-up, the feature is highlighted and the pop-up docks at the bottom of the screen. Not only can viewers clearly see the details within the pop-up, but they can also interact with the data.

→ This example of the Map Styler configurable app on an iPhone X shows what happens when a user interacts with a docked pop-up.



### Wide Accessibility

Esri continually strives to improve its interfaces through good design and coding practices to ensure that the content created with the software is usable by as many people as possible. Also, many Esri customers must be Section 508 or WCAG 2.0 compliant, which requires technology that is accessible to people with disabilities. The 4.x API brings enhanced accessibility for people with disabilities, allowing viewers to navigate the map and select app tools with their keyboards. Labels or instructions are also provided when viewers need to input information.

Start using these exciting capabilities, enabled by ArcGIS API 4.x for JavaScript, in the ArcGIS Online configurable apps and through ArcGIS for Developers.

# Share Your Data with the Esri GIS Community

## Contribute to Esri Basemaps with the New Community Maps Editor App

When Esri users share their authoritative data and services, the wider GIS community benefits greatly from having access to more up-to-date, accurate, and verified maps and basemaps. The Community Maps Program facilitates these updates by offering a channel through which organizations can contribute their data to ArcGIS.

To make it easier to submit data, Esri recently released the new Community Maps Editor app in beta. Accessible at [communitymaps.arcgis.com](http://communitymaps.arcgis.com), the app streamlines the data submission process by connecting participants with an efficient way to create and edit detailed features for special areas of interest within their communities.

### Additional Detail Leads to Better Accuracy

Esri's Community Maps Program is a cooperative effort to develop a suite of authoritative, global maps for use by a variety of applications, from ArcGIS Desktop and ArcGIS StoryMaps to mobile and custom web apps. With the Community Maps Program, contributed data is hosted in layers and basemaps in ArcGIS Online, enriching the data available to the Esri community. Contributed data is free to ArcGIS users as part of ArcGIS Living Atlas of the World.

Through Community Maps, Esri includes authoritative data from thousands of organizations in the ArcGIS user community to enhance the following:

 Basemaps	 Imagery
 Addresses	 Land Elevation & Bathymetry

Communities can contribute data or services that add detail and context to the local maps and apps that serve their citizens. These contributions not only allow local customization and broader use of community data, but they also offer communities the opportunity to put the intricacies of their neighborhoods on the map. Users can provide the following:

- Point of interest labels, streets and parking lots, sports facilities, and landscaping



Users of the Community Maps Editor app can easily share the details of their communities to have them included in Esri basemaps.

- Building footprints and addresses, including rooftop points
- Land elevation, bathymetry, hydrology, and stream gauges with real-time monitoring
- Basemap layers and high-resolution imagery

In continuing to develop this program, Esri built the Community Maps Editor app, an interactive app that enables users to create large-scale features and add more detail to Esri's basemaps. The app's powerful and intuitive editing environment makes it easy to create and share campus-level elements, such as sports fields, tennis courts, and athletic tracks.

Longtime Community Maps Program participant Joe Borgione uses the Community Maps Editor app to add these types of features, making his workflows more efficient. As an analyst with Salt Lake County in Utah, Borgione has helped update Esri basemaps to support local map precision and better community representation. For him, having the latest data on a map—whether it concerns sports stadiums or neighborhood parks—makes an impact.

“Working with databases, I have developed an eye for accuracy,” he said. “Having the most accurate and up-to-date data in the community maps is something I strive for.”

In turn, Borgione's team can work with the best available data in the field to make better decisions, and other organizations can benefit from that, too.

### How to Share, and Then Use, Community Data

Esri basemaps are powered by Esri's extensive portfolio of authoritative data available in Living Atlas, the foremost collection of geographic information from around the globe. The basemaps are curated for quality and updated every three weeks.

When used in analyses alongside additional data, including the ready-to-use demographic and environmental layers in ArcGIS, basemaps provide context for a range of inquiries, from citizen awareness and policy mapping to environmental change detection and management. Esri cartographers and database engineers curate the basemaps to provide the best-available map coverage on a global scale.

To get started with contributing to these basemaps, go to [communitymaps.arcgis.com](http://communitymaps.arcgis.com) and select an action: Provide Feedback, Edit Features, or Share Data. Guidelines for each section are available under More Details. Once data is submitted through the Community Maps Program, Esri's curators review it to ensure that it is an appropriate addition to Esri basemaps.

Accepted data is then integrated into Esri's global database and processed for inclusion in online and on-premises data and location service offerings, such as World Imagery and the suite of Esri Vector Basemaps. Many contributed features are suitable for inclusion in basemaps and Data Appliance for ArcGIS, Esri's on-premises basemap offering. Additionally, address information may be included in ArcGIS World Geocoding Service, World Geocoder for ArcGIS, and StreetMap Premium for ArcGIS.



## GEONIS. Utility Network Management across the Enterprise

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# Access and Deploy Authoritative Data Securely

Esri users can confidently protect their internal proprietary data by keeping it local—on their organization's network—with Data Appliance for ArcGIS. An on-premises GIS solution, Data Appliance scales with the Esri platform, granting secure access to global basemaps and reference layers that can be shared throughout the organization. This allows colleagues to safely create, publish, and share map services behind a firewall.

Various industries, from insurance and health-care companies to governments and utilities, need to access authoritative data securely while protecting that data within their internal databases. For organizations like these that rely on data confidentiality, Data Appliance alleviates the risk that their databases can be accessed externally or by unauthorized users, preempting fraudulence and data corruption.

During emergencies, Data Appliance can provide authoritative and secure data locally in a way that's high performing and supports billions of transactions. Should a storm or wildfire threaten an organization's Internet connection,

the platform will continue to run, offering a trusted solution when it's needed most.

## What's Included

Data Appliance includes a rich suite of authoritative data that's curated by Esri's expert team of geographers. The on-premises offering has an annual release and contains precached basemap content similar in detail and coverage to Esri's online basemaps.

The terabytes of rich, detailed data come from industry-leading data providers and can be used to enhance ArcGIS apps and services. This data is designed and optimized for publishing services using ArcGIS Enterprise. The data is delivered on a network attached storage (NAS) device by Esri partner Arxys, which provides hardware that's designed to fit easily into an organization's IT infrastructure by connecting directly to its existing network. The NAS connection on the private network allows organizations to quickly leverage the data to publish map tile services using ArcGIS Enterprise.

Upon deployment of Data Appliance, organizations gain access to a profusion of ready-to-use global basemaps, imagery, elevation data, and more. The most recent release of Data Appliance now offers Esri Vector Basemaps. They are available in a variety of styles and have a much smaller footprint than rasters. Users can scale vector basemaps to various sizes and style their maps as needed to support data visualization and analysis projects.

## Key Benefits of Data Appliance

The main advantage of using Data Appliance is the increased efficiency that comes from being able to publish Esri basemap services without having to process the large and varied datasets. Other benefits include the following:

- Quick and easy publishing of large sets of global geographic data
- Prerendered and optimized maps and data for high-performance publishing
- The ability to deploy basemaps in a secure, private network or over the Internet
- Preloaded hardware for storing the basemap caches, so there is no need to copy terabytes of data to another machine

same ones that are in ArcGIS Online, but they're available behind an organization's firewall. Data is available for areas around the world, including North America, Latin America, Europe, the Middle East, Africa, and Asia Pacific.

**World Geocoder for ArcGIS**—World Geocoder enables Esri users to securely map global addresses quickly and accurately behind a firewall. Enterprises can load addresses from around the world and put them on a map using a single locator.

**ArcGIS Business Analyst Enterprise**—Through desktop, web, and mobile apps, Business Analyst Enterprise provides location-based intelligence for market planning, site selection, and customer segmentation. Users can combine demographic, lifestyle, and spending data with map-based analytics for accurate reports and dynamic presentations.



## Data Solutions to Meet On-Premises Needs

Each organization is unique, so Esri provides a variety of Data Appliance solutions to fit myriad needs.

Maps	World Basic	World Standard	World Advanced	North America Standard	North America Advanced
Basemaps and reference maps at small and medium scales (down to 1:72,000 or level 13)	✓	✓	✓	✓	✓
All other maps at large scales		✓	✓	✓	✓
Esri Vector Basemaps for ArcGIS Enterprise*		✓	✓	✓	✓
Subset of high-resolution imagery		✓		✓	
All available high-resolution imagery			✓		✓

\*Esri Vector Basemaps may also be purchased as a stand-alone product. This includes vector basemaps and reference maps with small, medium, and large scales.

## Additional On-Premises Data Options

Having the right data solutions is critical for any organization that employs the ArcGIS platform. That's why Esri offers additional on-premises data options, including StreetMap Premium for ArcGIS, World Geocoder for ArcGIS, and ArcGIS Business Analyst, along with Data Appliance.

**StreetMap Premium for ArcGIS**—StreetMap Premium allows users to do map visualization, geocoding, and routing on-premises. The ready-to-use geocoding and routing capabilities are the

↑ Data Appliance for ArcGIS now offers Esri Vector Basemaps, which have a much smaller footprint than raster basemaps.

## Get Started

Esri's data team is available to answer questions and help users determine which data products fit their organization's needs. Email [dataapp@esri.com](mailto:dataapp@esri.com) for more information on how to get started with working securely in a data deployment.



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# Fourth of July Fireworks Patrols Get New Spark from GIS

By Greg Mattis, City of Visalia, California

**Fireworks** are a staple of Independence Day in the United States. On the Fourth of July, cities and towns all over the country host fireworks shows. People often try to add some spark to their own celebrations, too, but in some cases, they use fireworks that aren't deemed safe and sane.

Every year around this summer holiday, the City of Visalia, California, tracks down revelers in the area who set off illegal fireworks. Leading up to and on the Fourth of July, the fire department's fire prevention team coordinates with the police department to patrol Visalia in search of people using illegal fireworks.

In years past, fireworks-related calls for service inundated dispatch, and fire and police radio traffic buzzed with, "Fireworks reported in the vicinity of Dunworth and Parker," or "...Vine and Goddard," or "...Norman and Sweet." While these brief descriptions informed patrol teams about the reports and where they were coming from, they gave no context as to how the reports were related to one another or even when they each came in. The din of the radio also hindered patrol personnel from actually listening for fireworks explosions.

Because firefighters and police officers were having to spend so much valuable time figuring out how best to respond to these calls and locate illegal fireworks activity, Visalia's fire marshal Kurtis Brown reached out to the city's Information Services (IS) department and the GIS team to help them visualize all the reports. Coming up with a viable solution required a stack of ArcGIS technology.

## Solutions for Each Requirement

To begin the project, all the stakeholders from various city departments got together to discuss the challenges of responding to reports of illegal fireworks usage each Fourth of July. Together, staff members from 911 dispatch, the fire department's fire prevention team, the police department, city administration, and IS and GIS ironed out requirements for the solution, which included the following:

- Allow citizens to report the use of illegal fireworks online to help alleviate the call volume dispatch receives during the Fourth of July season.
- Integrate with the city's existing computer-aided dispatch (CAD) and automated records management systems (RMS) so that reports called in would automatically go to crews in the field without dispatch having to broadcast them over the radio.
- Have a web-based map that's updated in near real time with reports coming in both online and from dispatch.
- Enable patrol staff to see, on the map, where they are in relation to other on-duty patrols.

This couldn't be a one-app solution. These requirements had to be tackled individually with various elements of the ArcGIS platform.

### Enabling Internet Reporting

To allow citizens to report illegal fireworks activity via the Internet and have the information show up on a map, the GIS team evaluated several out-of-the-box solutions from Esri, including Crowdsense Reporter, Survey123 for ArcGIS, and the GeoForm template configurable app. Because the fire and police departments were only responding to calls within city limits, the GIS team chose to use Crowdsense Reporter for this, since it can restrict responses to a specific geographic area.

The city also wanted to add some security features to the online reporting app. For instance, stakeholders only wanted online reporting to be available while fire and police personnel were on patrol. They also didn't want people to submit the same report over and over, so they wanted to restrict the number of reports a citizen could make during a set amount of time. Thus, staff on the IS and GIS teams decided to implement a self-hosted version of Crowdsense Reporter and configure it using ArcGIS API for JavaScript.

### Rectifying a Database Disconnect

Integrating the solution with Visalia's existing CAD/RMS proved to be a bit more difficult. The city's CAD/RMS uses a non-Microsoft SQL Server relational database management system, while the rest of the city's GIS resources are stored in ArcSDE, which operates on SQL Server. To remedy this disconnect, the GIS team created a scheduled task that, through a mixture of batch processes and Python scripts, extracts calls out of the CAD/RMS, imports them to a staging table in SQL Server, and then puts all the geovalidated calls on a map based on their latitude and longitude.

### Accessing the Map Online

To make the real-time map of all the illegal fireworks reports available to patrol teams via the Internet, the GIS team knew it had to employ ArcGIS Online. But the city had a limited number of named users, so the team published the map as a secure service to ArcGIS Server before adding it to ArcGIS Online. This allowed the city to share the map publicly but keep the layers with the report locations protected so that only employees with authenticated credentials could see and interact with the data.

### Tracking Patrol Cars via Cell Phones

Allowing the firefighters and police officers on patrol to see where other patrol cars were located was going to require a new solution as well, since the fire prevention team's patrol cars don't have automatic vehicle locators. The GIS team chose to implement Workforce for ArcGIS to track the city-provided cell phones that patrol personnel were already using.

### An Effective Patrol

The City of Visalia started its patrols for illegal fireworks usage on June 30, 2018, and continued them through July 5, 2018. Because this was the first year the city had used this new app-based reporting method, IS and GIS staff participated in some of the patrols and consistently monitored the apps to make sure they worked well.

Everything went smoothly, save for one 52-minute outage of the online reporting system on the Fourth of July. During this time, however, residents could still call their reports in to dispatch, and the firefighters and police officers on patrol were still able to see all these reports on the map. Several users remarked on how easy it was to use the apps.

"Our patrols for dangerous fireworks operated smoother and more efficiently than ever before," said Corbin Reed, senior fire inspector for the City of Visalia. "I was able to easily see calls in real time, decreasing response times drastically. With the live unit tracking, I was able to cover areas efficiently with less overlap of patrols, [and because] users [had] the ability to drop a pin on a map, the locations provided by the public were much more accurate than in years past."

Given that the map was recording, in real time, both the online reports and calls to dispatch, no radio traffic was dedicated to relaying the locations of suspected illegal fireworks activity for the entirety of the patrol period. This made it easier for the fire prevention team to focus on the patrols and enabled responders to be stealthier than before, since people could no longer listen to fire and police scanners to figure out where the patrols were heading next.

Visalia's fireworks patrols ended up being far more successful in 2018 than they had been previously.

"Being able to see where all the patrols were located and visualize clusters of reports enabled our team to better allocate resources and effectively target areas that had a lot of activity," said Brown.

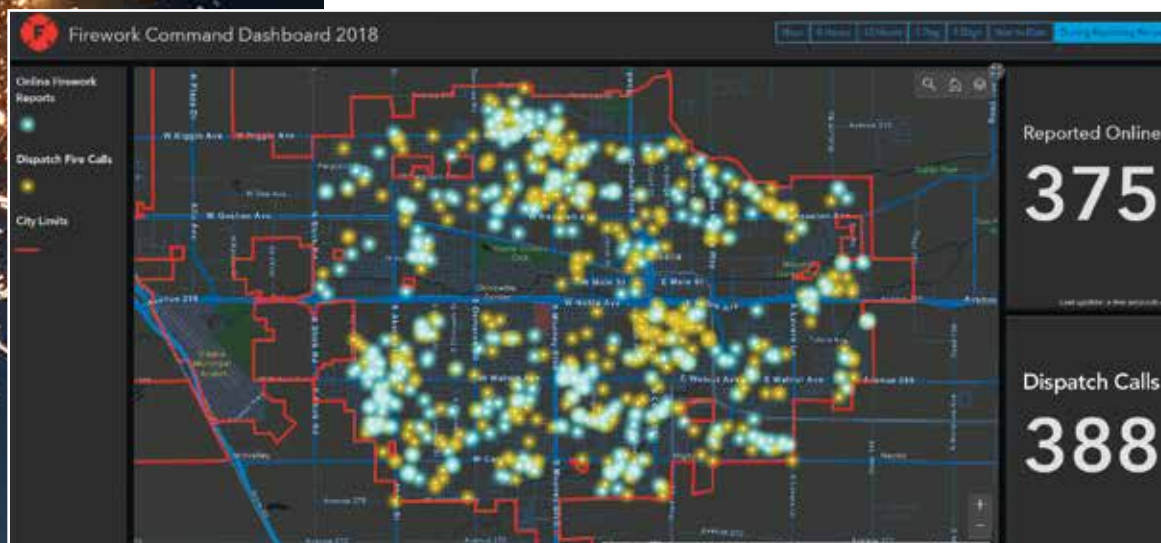
Citizen engagement in reporting illegal fireworks increased by more than 100 percent, with three out of the six days of the patrol seeing more reports made online than via phone calls to dispatch. Additionally, the fire and police departments wrote a record 87 citations, totaling \$87,000 in fines, for setting off illegal fireworks—an increase of 74 percent over 2017.

### Looking Ahead

Using ArcGIS technology to patrol and pinpoint illegal fireworks activity was a resounding success in Visalia. Because of that, the city plans to use this system for Independence Day fireworks patrols going forward, as well as for other, similar efforts.

The city recently moved from a stand-alone ArcGIS Server to ArcGIS Enterprise, which is greatly expanding the IS and GIS teams' ability to develop new GIS-based apps and geospatial workflows. In fact, staff members are already looking into issuing citations with Survey123 and implementing Tracker for ArcGIS.

For more information, email [gis@visalia.city](mailto:gis@visalia.city) or visit the city's open data site at [geodata.visalia.city](http://geodata.visalia.city).



← After each patrol, command staff at the fire and police departments were able to use this dashboard to see how many calls versus online reports came in the previous night and where they were all located on the map.

### About the Author

Greg Mattis, who holds a bachelor of science in geography from California State Polytechnic University, Pomona, is the GIS analyst for the City of Visalia. Under the direction of the GIS supervisor, Mattis maintains the city's GIS data and works with other departments to equip their employees with innovative GIS solutions.

few years, the Greenland group at GST turned to Esri to get help with creating a central, enterprise-wide geodatabase for all the data portrayed on both its paper and electronic charts.

“The way Esri was thinking—of data and a database structure and, eventually, potential automation—that was, in a sense, unique,” said Andersen.

For Greenland, the group implemented what is now called ArcGIS for Maritime: Charting, a complete system for managing and producing maritime data and products. Maritime: Charting

### In Lithuania, an Upgrade in Maritime Capabilities

Lithuania’s hydrographic office was Esri’s first international maritime user. The office, which is part of the Lithuanian Transport Safety Administration (LTSA), was an early adopter of Esri’s original nautical chart production system and used it for years.

In April, LTSA renewed its partnership with Esri; Hnit-Baltic, Esri’s official distributor in Lithuania; and Quality Position Services (QPS), a subsidiary of Saab, to modernize its nautical charting and bathymetry capabilities. The hydrographic office will implement a new seabed database and nautical cartography system, as well as upgrade the automation of its ENCs and paper charts.

LTSA will also use Esri’s data management capabilities to share hydrographic information across industry sectors to spur maritime-related economic growth. This will be helpful in approaching the blue economy.

“Because the hydrographic office belongs to LTSA, and LTSA uses Esri technology for other transportation needs, such as roads and highways, the platform can cover multiple domains in Lithuania,” said Esri’s Rafael Ponce. “Exchanging information from land to sea will be much easier, seamless, and invaluable.”

stores all the data in Esri’s Nautical Information System (NIS), an enterprise geodatabase, which makes it easier to create data products and incorporate automation.

Development took a few years, in part because so much decades-old data needed to be cleaned and classified and in part because of substantial internal reorganization at the Danish Hydrographic Office. But the division’s close collaboration with Esri paid off magnificently.

“At the end of last year, the Danish Hydrographic Office produced two charts for Greenland that were 70 percent automated,” said Rafael Ponce, the executive consultant for maritime services at Esri. “It was a huge improvement.”

The data modernization project for Greenland was so successful in general that when GST needed a next generation chart production system for all Danish waters, the choice fell again to Maritime: Charting. In February, the agency partnered with Esri and its official distributor in Denmark, Geoinfo A/S, to implement this project, which focuses on both paper and electronic charting.

“By the end of the current project, we expect to have a complete Nautical Information System for all three regions—Greenland, Denmark, and the Faroe Islands,” said Ponce.

Having readily accessible data on the world’s oceans, in a system that enables this information to be used to create a range of map products, is important not only for navigation but also for understanding the 71 percent of the globe that isn’t land. The blue economy—a reference to all economic activity that stems from or affects oceans and other waterways—generates an estimated \$2.5 trillion each year and is anticipated to grow at twice the rate of the rest of the global economy by 2030.

“We’re trying to help people understand their world; make good decisions from the best available data; and, where possible, identify where we need more data,” said Guy Noll, Esri’s maritime GIS consultant.

Which is why Esri is working closely with other hydrographic offices—including the National Oceanic and Atmospheric Administration’s (NOAA) Office of Coast Survey and the Lithuanian Transport Safety Administration’s (LTSA) Hydrography Division, among others—to modernize their maritime mapping systems.

“The Esri platform enables the foundational technology needed to develop a marine spatial data infrastructure (MSDI) from which new products and services can be created, transforming traditional hydrographic offices into true geospatial agencies,” said Ponce.

### Updated Processes for Greenland Inspire Modernized Methods in Denmark

For much of GST’s recent history, its hydrographic office has been divided into regions: Danish waters and the Faroe Islands, with Greenland on its own. Each division did its own maritime charting and hydrographic mapping without much overlap.

It was during this period that the Greenland group began updating the island’s coastline maps and conflating all its old maritime charts to keep up with the fast pace of modern technology. But data for Greenland was lacking, according to Andersen, and the group was starting from scratch in creating electronic charts, said Ponce. So the team had to establish all new data cataloging routines and come up with its own schemas. Additionally, going from a file-based cartographic production environment to a database-driven environment was challenging.

“Sometimes the data was 50, 60, or more years old, coming from different sources—in some cases, it was local data. There were also sparse bathymetries,” or water depth measurements, said Ponce. “Before creating the central database, the NIS, a lot of work had to be done to just clean and classify the legacy data, which was at different levels of certainty as to how accurate it was, to make it all suitable for producing navigational products.”

That instilled a kind of intelligence in the process, said Andersen, because his team now does quality control on the data as it’s being created. At the same time, the group is putting everything into the S-57 data model, originally a data exchange standard from the International Hydrographic Organization (IHO) aimed at ensuring that all data in ENCs are properly attributed and encoded to be read by Electronic Chart Display and Information Systems (ECDIS). It is essentially obligatory to use this data model, so updating old products in S-57 will be an ongoing challenge for GST and system suppliers like Esri for years to come as they begin to also implement the new S-100 and S-101 data models currently being developed. And while GST is still

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devoted to making paper charts, given that they're used widely by professional mariners, the agency is focused on making ENC's. More importantly, it is operating in an ENC-first manner, which reflects where maritime mapping is headed.

"With GST's data organized around the S-57 standard, the agency can extract a lot of information from it using a combination of geoprocessing tools and Python scripts to automate more and more of the processes associated with making paper charts," explained Ponce.

Now, the system that was created for Greenland is going to be expanded to Danish waters and the Faroe Islands. But the implementation will be different.

"Danish waters already have a full catalog of ENC's, but those ENC's have been maintained as independent files," said Ponce. "With the new system, GST is going to produce those in a central database. The improvement will be in streamlining production, bringing all that information into the NIS to create data products more easily and automatically. This will result in GST being able to update its products more frequently."

This could be decisive for Denmark in gaining a foothold in the blue economy. As ocean-based activities—from shipping, tourism, and fishing to offshore mining and renewable energy production—move farther north, being able to produce a variety of maritime mapping products, quickly, will be key.

"Hydrographic offices around the world are facing new challenges in the twenty-first century, and Esri tools are helping them evolve and address those challenges in a better way," said Ponce.

### For US's Coast Survey, a Change in Focus to Data Itself

NOAA's Coast Survey, which delivers navigational products and services for the United States' 3.4 million square nautical miles of exclusive economic zones and 95,000 miles of coastline, was the first hydrographic office to turn to Esri for nautical charting. In 2007, Coast Survey's Marine Chart Division (MCD) began using ArcGIS technology to manage its hydrographic data and facilitate the production of ENC's and paper charts. By 2014, the organization was changing its focus from making cartographic representations of its data to managing the data itself.

"As Coast Survey matured as a GIS organization, staff realized that their workflow wasn't very efficient," said Noll. "Esri evolved with the organization and gave it new tools, including Products on Demand in ArcGIS for Maritime: Server, plus Python-scripted geoprocessing tools that allowed it to automate certain parts of its production."

"It's still an iterative process," said John E. Nyberg, chief of MCD, "but we do have all our data in a database now, and we've moved to an ENC-first approach."

Unlike at GST, however, Coast Survey is hedging away from paper charts—encouraging mariners to use them more as backups—and more toward ENC-first. This is an important shift, given that, as Nyberg puts it, Coast Survey's charting dataset is a foundational basemap for the blue economy.

"As the blue economy grows, there's a need for everything within it to be working from a common framework, using common data content," said Noll. "That's what Coast Survey and other hydrographic offices like it maintain."

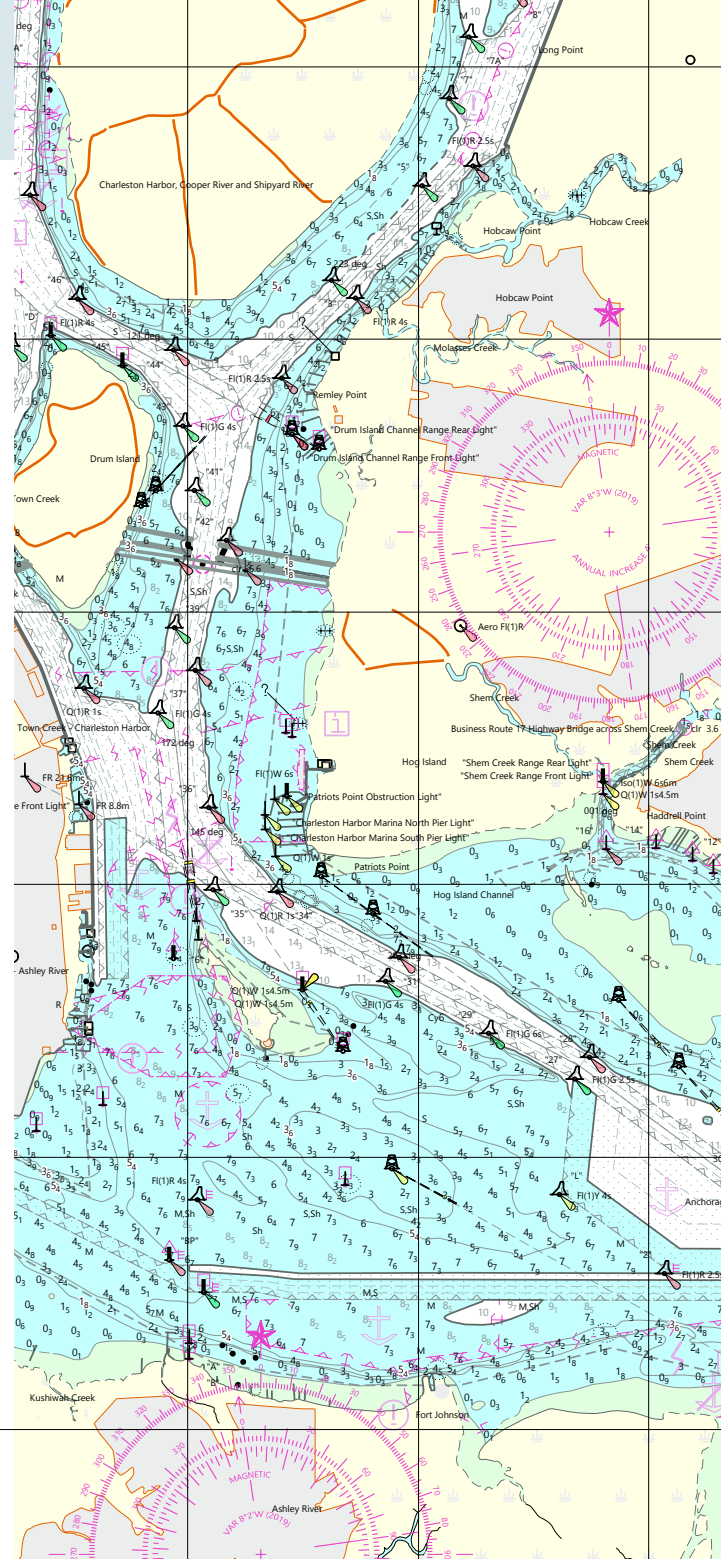
Thus, commercial ships with ever-improving navigational systems can exploit this data. Recreational boaters, of which there are many in the United States, can use Coast Survey's ENC's directly or through partner providers. And all users—from professional mariners to anglers in tiny johnboats—can get up-to-date, high-resolution charts.

"We've moved away from the notion that ENC's and paper charts have to be equal," said Nyberg.

According to Noll, the fact that Coast Survey has gone ENC-first opens the door to a broader production paradigm.

"Because Coast Survey is focusing most of its effort on the data accuracy and quality of the database, and then relying on ArcGIS tools to flag and create new products—soon, automatically—that means it can update its ENC's every week," he said.

Nyberg hopes that Coast Survey will eventually update its ENC's more often, potentially even as the data is added to the database.



→ With the Products on Demand functionality in ArcGIS for Maritime: Server, users can create a paper chart, like this one of Charleston Harbor in South Carolina, from Coast Survey's electronic chart database.

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# Bureau of Ocean Energy Management (BOEM) Uses GIS to Manage Marine Minerals

By Cherie Jarvis, Quantum Spatial, Inc.

Shoreline erosion is a significant problem that impacts communities' ability to protect natural resources and public infrastructure, as well as support tourism, energy, and defense. To better manage nonenergy marine minerals like sand and gravel along the nation's outer continental shelf (OCS), the US Bureau of Ocean Energy Management's (BOEM) Marine Minerals Program created a new GIS solution that combines current and historical data.

The project—called the Marine Minerals Information System (MMIS)—was developed by BOEM in collaboration with the National Oceanic and Atmospheric Administration (NOAA), the Bureau of Safety and Environmental Enforcement (BSEE), and the US Department of the Interior to support public policy decision-making; improve the integrity of BOEM resource management and leasing oversight; increase coastal resilience; and reduce response time, especially after extreme coastal storms.

BOEM had accumulated more than three decades' worth of marine minerals data and documentation on a project-by-project basis but was hampered by the lack of a centralized system for managing geospatial information. The agency contracted with Esri partner Quantum Spatial, Inc. (QSI), to develop the MMIS, an enterprise GIS (eGIS) solution that now serves as the central authoritative system of record for available ocean sand and minerals geospatial data and nongeospatial documentation.

## MAKING SENSE OF COMPLEX, DIVERSE DATA

Creating the MMIS, which began in 2014, was a formidable task. It covered the OCS along the US federal waters of Alaska, the Pacific and Atlantic Oceans, and the Gulf of Mexico. Other challenges included the scope and volume of information, variable data formats, and the number and type of data sources that QSI had to incorporate into the eGIS. QSI also needed to coalesce all available data into a standardized data model, then develop tools for viewing, analyzing, and managing the MMIS data.

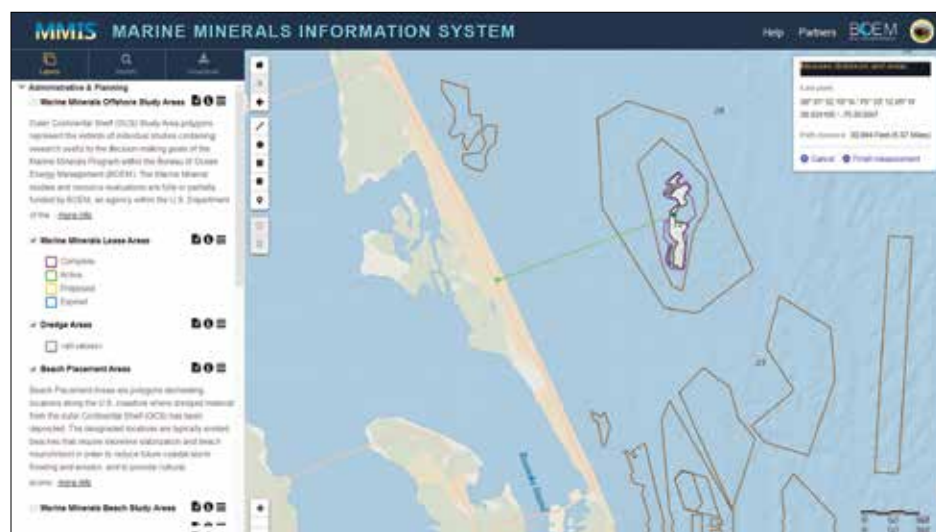
To start, QSI outlined the complex data needs for the MMIS, which included the following:

- Accurately capturing the characteristics of the seafloor
- Quantifying and delineating what was known about offshore sediment materials
- Understanding details such as the location, extent, and volume of offshore marine minerals, as well as their specific characteristics, including grain size, texture, Munsell color, and soil classification
- Incorporating historical data and documentation on extraction, leasing, and deposition activities to ensure that future activities are orchestrated and based on reliable information

After assessing BOEM's IT capabilities and evaluating security requirements, the team at QSI determined that the system should be built leveraging Esri technology, which BOEM users were already familiar with. QSI designed the system architecture based on BOEM's needs and Esri best practices.

The MMIS uses the ArcGIS platform, including ArcGIS Enterprise, ArcSDE with Microsoft SQL Server, and ArcGIS Desktop, as well as a custom desktop tool for matching source material from the OCS to the beach and a public-facing online viewer, built with Leaflet, that consumes web services hosted in ArcGIS Enterprise. The system is a robust relational geodatabase that is designed to be continuously populated by data from BOEM marine minerals scientists and provide all users with the ability to access relevant documents geospatially and visualize information for BOEM's active and past projects.

After designing the MMIS, QSI identified, collected, organized, evaluated, and incorporated 150,000 digital data assets, as well as nondigital documents with associated metadata, into the eGIS. This data represented more than 30 years of records collected and/or cataloged by myriad agencies and entities, including BOEM; the US Army Corps of Engineers; the US Geological Survey; universities; state survey offices; and other programs such as cooperative agreements, sand lease projects, and environmental studies.



↑ The public can use a custom web app to view, analyze, and download information about marine minerals across the coastal United States, including off the shores of North Carolina. (Image courtesy of the Bureau of Ocean Energy Management [BOEM]).

Since data from disparate sources is rarely standardized, QSI then had to address the variables in accuracy, comprehensiveness, resolution, spatial and temporal scale, and geospatial nature. The company created a standardized data model using case studies and Esri's 10-step guide for designing geodatabases to structure, manage, and maintain spatial data in the MMIS geodatabase.

QSI combined elements of multiple scientific datasets and standards into a new comprehensive schema that could be used for all types of offshore sand and gravel data, meeting BOEM's needs. In building the data model, QSI populated the database for different pilot areas as well to identify gaps or shortcomings in its schema. This enabled the company to normalize the data model for universal functionality.

## TURNING DATA INTO USABLE INSIGHTS

To extend the MMIS's usability and functionality, QSI developed tools for users that enable sophisticated viewing, analysis, queries, reporting, and exploration of the data. The goal was to facilitate more effective communication among federal and state partners as they manage offshore mineral resources.

The tools that QSI built include the following:

- **SediSearch (Sediment Search):** This Python-built add-in to ArcGIS Desktop enables users to efficiently search and match marine resource material attributes—such as available volume, grain size, texture, classification, and color—to the needs or characteristics of an onshore beach or other coastal site that's deprived of nourishment. SediSearch was designed to provide assurance that the offshore-to-onshore transfer of marine materials will ultimately result in identifying compatible sediment materials for shoreline protection, the restoration of beaches and wetlands, and effective shoreline construction projects.
- **A web viewer:** Accessible at <https://mmis.doi.gov/BOEMMMIS>, this is a custom web app for viewing, analyzing, and downloading data from the MMIS. It is an unrestricted version of MMIS that enables users from outside BOEM to obtain marine minerals information that they can use to plan activities led by states and local agencies. Key MMIS features in this publicly accessible app include
  - More than 30 years of BOEM-funded geologic and geophysical research data
  - Data from over 40 partners in federal, state, and local government; academia; and other entities
  - A viewer with more than 20 data layers
  - The offshore sediment data for 18 coastal states
  - GIS mapping capabilities
  - Tools to download data into geodatabases, shapefiles, or .csv files
  - Statistics on the volume of sand dredged from the OCS, the number of active projects being managed by BOEM, the number of projects by state, and the miles of shoreline restored by state
  - Links to environmental studies and assessments
- **A dashboard:** Built using Operations Dashboard for ArcGIS, this tool—accessible at [boem.gov/MMP-Current-Statistics](http://boem.gov/MMP-Current-Statistics)—enables users to monitor and visually track project activities on a national, state, or local level. The dashboard contains information dating back 24 years and provides quick insights on miles of restored coastline, the total number of leases executed, and the total volume of sand allocated to specific areas. The dashboard has been embedded within BOEM's public-facing website, providing answers to the many questions the agency receives about the Marine Minerals Program.

## DELIVERING RESULTS

The MMIS and its related interactive viewer tools have enabled BOEM to save time and money by keeping data in a ready state for scientists and the public to use whenever the need arises. In addition, the standardized data and analytical capabilities are supporting forthcoming resource planning and decision-making. It is also helping to resolve marine use conflicts—such as submarine cables being laid over viable sand resources; the accidental capture of endangered marine fish, sea turtles, or other wildlife; and the protection of archaeological sites within federal waters—and will likely aid in preventing future conflicts. Additionally, the standardized data is providing reliable shared access to marine minerals information that will assist with coordinating responsible management far into the future.

By delivering new, authoritative, and accurate data sources that agency officials, planners, contractors, scientists, and citizens can use to make informed decisions, the MMIS enhances the public's faith in how valuable geospatial data is for public policy. It also gives stakeholders and the general public greater confidence in BOEM's performance and accountability in negotiating lease agreements for the OCS.

### About the Author

Cherie Jarvis is the enterprise GIS practice lead at QSI where she specializes in taking an agile approach to geospatial projects in the federal government. Jarvis is a certified Scrum product owner who has helped numerous organizations leverage agile methodologies for software development. She has more than 20 years of experience in a variety of IT environments, including data management, software development, and GIS. For more information, email her at [cjarvis@quantumspatial.com](mailto:cjarvis@quantumspatial.com).



# A LITTLE INNOVATION GOES A LONG WAY

Dutch Kadaster, the Netherlands' national cadastre, land registry, and mapping agency, was the first mapping authority in the world to fully automate the production of multiscale maps and data. This was a huge accomplishment, given that, although the mapping community had buzzed about the potential of automating multiresolution geospatial map production for decades, many were still skeptical that it could even be done. The feat is even more impressive considering that it was carried out by a small, motley team that was in a bind.

In 2010, the government in the Netherlands legislated that Dutch Kadaster had to update the nation's topographical maps more frequently—every two years instead of every four to six years. At the same time, however, the geoinformation department at Dutch Kadaster was facing staff and budget cuts as a result of the ongoing global recession. The department was going to have to produce more information at a quicker clip with fewer people.

Ben Bruns, the manager of Dutch Kadaster's GIS customer solutions department, knew that his team was going to have to innovate. He had gotten a tip from Jantien Stoter, a professor at Delft University of Technology who was also a consultant at Dutch Kadaster, that Esri had some automation technology that was ready to use. Bruns took that information and ran with it.

"Within a half a year, we had accomplished automatic generalization," said Vincent van Altena, a senior GIS specialist at Dutch Kadaster, referring to what would become multiresolution geospatial map production. "It wasn't perfect, but it was fully automated. Even the most severe critics were amazed at what we had done."

"The system takes Dutch Kadaster's best-scale data, which is TOP10NL, and automates the process from beginning to end, using that data to automatically produce the map products it needs," said Mark Cygan, Esri's director of national mapping and statistics solutions. "The system encapsulates the production process in

400 geoprocessing models, which are aggregated into three big geoprocessing models. The team can then push what Ben calls the *make map button* to generate maps for the whole country in one pass."

Now, Dutch Kadaster delivers updated and higher-quality topographical maps of the Netherlands in less than two years. And, according to Cygan, the organization keeps improving.

"The last I saw, Dutch Kadaster was able to do all the 1:50,000-scale maps for the country in two weeks with one operator," said Cygan.

But the innovation didn't stop there. After automating Dutch Kadaster's 1:50,000-scale maps, the team was soon able to automate the Netherlands' 1:100,000-scale maps, as well as the country's basemap, which has 15 different zoom levels. Then the geoinformation division automated all its maps with scales ranging from 1:25,000 to 1:1,000,000.

"This was Ben's vision from day one, when he started with automatic generalization," said Iris Reimerink, a senior GIS specialist at Dutch Kadaster. "The day we did it was a milestone for him. I remember him saying, 'I knew this was possible long before we started it.'"

Once Dutch Kadaster figured out how to automate its own map products, Bruns and his team set out to share what they did with other mapping agencies around the world. In the ensuing years, the team hosted four workshops that national geospatial authorities from at least 25 countries attended. The group not only taught these agencies about the technology that makes automation work, but it also shared how it handled the change management part of the process.

"Mapmakers from Ordnance Survey Ireland (OSi) attended the workshops, and there's a direct correlation to the incredible automation work they have done over the past few years," said Cygan. "Same with Great Britain's Ordnance Survey (OS) and many other mapping authorities around the world."

While all this was accomplished by a skilled team of people working both at and with Dutch Kadaster, "it was Ben's leadership, and the belief of Kadaster's executives in his leadership abilities, that made it all possible," added Cygan.

Bruns, who has a master's degree in geoinformation technology from Vrije Universiteit Amsterdam, began his career at Dutch Kadaster as a cartographer. He quickly progressed into management roles, including the head of one of the cartography division's sections, the product manager for topography, and the manager of GIS customer solutions. According to several colleagues, he's always found ways to innovate.

Around 1995, he was commissioned to lead the Dutch contribution to the Vector Map (VMap) program, an international project that encouraged countries to digitize and share their map data. In

addition to being project lead, Bruns was an active developer on VMap, cooperating with both IT and production staff. When VMap was replaced by the Multinational Geospatial Co-production Program (MGCP), a defense initiative aimed at digitizing and sharing high-resolution vector data for places dealing with humanitarian or military crises, Dutch Kadaster's topographic service (which is now the geoinformation department) became a testing ground and quality control center under Bruns's leadership.

Bruns was also closely involved in the development of TOP10NL, a 1:10,000-scale topographic geodata-base of the Netherlands.

"Ben was one of the originators of this," said van Altena. "He designed the data model along with his colleagues and led the technical implementation. That's really important because if there was no TOP10NL, automatic generalization would not have been possible."

It also wouldn't have been possible without Bruns's imaginative leadership style. When his team suddenly had to accelerate map production, he came up with a concept called HIGH5, which brings people from different departments and backgrounds together for five weeks to solve a problem.

"This was one of the first times we used HIGH5," recalled van Altena. "The results were so promising that we got the green light to keep using it."

As Dutch Kadaster waded deeper into automation, Bruns and his boss, Ulrike Schild, Dutch Kadaster's head of geoinformation, also adhered to the lean management philosophy.

"The philosophy is, you have a lot of spillage in a production process, so you need to try to eliminate that. The best way to do that is to evaluate all individual production steps, and if it does not add customer value to your end product, it has to go," explained Marc Post, who's also a senior GIS specialist for Dutch Kadaster. "This customer-oriented approach was something completely new within Dutch Kadaster, and it took a lot of effort and courage to introduce that into a world of traditional cartographic work."

"This had a huge impact on production acceleration," added van Altena.

Another management philosophy that Bruns abides by is having a heterogeneous team.

"The members of his teams must have different expertise," said van Altena, whose background is in theology. "If people from different backgrounds are able to communicate with each other, they can come up with different ideas."

"In his quest for a team, Ben is looking for unique characters, not copies or clones," said Reimerink, whose training is in conservation and GIS.

"Each member of my team is creative, tenacious, independent, and stubborn," said Bruns. "Incredible innovations arise from the energy that comes from giving these distinctive people space and direction."

"He also truly believes that everyone on his team is doing their best and is being honest about what's going on," added Post, whose background is in conservation as well. "Without that trust, the innovation doesn't happen."

In the same vein, Bruns trusted Dutch Kadaster's customers to tell his team what they wanted to see in their maps and involved them directly in the automation process.

"Cartographers have a traditional way of doing things, according to a list of specifications, but to automate our map production, we had to create new rules," Post explained.

"Ben's team members said, these maps aren't going to look like they did in the past, but they'll meet customers' needs," said Cygan. "They then went directly to users and asked, is this map going to meet your needs and do everything you need it to do? All of Dutch Kadaster's major customers were happy with the results, and many said they couldn't tell the difference from previous maps. Other mapping agencies, including OSi and OS, are finding the same thing."

Now that Dutch Kadaster has a handle on automatic multiscale mapping, Bruns's team is in the process of developing an automatically constructed 3D topographic dataset for the Netherlands, taken from point clouds and 2D base data. The geoinformation division is also exploring using machine learning techniques for topographic data. It seems that the innovation will never stop.

→ Ben Bruns



# GIS Hero

# Making Sure Your Organization Is Data Driven

By Charles Bullock, Brandman University

Most organizations only use a small amount of their data's analytic potential, according to a December 2018 report by research and advisory firm Gartner. But leveraging data—and being data driven—is essential to creating a sustainable advantage over the competition.

So what does it mean to be data driven? And how can an organization build a culture that's galvanized by data, where employees use data and analytics to drive growth, profitability, and innovation?

A data-driven organization does two things really well. First, it understands that data is a valuable asset. Second, it empowers employees at every organizational level with the access, knowledge, and tools they need to use that data to turn business insights into actionable opportunities.

Many companies attempt to develop a data-driven culture by employing a highly skilled and creative data science team that works with volumes of data and puts together related reports that, all too often, fail to get acted on. Following a data strategy like this—that relies heavily on a data science team—usually ends in failure. While these experts are highly qualified to generate the data and reports that enable analysis, a stand-alone data science team does very little to build a company-wide culture of data-driven decision-making.

Why is that? According to the Gartner report, entitled *Predicts 2019: Analytics and BI Strategy*, it's because the data science team doesn't tell stories that are persuasive or even visible to decision-makers. Often, decision-makers lack the knowledge and tools they need to analyze the data. In turn, the data science team lacks the skills required to clearly communicate how an analytic report could translate into business process improvements that increase revenue, reduce costs, or otherwise drive innovation.

Moreover, the demand for data scientists is outpacing the number of college graduates who study data science or data analytics, according to a recent Gallup poll. And there is a large gap between the number of data analysts who have the functional knowledge (e.g., in marketing or operations management) needed to translate data into real business insights that are actionable, found a report by job market analytics company Burning Glass Technologies.

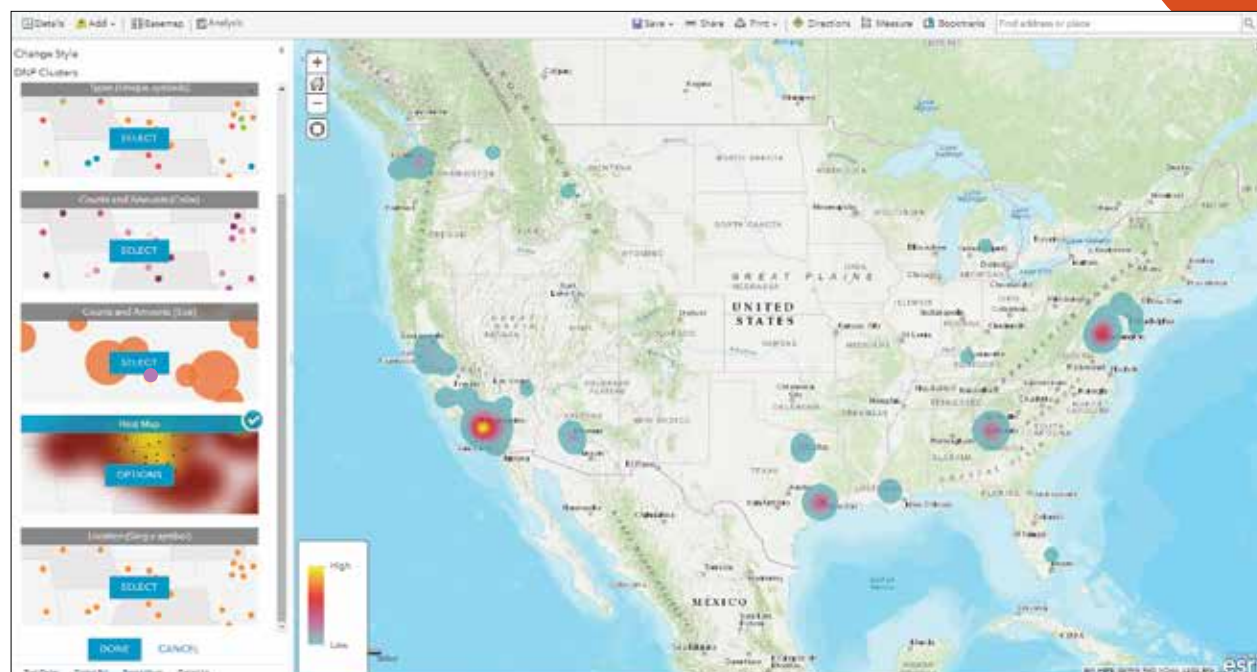
What can leaders do about all this? Well, they should certainly be asking themselves the following two questions:

- What tools should I buy for my employees to use to make data-driven decisions?
- How do I scale my workforce's analytical abilities through higher education and training?

Fortunately, as the Gartner report explains, the availability of easy-to-use analytics software is on the rise. Now, with programs such as Insights for ArcGIS, performing data analysis simply takes a few clicks of the mouse or taps on a screen rather than full-fledged computer programming skills. This is giving rise to a new role that Gartner calls the "citizen data scientist"—someone within an organization who can execute analyses that, just a few years ago, would have required a highly experienced data scientist.

Additionally, it is now easier than ever for organizations to grow their employees' data analytics skills—thus enabling more of them to become data citizen scientists. Increasingly, organizations are encouraging (and often paying for) staff to take online classes and participate in certificate programs that teach them how to access data and use analytic tools to solve complex business issues and social problems.

Brandman University, where I am provost, has been recognized by its accreditor as a data-driven organization, particularly in academic affairs. We have the tools—and several of us at various levels have developed the skills we need—to conduct market-focused spatial analysis. To do this, my colleagues and I start with the big picture, presented in a story map, that allows us to then take a deep dive into the data itself to solve problems or identify opportunities.



↑ Brandman used Insights for ArcGIS to map where applicants to its online nursing program were from so the university could identify applicant clusters and do more targeted marketing in those locations.

For instance, when we were developing our product marketing strategy for Brandman's online graduate nursing program for fall 2019, we learned anecdotally that this program was growing on the East Coast due to referrals from current students and recent graduates who were living there. But two things were unclear: whether these referrals were concentrated in particular locations on the East Coast and, if so, whether any clusters of referrals were large enough to warrant targeted marketing campaigns.

Using Insights, Brandman's associate vice chancellor of marketing operations—who is not a data scientist—mapped our online nursing program application data. He was able to identify significant clusters of applicants in and around Washington, DC; Atlanta, Georgia; and Houston, Texas (in addition to Southern California, which makes sense because our home campus is in Orange County, California). This location intelligence told us that we needed to focus some significant marketing efforts in these locations. As a result, for fall 2019, we are taking two new marketing approaches. First, we are testing a limited-time referral scholarship to see if that can augment referrals in these areas. Second, we are targeting major health-care employers in these markets for our partnership program, which provides incentives to them to create a cohort of employees (nurses) to start and complete Brandman's online nursing program as a group.

Clearly, GIS is a powerful tool to use for data-driven storytelling. For Brandman, having a heat map that showed where our online nursing program applicants were located was a persuasive and visible indicator that we needed to develop a targeted marketing and referral campaign to harness these opportunities. For other organizations, GIS can help manage assets in real time, execute enterprise resource planning (ERP), and understand complex relationships.

Additionally, with the rise of 5G technology alongside the Internet of Things (IoT), Brandman's business advisory council believes that the convergence of location intelligence and data science will progress even more. In my opinion, GIS will be the driving force in the 5G revolution, with the two technologies transforming the way we conduct business, operate government bodies, and live our personal lives.

Digital transformation like this is a great opportunity, as James McCormick, a principal analyst at market research firm Forrester, pointed out on the *Esri & The Science of Where* podcast.

"Location—and context in particular—is really powerful for the way we understand our businesses and our customers, and that's really fueling interest in spatial and location technologies," he said.

Very few companies are actually leveraging data and analytics to gain a competitive advantage, though, McCormick added. By 2021, however, Forrester projects that having an insights-driven business strategy will be the norm.

"We need to embrace insights at scale," McCormick said, "so we need to have data and analytics technologies that deliver strategic value."


That is what GIS can offer. By combining asset information or ERP data with GIS, organizations can uncover insights and opportunities that simply weren't visible before. And with the global geographic information available from Esri via ArcGIS Online and ArcGIS Living Atlas of the World, the opportunities to enhance data are remarkable.

But when it comes to filling growing skills gaps—between analyzing data and using it to drive growth, profitability, and innovation, for example—organizations need to stop focusing on hiring this expertise and start training their current workforce, as additional research from Gartner shows.

So how can your company scale staff skills and develop a data-driven culture? By not cordoning off data so it's the sole responsibility of a data science team and instead empowering more people—from managers to marketing professionals—to use GIS and other data analytic tools to make impactful decisions.

## About the Author

Charles Bullock is the provost of Brandman University, a member of the Chapman University system in Southern California that serves over 13,000 students in more than 80 undergraduate, graduate, and certificate programs. For more information about Brandman and its undergraduate GIS programs (a bachelor of arts in spatial social sciences and a certificate in GIS use for nonprofit organizations), as well as its graduate programs (a master of business administration in business intelligence and data analytics and a master of GIS and data analytics), visit [brandman.edu](http://brandman.edu).



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# Seattle Zoo Builds Basemap Around Lions, Tigers, and Bears

Woodland Park Zoo in Seattle, Washington, welcomes more than 1.3 million guests each year to its 92 acres of award-winning exhibits and gardens. Visitors can see hundreds of animal species and thousands of trees, shrubs, herbs, and vines—and even experience a sensory garden.

Since its founding in 1899, the zoo has added countless exhibits. Today, Woodland Park Zoo ranks second (only to the Bronx Zoo in New York City) in the number of times it's been honored for its exhibits by the Association of Zoos and Aquariums.

Each time the zoo adds an exhibit, however, its facilities team has to adjust related infrastructure. That means that irrigation valves, water lines, and underground gas lines might all get moved.

"With every new exhibit comes changes in how the utilities and infrastructure are laid out," said lead gardener Dann Block.

In its 120 years, Woodland Park Zoo has refined its location intelligence tools almost as many times as it has updated its exhibits. Zoo employees have located infrastructure using everything from paper maps and institutional knowledge to CAD drawings and as-builts.

"We've got maps dating back to the 1950s that were hand drawn," said Block.

As employees retire and paper maps get lost or become outdated, it gets even more challenging to locate current infrastructure. An irrigation box might appear in one place on a map, for instance, despite having been moved years ago.

"We're constantly digging holes and finding stuff we didn't expect to be there," said Block.

So he decided to capture all the zoo's infrastructure data once and for all.

"I wanted a good set of maps," Block said.

Employing several components of the ArcGIS platform, along with solutions from Esri partners Eos Positioning Systems and Laser Technology, Inc. (LTI), Block is building the zoo's first accurate, up-to-date set of maps that employees and the public will eventually be able to use.

## From a Garden Inventory, an Idea Blossoms

In 2015, Woodland Park Zoo hired a graduate student to inventory its trees. Using his university's GPS equipment along with ArcGIS Desktop, the student mapped about 3,000 trees.

Block, who started working at the zoo in 2016, compared the student's GIS inventory to the zoo's CAD drawings.

"We realized we had some inaccuracies in our data when we put everything together in ArcMap," Block said. "We had tree points in the middle of buildings or pathways. When we added aerial imagery, we noticed that some of the CAD lines were out of date and tree centers were sometimes more than 20 feet outside the canopy of the tree on the image."

The inventory was a good start, but Block needed to improve it to make it usable. He envisioned a public-facing map that highlighted the zoo's gardens, showcasing its dedication to plants that both thrive in Seattle's climate but are honest to their exhibits.

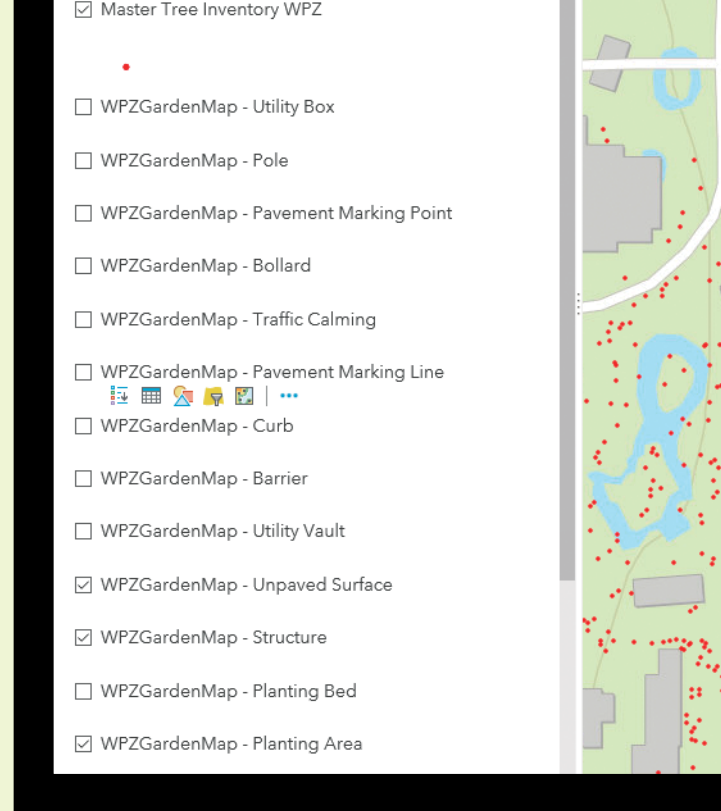
"My original intent was to create a map app that shows the public the different plants in the zoo—the really unique ones that can grow here but aren't found locally," Block explained.

So Block, who had no GIS training, turned to the GIS resources available to zoo staff to learn how to update the garden inventory. He signed up for an intensive, seven-day TeachMeGIS.com course taught by the King County GIS department that covered fundamental, intermediate, and advanced concepts in ArcMap. Block also took online introductory ArcGIS Desktop courses from Esri, which allowed him to work through about 50 hours of coursework in small chunks each morning. In addition, he asked the zoo's Learning & Innovation department, which uses Esri software to create story maps, for an ArcGIS nonprofit license.

In his self-guided research, Block discovered a YouTube tutorial that transformed his vision.

"It was fortuitous to find it," he said.

According to Block, the video demonstrated an early version of what had since become the free ArcGIS for Parks and Gardens Data Model. Today, this data model is a full, downloadable solution managed by the Alliance for Public Gardens GIS at the University



of California, Davis, and contains everything needed to create a park basemap. That includes plant center points, garden beds, exhibits, annual access areas, perimeters, sprinkler heads, valve shut-offs, curbs, pathways, asphalt, and much more.

"The ArcGIS Parks and Gardens Data Model had pretty much everything we needed to make a basemap," Block said. "I had to tweak some names, but that's about it."

Block then set out to re-create a comprehensive Woodland Park Zoo basemap—accurately.

## The Technology Needed to Peek Through the Canopy

Inspired by the ArcGIS Park and Gardens Data Model, Block researched the technology he would need to remap the zoo's infrastructure and gardens.

Since he already had an ArcGIS license, Block chose to use Collector for ArcGIS to gather data on his iPhone 8. But he needed to improve his mobile location accuracy beyond what the graduate student had achieved with legacy GPS and what the iPhone offered on its own.

The surrounding conditions didn't make that easy. Woodland Park Zoo sits on a hill. While tracking satellites on a hilltop—in the zoo's southwest corner, for instance—proved relatively easy thanks to open skies, tracking satellites where the park's elevation dropped hundreds of feet, such as in the park's northeast corner, was challenging. The fact that the zoo is encircled by Seattle's urban environment didn't help, either.

After researching Bluetooth GPS receivers that performed well under an urban canopy, Block decided to use Eos's Arrow 100 GNSS receiver, which an independent study had ranked as the best performing and most affordable GPS receiver. Block and his supervisors also appreciated that the Arrow 100 used free Satellite-Based Augmentation System (SBAS) signals to correct down to submeter accuracy, rather than requiring a paid subscription to make Global Navigation Satellite System (GNSS) corrections.

"We looked at all the equipment and software out there, and the Arrow 100 had the best ratings under trees," Block said. "We determined that it was the best GNSS receiver available, with the best performance, that fit our budget."

← For lead gardener Dann Block, large trees, exhibit structures, and zoo animals such as lions proved to be significant obstacles to collecting data points for GIS mapping.

Woodland Park Zoo in Seattle, Washington, is home to hundreds of animal species and thousands of trees, shrubs, herbs, and vines.





← Block has so far mapped 10 percent of Woodland Park Zoo's infrastructure and gardens. He hopes to eventually use this data to build a publicly accessible app that shows garden layouts and plant locations.

Block mounted his Arrow 100 antenna to a 15-foot telescoping survey pole. The rod let him extend the antenna's reach to achieve a better view of the sky in some locations.

But even a longer rod couldn't eliminate the zoo's biggest challenge: the trees Block wanted to map were obstructing the sky.

#### Laser Mapping Increases Accuracy and Protects Animals

Next to the base of a big tree, of which Woodland Park Zoo has plenty, satellite signals would drop even when tracking all four global constellations, and the location point would "hover around a large area," according to Block. If he could get away from the trees, to clearer skies, he could collect his data with higher accuracy. But to do that, he would need to be able to capture points from afar with a laser range finder, which would then feed the asset location into Collector.

Block had seen that Eos introduced a new laser mapping solution for Collector in iOS, so he reached out to the company through its online contact form to see if Eos could recommend a good laser range finder.

"I would like to find a laser range finder to map our gardens and infrastructure," Block wrote, "most of which is under dense canopy cover."

Eos recommended the TruPulse 200x from LTI, which would allow Block to map trees, valves, and other targets from hundreds of feet away while retaining his submeter accuracy. It also worked seamlessly with Block's existing Collector app running on iOS, as well as his Arrow 100.

He ordered the TruPulse 200x and started laser mapping the trees and infrastructure that were located under other trees and buildings. His accuracy was usually about 20 centimeters.

"It's a great tool to have," he said. "When I'm in dense canopy and I have all these trees, I can just pop back out, get a line of sight, and take my location point from there."

The zoo also purchased LTI's TruPulse Foliage Filter, a lens that filters out foliage and other obstructions so only the target is acquired. That helped Block take points under dense shrubbery, which happens to be where irrigation valve boxes are usually situated.

"With the laser offset, I don't have to guess where my points are now. I can actually get pretty close," Block said. "Depending on how close I am to buildings, I can get as good as 20 centimeters."

The laser offset also allows Block to take extra precautions for the animals' safety. If he were to enter each exhibit to collect data, the animals would have to be kept in their sleeping quarters.

"This usually disrupts their daily routines, so we avoid this whenever we can," Block said. "It also involves lots of coordination between departments."

The range finder comes in handy in inherently challenging places as well, where standing to capture data would be hard. This includes roof edges, moats, and fences surrounded by thorny bushes.

"The laser range finder is useful anywhere safety is an issue for our workers or equipment," said Block.

#### A Robust Map for Employees and, Eventually, the Public

So far, Block has mapped 10 percent of Woodland Park Zoo's infrastructure and gardens. He began by mapping polygons of garden beds and exhibits so he could create pathways that hint at where valve and electrical boxes might be.

"We can populate where our valve and electrical boxes are based on the edges," he said.

Meanwhile, he's working to figure out how to link digital scans of existing as-builts to the data in ArcGIS. This will enable field crews to pull up the history of any point in the field through Collector, including for buried assets.

"When our field crews are using Collector, they can see what we've collected so far and also look at the as-builts to have an idea of what the underground should look like," Block said. "We can also populate the map with photos, links to work orders and work history, as-built maps, historical information, and more."

The first milestone for Block will be completing the basemap for the entire zoo within the ArcGIS for Parks and Gardens Data Model. It will show polygons of garden beds, exhibits, buildings, and pathways, as well as points that represent trees and other infrastructure. Block has also received requests to add other data to the map, such as storm water runoff.

Block and the zoo's facilities teams now envision that their crews—including outdoor and indoor horticulture specialists, maintenance workers, pool operators, plumbers, electricians, carpenters, and general laborers—will use Collector on their company-issued phones to look up accurate information as they go about their work.

"Most importantly, the map will be available to any employee in ArcGIS Online to locate infrastructure and related information in the field," he said.

Block expects the project to take several years to complete. But once it's done, he also anticipates designing that garden app that got him started.

"We can eventually use this to document the garden layouts and plant locations, which could be incorporated into an app that the public can access," Block said.



# Prioritizing Places for Protection

By Hugh Possingham, The Nature Conservancy

Since its inception in 1951, The Nature Conservancy (TNC) has been a global leader in working with public and private partners to protect the lands and waters on which all life depends. Over the years, TNC's mission has evolved to tackle the ever-more complex problems associated with climate change, all of which require more diverse actions. Yet protection of place remains key for the organization, as exemplified by its recent acquisition of the Jack and Laura Dangermond Preserve at Point Conception, California, where nearly 25,000 acres of unspoiled coastal habitat will be preserved. (Read more about this in *ArcNews* at [p.ctx.ly/r/9eks](http://p.ctx.ly/r/9eks).)

To carry out its mission, TNC needs to know where to create protected areas that will sustain biodiversity and ecosystem services well into the future. Science-based conservation plans need to pinpoint the places where specific protection actions—such as land acquisitions or easements, encouraging indigenous land tenure, or creating no-trawl zones—need to be implemented to deliver the greatest return on investment for both people and nature. Thus, TNC is revolutionizing its approach to conservation, incorporating new principles, tools, and spatial data to inform its strategies.

## The Recipe for Successful Conservation

Figuring out how to prioritize areas for conservation is like being a master chef. In the same way that chefs have to have sound knowledge of the main ingredients that make up particular dishes and then chop, cook, and spice them up in ways that elevate those ingredients to an integrated outcome, conservationists at TNC must be able to model and analyze the elements that make a place ripe for conservation and protection.

At TNC, the three main ingredients for protection action are as follows:

- The ecological or biophysical assets or values that TNC cares most about protecting
- The defined set of actions TNC would take to create and manage protected areas
- The factors or conditions that could affect TNC's ability to have an impact and be successful

Making determinations about these considerations revolves around being able to decipher the spatial data that TNC's scientists assemble using software and tools from Esri. To continue the metaphor, this is the taste testing that happens after all the ingredients are blended together.

In the early 2000s, TNC centered its strategic planning on the ecoregional maps it made, which showed the most important parts of the land- and seascape to protect. The intervening years, however, have seen a massive expansion in the amount and types of spatial data available, not to mention improvements in the models and tools that can be used to manipulate data.

That is why TNC is transforming systematic conservation planning into a process I call *spatial action mapping*. Spatial action mapping is all about picking the best places to act. It moves

us from the traditional mapping of biodiversity assets—such as maps of species richness, ecosystem services, and wilderness areas—to maps of cost-effective and feasible actions. It takes us from the ingredients to the integrated outcome.

Below is the recipe for protection action. Applied well, the ingredients should deliver the maximum return on investment for conservation.

## STEP 1: Determine What's Valuable

The first ingredient—identifying the assets and values to protect—can be added to this conservation recipe in several ways.

While recent literature has been dominated by ecologists and biogeographers who map natural assets, revealing places that support critical elements of biodiversity, these assets are not prioritizations in their own right. For protection, TNC considers two values to be the most critical: *representation* of biodiversity features, such as habitats and species, and *resilience*, particularly to climate change. TNC is in the midst of developing national and global maps of these values.

The maps are essential, but by themselves, they are insufficient for prioritizing action. That's because these two ingredients—representation and resilience—are only two components of this recipe.

## STEP 2: Take Action

The next ingredient to be carefully folded into this recipe is knowing what concrete actions need to be taken in particular places.

TNC uses the International Union for Conservation of Nature's (IUCN) definition of a protected area: "a clearly defined geographical space recognized, dedicated, and managed,

through legal or other effective means, to long-term conservation of nature associated with ecosystem services and cultural values." Given that protection entails the long-term conservation of a clearly defined space, TNC must take action to safeguard places that are critical for biodiversity or ecosystem services before they are converted for intensive human use—for agriculture, trawling, or infrastructure. In some cases, TNC also considers actions that involve partial or temporary protection, though the organization's core business is long-term conservation.

## STEP 3: Heed Other Factors

Once TNC has identified valuable assets and is aware of the types of actions that need to be taken to protect them, the organization has to ensure that its investments in protection have the greatest benefit—the third ingredient in this recipe. For this, TNC analyzes two sets of factors: first, the potential impacts that conservation actions can have, and second, the conditions that would enable success.

## Evaluating Potential Impacts

When evaluating the magnitude of the potential impact of protection actions, there are three factors that are important to consider:

- The risk that the area will eventually be converted, destroying the values that TNC is trying to protect
- The risk that ineffective management will lead to the degradation of those values
- The potential for several additional benefits to manifest from any given protection action, such as carbon sequestration or improvements in human health

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→ This spatial action map, which The Nature Conservancy (TNC) built using Marxan, shows the marine zoning design declared in 2016 for St. Kitts and Nevis in the Caribbean. (Map courtesy of TNC, Caribbean Division.)



Risk of conversion is driven by changes in land use that permanently degrade or eliminate the values that TNC is aiming to safeguard. Places that require certain types or high degrees of management may demand specific protection actions that are geared toward preventing the deterioration of values. And protecting places that have additional value—that help achieve other TNC conservation goals, for example—provides a greater return on investment.

Being able to analyze and map these risks and benefits, as well as how they impact the places that have healthy representation and are resilient, indicates where protection actions are likely to have the greatest overall effect.

#### Pinpointing Indicators of Success

The right circumstances greatly improve the likelihood that protection actions will be effective. The two critical indicators that TNC evaluates for this are, first, the probability of success, and second, whether the actions are compatible with cultural and social values.

Examining the likelihood of success includes evaluating the benefits of action, gauging political feasibility, and determining whether TNC can raise funding. When it comes to finding compatible cultural and social values, there are many indigenous and local communities throughout the world whose principles support the conservation of natural resources. The places where these communities live can embody an important enabling condition for the success of conservation protection actions.

Analyzing and mapping these two critical indicators ensures that TNC acts in places where it is most likely to succeed in achieving its goals.

#### STEP 4: Blend the Ingredients

With all these ingredients in their various forms and flavors, TNC has the right recipe to ensure the meaningful, strategic, and effective deployment of protection activities around the globe so that critical lands and waters will be conserved well into the future.

Over the years, TNC has used a suite of tried and trusted tools to whip this recipe into successful servings of conservation. In particular, Marxan—a tool developed by my lab almost 20 years ago that can take data from any GIS software and assemble it for analysis—serves as the blender, while the Marxan user is the cook. Esri tools function as the taste tester, helping TNC conservationists visualize what might work and what probably won't. All three—the blender, the cook, and the taste tester—must be good at what they do, or the recipe will fail.

At TNC, this recipe and its associated utensils yield maps for action that outline the highest-priority areas for protection. These maps are not only about the important places; they also outline precisely what actions must be taken—and for what reasons—to ensure that these spaces are protected. With these spatial action maps, TNC and its partners are leading the way in conservation action prioritization around the globe.

This article forms the basis of TNC protection policy. It incorporates input from many TNC leaders and scientists, in particular Kacky Andrews, Joe Fargione, Tim Boucher, Christina Kennedy, Joe Kiesecker, Mark Anderson, Eddie Game, Nick Wolff, David Banks, and Jennifer McGowan.

#### About the Author

Hugh Possingham is the chief scientist of TNC. His expertise is in ecology, applied mathematics, spatial planning, operations research, and economic instruments for conservation outcomes. He has more than 600 peer-reviewed scientific publications and is a foreign associate of the United States' National Academy of Sciences.

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# Open Data Site Supports Fish, Wildlife Conservation Efforts in North America

State fish and wildlife personnel from across the western United States are working together to save priority species and their habitats, and many of them are connected with the Western Association of Fish and Wildlife Agencies (WAFWA). A nonprofit organization, WAFWA coordinates with agencies from 19 US states and 5 Canadian provinces over 3.7 million square miles of some of North America's most wild and scenic country to ensure strategic, science-based conservation and practical resource management.

The organization shares data using an online land-use planning solution called the Crucial Habitat Assessment Tool (CHAT). Recently, WAFWA leaders decided to upgrade CHAT to an open data website so it would be easier to customize, control content, and collect and share information.

"We needed a technological solution to help our conservation work reach new heights—one that allows us to grow the site and add new features," said Mike Houts, GIS lead for WAFWA-CHAT and a research associate for the Kansas Biological Survey at the University of Kansas.

## An Upgrade Facilitates Growth

CHAT, a nonregulatory tool originally created by the Western Governors' Association, uses the best available data to rank each area in the region with regard to wildlife habitat conservation and how well state policies support that. The CHAT website was initially created by a third-party company that employed an online map service to display relevant data.

To upgrade CHAT so it could be managed internally, Houts and the GIS team elected to use

ArcGIS Online and ArcGIS Hub. They took advantage of the ArcGIS Online cloud-based mapping capabilities to create and share maps and data. Then they used ArcGIS Hub to share open data on WAFWA's hub site, wafwachat.org, with the goal of engaging governments and communities around related policy initiatives.

"Over the course of the last year, we really started digging into ArcGIS Online and ArcGIS Hub, and that's turned out to be incredibly beneficial," said Houts.

The use of CHAT data and maps is quickly growing based on the needs of specific projects and initiatives. To facilitate the expansion of CHAT to states beyond the western United States and address data and location privacy concerns, the University of Kansas developed the Nested Hexagon Framework (NHF). Covering all of North America, the NHF consists of three nested spatial mapping units and a standardized set of attributes—such as species name and observation date—to summarize integrated datasets and convey information. By relating the attribute data to a hexagonal/cog/wheel spatial mapping unit (which is somewhat analogous to the Public Land Survey System's township/range/section mapping unit used in the United States), the NHF allows various agencies to share their information without revealing raw data, such as sensitive spatial data or precise locations. This has proven valuable for states with stringent privacy laws. States can then use the datasets summarized by the NHF to determine CHAT ranks.

## Improved Control

The CHAT GIS team selected ArcGIS Hub because of its high usability. Houts said the site's primary web page and the secondary topic-specific pages are now easier to design and implement. Overall website management has also been simplified. When creating a new hub page to summarize a

WAFWA project, for example, project leaders can easily convert a Microsoft PowerPoint presentation that highlights goals and content into a story map that can then be posted on the hub page.

"Now we've got improved control over these sites and can add new projects and new text," said Houts. "Our team can update things really easily, as opposed to going through our third-party vendor."

Because ArcGIS Hub enables open data sharing and better data management, WAFWA can efficiently share data with people from state agencies who visit the site. This is a huge development, given that, as Houts noted, the details in CHAT data were not openly shared before. Harnessing this momentum, WAFWA and state agencies are now working to leverage the CHAT and the NHF to make more information available for use in decision-making processes.

Visitors to WAFWA's hub site can download CHAT attribute data for the entire western United States as a .dbf file, and the NHF spatial grid is available for download in 5 x 5 degree tiles. Users simply download each piece and join them by the hexagon ID to get the information for their area of interest. Splitting the data up like this makes the downloads smaller and more focused. The GIS team also created a dashboard that logs the number of downloads and what areas are downloaded to help keep track of areas of high interest. The only requirement to obtain data is a valid email address.

## Making Data More Accessible

States participating in WAFWA's CHAT update their habitat priority rankings as needed, and efforts are now under way to launch a mechanism through which dataset owners can submit their data for integration into the NHF. Once this data is summarized and incorporated into the framework, CHAT users will be able to see additional details about what is within each cell.



↑ The Western Association of Fish and Wildlife Agencies (WAFWA) shares conservation data via a land-use planning solution called the Crucial Habitat Assessment Tool (CHAT), which is now managed using ArcGIS Online and ArcGIS Hub.

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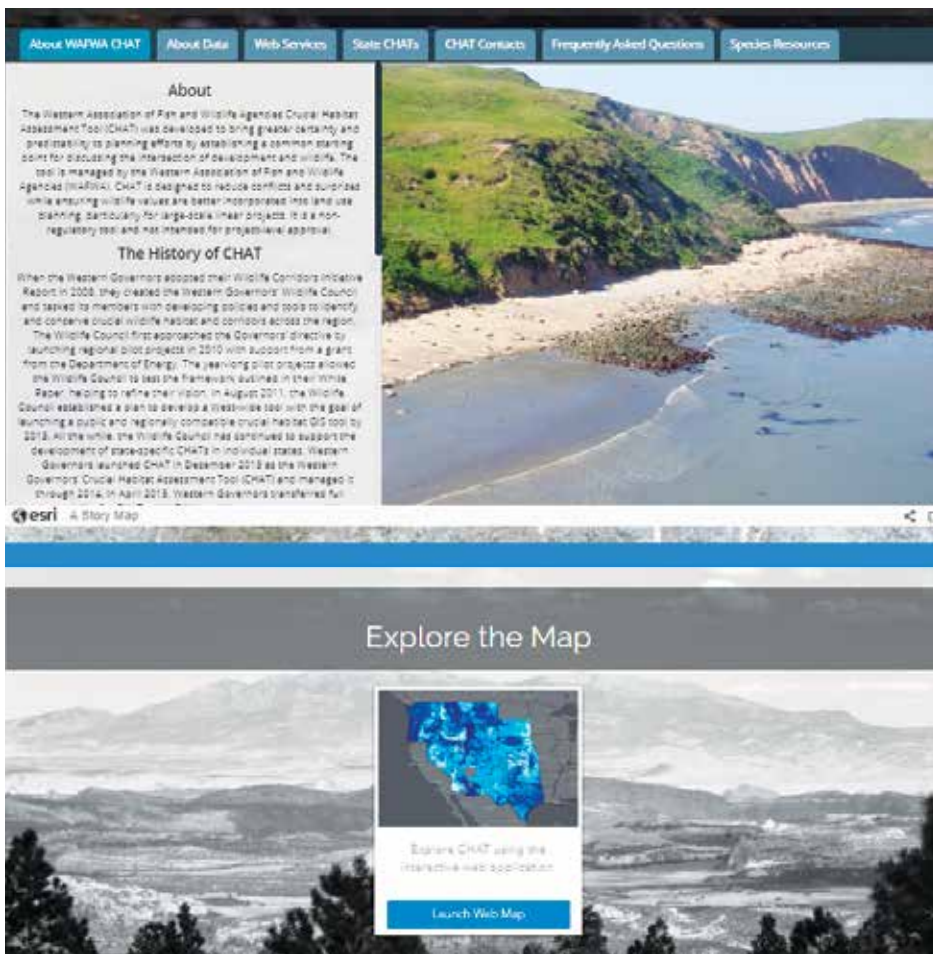
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↑ To easily and clearly communicate important conservation information, WAFWA displays story maps on its ArcGIS Hub pages.

“The goal of collecting all this data is to help make better decisions and inform, but it doesn’t do any good if the information is not made accessible,” said Houts. “So CHAT, the NHF, and ArcGIS Hub are helping make our data accessible to decision-makers and the public while protecting the raw data.”

WAFWA partners and the public can also use ArcGIS Hub capabilities to provide input on how the CHAT tool is working and what new functionalities they may want to see in the future via a feedback option on the web page.

“The ArcGIS platform and ArcGIS Hub provide the powerful data sharing capabilities that we require—along with the visualization and analytics—to achieve our goal of making the data accessible and useful,” said Chanda Pettie,

a WAFWA-CHAT coordinator. “WAFWA can now provide discoverable, science-supported data to assist in making sound resource management decisions.”

#### Enhanced Collaboration

WAFWA’s implementation of ArcGIS Online and ArcGIS Hub has greatly improved data sharing and is fostering increased collaboration. For starters, the use of Hub has enhanced data management and is getting agencies to better handle their data for CHAT analyses and summaries.

“ArcGIS Hub and ArcGIS Online are helping us meet our goals by making the project information more accessible to the public, as well as planners and developers,” said Houts. “The hub site gives a nice project overview on things,

while download and online mapping tools provide additional information for queries, analysis, and project summaries.”

The use of ArcGIS Online has also improved collaboration within WAFWA, as well as with external agencies. One of Houts’s favorite features of ArcGIS Online is the ability to share a map or web page before it’s published.

“Being able to easily and securely share draft online maps with team members has saved a lot of time and effort, especially when multiple versions exist,” he said. “We can create maps and datasets online with different tools, and designated workgroup stakeholders can browse and review project details before a project page goes live.”

For Houts and his team, the ArcGIS Online interface simplifies how mapping apps are created and improves the user experience. Those who are not skilled in GIS can effortlessly examine a map and obtain detailed information.

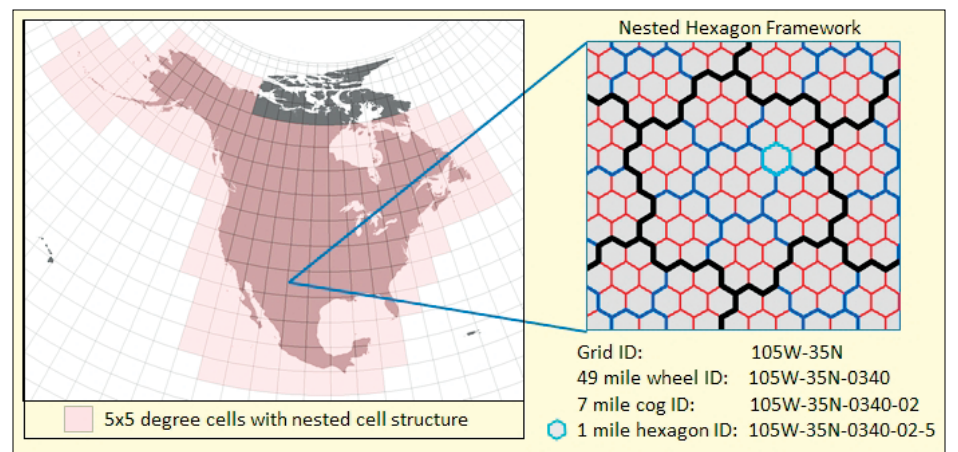
#### Additional Apps for Data Collection

WAFWA employs other Esri tools to collect and share data with CHAT as well. For example,

WAFWA teams use Collector for ArcGIS and Survey123 for ArcGIS to administer breeding surveys on the lesser prairie chicken, a bird of conservation interest in the southern Great Plains.

Previously, regional biologists had to create maps for each property and location that was about to be or already surveyed, as well as a master map to provide an overview of all locations and data forms. Data used to be submitted via scanned hard copies and often included illegible, incomplete, or inconsistent answers. Now, however, app users can report lesser prairie chicken sightings and other details by answering questions via drop-down menus on their smartphones or tablets. The information is then sent directly to a WAFWA database, where regional biologists can view all the collected data and interact with the map to perform analysis.

According to Houts, the apps have made “data collection easy and submitted data more complete, consistent, and accurate.”



↑ The Nested Hexagon Framework (NHF) consists of three nested spatial mapping units (in black, blue, and red on the map) and a standardized set of attributes to summarize datasets and convey information.

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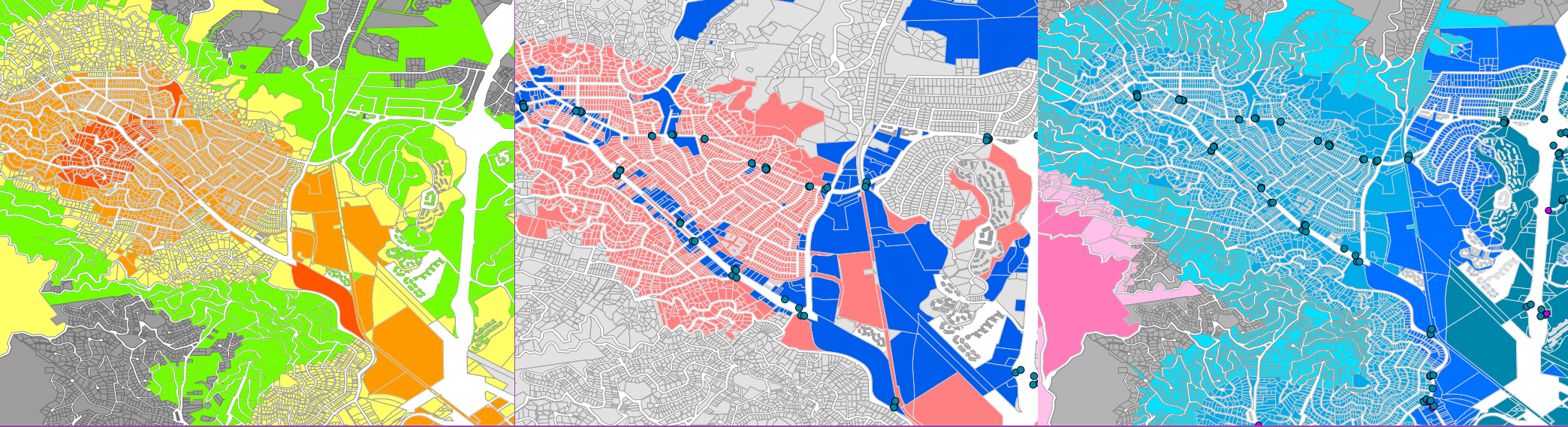
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# Cloud-Based National Parcel Layer Grants Users Access to Greater Detail

By Dennis H. Klein, Boundary Solutions, Inc.

↑ Using ParcelAtlas, local governments and developers can figure out a community's walkability and transit scores. On the map to the left, gray parcels are not walkable; green parcels are slightly walkable; and orange and red parcels are highly walkable. The middle map shows where live-work housing should be, with pink indicating residential parcels and blue representing the destinations that visitors can walk to. The map on the right helps users determine residential parcels' proximity to transit stops (the dots) that would require only up to a 30-minute commute (in blue) to areas with a considerable number of jobs.

Thanks to online national parcel layer content services, geospatial analysis is getting increasingly granular. In the past, the smallest analytical unit for a demographic map was a census block, which, in the United States, typically consists of about 1,000 households. In a national parcel layer, however, the smallest analytical unit is a single parcel containing one household. Thus, a national parcel layer offers 1,000 times more resolution—on demographic patterns, population density, home sale prices, income levels, and more—than a census block layer.

When it comes to getting a return on investment in using a national parcel layer, it's still early. Some argue that there is so much to learn about how to use the many attributes linked to parcel boundaries that, 30 years from now, it will still be early.

There is something new on the scene, though: ParcelAtlas FEATURES, a cloud-based cadastral content service in which the whole database, with its 151 million parcels across 2,900 US counties, performs as though the entire nation is a single geodatabase. When a user enters an address on a map, the map zooms to that location, and the geospatial data for the area around that address is fully actionable, with only the parcels visible on the screen being activated.

Codeveloped by Esri partner Team Augmented Reality, Inc., and Boundary Solutions, Inc. (BSI), ParcelAtlas is hosted entirely within ArcGIS Online and is available in ArcGIS Marketplace. The subscription-based service deploys digital parcel map content directly to ArcGIS Online for use in ArcGIS Pro, ArcMap, and other ArcGIS technology. It can also be incorporated into non-Esri products via REST services. BSI makes its best efforts to keep every county's data current to within a year and updates attributes quarterly.

Having up-to-date parcel layers available for easy use in ArcGIS Online is not only convenient, but it also fundamentally improves the analysis and data services that can be generated using this data. Now, users don't need to download a national parcel layer content service, mount it, monitor it, and keep it current themselves. Rather, they can just log in to ParcelAtlas to access and use BSI's always-up-to-date national parcel layer content service, and then wherever they need to go on a map, live data is there.

## Accurate, Complete, and Accessible

Since Roman times, the cadastre (i.e., a parcel map and its attributes) has defined the legal, physical, and cultural characteristics of land in service of two main missions—first, to collect taxes, and second, to define ownership. Throughout the centuries, multipurpose cadastre operations have had to meet three requirements: accuracy, completeness, and accessibility.

Regarding accuracy, ParcelAtlas' metadata includes 18 different metrics that inform subscribers of the data's qualities and characteristics. ParcelAtlas is also about as complete as it gets, with more than 99 percent of all boundaries available for the United States, along with seamless attribute data coverage. Accessibility is where ParcelAtlas really changes the game, though. In addition to making traditional REST deployment viable, ParcelAtlas delivers fully functional live data on-screen and enables offline data sharing via a Web Feature Service (WFS).

Even though ParcelAtlas is a national parcel layer, users can selectively turn content on or off to tailor its coverage to match their exact needs. Subscriptions are either quarterly or annual, and users can select which part(s) of the country they want access to and how many users they want to register. Additionally, subscribers can choose whether to access IN STOCK parcels only, which consists of 122 million parcels for 1,800 counties across the United States, or expand coverage with IN STOCK ADD, which augments coverage by 29 million more parcels and 1,100 counties.

## Apply ParcelAtlas for Emergency Management, Climate Change, and More

The uses for ParcelAtlas are myriad and varied. The following are just some examples of the many ways in which this service can be applied:

- **Improving emergency management:** Public safety and emergency services organizations can use the national cadastre for everything from flood planning and damage assessment to building up community resilience and fighting forest fires. For instance, insurance companies and banks can use parcel maps to preassess the potential for flooding to strike specific areas as an aggregate value. Local governments can make use of ParcelAtlas' parcel-specific locations to better coordinate post-disaster debris reporting, while aid organizations and federal authorities can intersect spatial extents with parcel boundaries to expedite recovery operations. Being able to identify parcel-specific locations ensures that critical facilities will be accounted for in an emergency and that evacuation zone notices get sent to the right people. Additionally, during forest fires, the US Forest Service and fire departments across the United States can overlay real-time imagery onto parcel maps to know exactly where they are fighting fires moment to moment.
- **Engaging with the community:** When people can see the land boundaries for where they live on apps built by their own local governments, it greatly increases their awareness about proposed projects and infrastructural developments and makes them feel like they have some input in the

decision-making process. More importantly, being able to analyze such variables as building sale price, assessed value, year built, use code, and/or floor area ratios for commercial, office, and residential properties can greatly complement census block-based demographics, which can give city employees, county staff, and even citizens a broader understanding of the issues and sentiments within a community.

- **Generating data models for climate change reversal:** For communities and developers that are seeking to engage in climate change-reversing development, it is helpful, for example, for local and regional governments to be able to alleviate residents' gridlock-causing commutes. One way to do this is to identify the parcels that have both high walkability and public transit scores to locate only those parcels in specific overlay zones. In ParcelAtlas, users simply have to identify all the parcels that can be destinations, such as businesses and government or nongovernmental organization (NGO) offices and facilities; buffer them; count how many destinations and transit stops are within a half mile; and then assign a relative walk and transit score to each parcel. With this, governments and developers know just where to locate live-work housing to eliminate carbon-intensive commutes and traffic jams.

## Get Started with ParcelAtlas

Esri users can explore ParcelAtlas by subscribing to the ParcelAtlas FREE layer in ArcGIS Marketplace. This introductory service contains parcel data for six Massachusetts counties, all composed of two bundled layers: a fast-tiled layer for zoomed-out use and a full feature layer for when zoomed in. From there, users can upgrade to the ParcelAtlas FEATURES subscription or the REST Service subscription, used for making custom apps. Learn more about these offerings at [p.ctx.ly/r/9ery](http://p.ctx.ly/r/9ery).

## About the Author

Dennis H. Klein, GISP, PE, is the president and CEO of BSI. He has a bachelor's of science degree in civil engineering from the University of Maryland and a master's degree from the University of California, Berkeley, Institute of Transportation Studies. He spent the 1970s building pin-registered Mylar-on-light-table land information systems before turning to GIS in the 1980s when he founded Facility Mapping Systems, an AutoCAD-based municipal GIS. He has been involved in GIS full time ever since. Klein founded BSI in 2001.

# Tunisia Automates Census Work with Web, Mobile, and Enterprise GIS

By Nejib Elkhelifi, Moncef Jarboui, and Tarek Tkitek, National Statistical Institute, Tunisia; and Omar Gaafar, Graphtech

In 2024, the National Statistical Institute (NSI) in Tunisia will count all 11.5 million people living in the North African country. As in many other countries, conducting the census is the most intense and expensive peacetime operation that occurs in Tunisia. The process relies on tens of thousands of fieldworkers and requires a big budget—it cost about 40 million Tunisian dinars (approximately US\$13 million) to administer it in 2014.

To make the count easier and more efficient, a team of IT engineers and GIS enthusiasts at NSI has instituted Air Stat, an initiative that aims to automate census surveys and their related statistical processes. But instead of having this revolve around developing a bunch of apps from scratch, the engineers working on the project made it their goal to have Air Stat integrate cutting-edge technologies, such as cloud computing, mobility, and web and mobile GIS, as building blocks for design. This way, the IT engineers can easily assemble agile and secure solutions—without getting bogged down in coding—that can automate any mobile or web-based survey and statistical process from sampling to dissemination.

The project, which began in 2014, is part of a United Nations-financed initiative to use mobile technology in statistical processes in countries in Africa. NSI has already deployed Air Stat for use in other, smaller surveys taken throughout Tunisia, and the organization is realizing the benefits of having better-quality and more secure data, not to mention faster processes for getting field data into NSI's databases and ready for analysis.

What really made all this possible was the release of the new generation of ArcGIS Enterprise (10.5.x and 10.6.x), since that enabled the engineers to implement and deploy an array of functionality quickly, encased within a few key pieces of ArcGIS technology. Now, NSI is gearing up to deploy its solutions in full for the 2024 census.

## The Building Blocks of Successful Enumeration

For Air Stat to work, it relies on three key building blocks: the cloud, enterprise mobility management (EMM), and web and mobile GIS.

The very first building block NSI engineers tested and deployed was a private cloud. They knew that field staff would need access to NSI's local storage, servers, data, and apps anytime, anywhere, and that it was essential that everyone have granular access control to protect sensitive data while facilitating productivity.

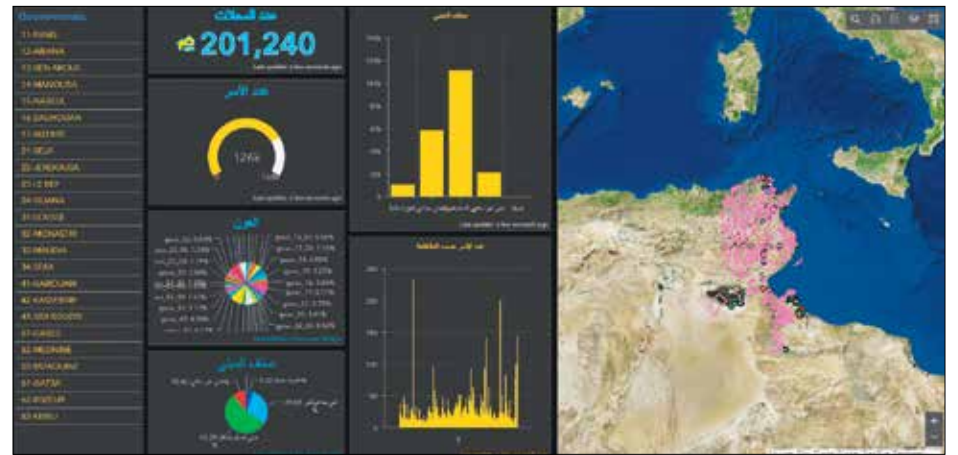
The engineers also wanted to ensure that NSI staff could remotely manage and provide security for the mobile census fleet. This is where the EMM building block comes in, which encompasses managing mobile devices, apps, and data. The team chose to implement a per-app virtual private network (VPN), which encrypts data on an app-by-app basis rather than encrypting all the data moving between the field devices and NSI's internal servers. The IT engineers also designed the system so that specific types of users have profiles that are tied to distinct apps on their devices. Enumerators, for example, get Survey123 for ArcGIS automatically installed on their devices—and only that app can access NSI's internal servers—while the chief enumerators' devices automatically get Collector for ArcGIS. Now, thanks to the EMM and the new generation of ArcGIS Enterprise, during the census, NSI will know exactly where its mobile devices are and will be able to do things like send notifications directly to device users, remotely install and uninstall apps, sync field-collected data both online and offline, and remotely wipe the devices.

The third building block for Air Stat is web and mobile GIS. The engineers wanted NSI's apps to be map oriented and customizable, with the ability to collect any kind of geographic information needed. Additionally, because NSI manages such a huge workforce during the census, the team knew it would need to develop real-time dispatching capabilities and interactive, real-time dashboards. The apps would need to be functional on multiple platforms—including iOS, Android, Windows, and the web—and able to work in numerous languages. Luckily, these requirements were met by deploying Esri's suite of field apps, including Collector, Survey123, a data validation app built with Web AppBuilder for ArcGIS, Operations Dashboard for ArcGIS, and Workforce for ArcGIS.

NSI's building blocks are continually expanding, but to ensure that all these functionalities are in top form by the time the census rolls around, the organization has already implemented Air Stat in several other Tunisian surveys. For example, the civil registration survey, which continually records births, marriages, and deaths, now has secure remote access, so the data moving between remote workstations and NSI's internal servers is encrypted. The country's 2018 Multiple Indicator Cluster



↑ The National Statistical Institute's (NSI) field apps are map oriented and customizable.



↑ An interactive, real-time dashboard built with Operations Dashboard for ArcGIS lets NSI staff monitor in-progress surveys.

Survey (MICS6), a household survey supported by the United Nations Children's Fund (UNICEF), employed secure and automatic online/offline synchronization. And the country's complex quarterly labor force surveys, which is what Air Stat is currently predominantly used for, now utilize map-oriented apps, the form generator for questionnaire-like apps, automatic deployment, online and offline syncing, workforce management, real-time and interactive dashboards, and spatial analysis.

## Effective App Implementations and Continued Development

With Tunisia's next census just five years away, NSI is at full throttle in testing, perfecting, and releasing its survey, data gathering, data validation, workforce monitoring, and spatial analysis functionality and apps.

The organization's questionnaire-oriented app, which was built using Survey123, is being used consistently by enumerators for the labor force surveys to collect data from households and all their members. Use of the app ensures ongoing data consistency and coherence and allows NSI staff to visualize the households and their data on a map. So far, NSI has collected almost 100,000 of these complex surveys using this app—most of which contain more than 200 questions with complicated conditional logic and related tables.

Through the labor force survey, NSI has also gathered more than 400,000 data points using its map-oriented app based on Collector. With this app, chief enumerators can record and update any kind of geographic information, including points, lines, polygons, tables, and questionnaires. They can draw and fix geographic shapes, such as buildings, districts, and routes. They can also launch preselected questionnaires that already have some fields filled out. All this data and its related tables can be reliably synced to NSI's internal servers once they are collected.

In addition, the engineers used Operations Dashboard to set up an interactive, real-time dashboard that allows NSI staff to monitor in-progress surveys, seeing incoming data, key performance indicators, where fieldworkers are located, and more. They can also filter this data at the national, governorate, district, and even enumerator levels.

Development work isn't done, however. The engineers are currently conducting preliminary tests on Workforce, which will allow NSI to dispatch and manage fieldworkers based on survey, district, date, priority, and enumerator. This will help NSI manage simultaneous surveys, coordinate related field operations, and avoid conducting conflicting visits at the same households. They are also actively exploring how to do spatial analysis of the collected data using ArcGIS Pro, Insights for ArcGIS, and other Esri technology.

## Making Headway Toward a Smooth Census

While not all the technological kinks have been worked out quite yet, NSI is making promising progress toward its goal of having agile and secure solutions available for Tunisia's 2024 census that will automate many enumeration-related activities and make the count—and the ensuing statistical analysis—as smooth a process as possible. For more information, email Nejib Elkhelifi, NSI's lead for the Air Stat initiative, at [elkhelifi.nejib@ins.tn](mailto:elkhelifi.nejib@ins.tn).

All presented analysis and screenshots are provided for demonstration purposes only. They do not represent the official work of the NSI.

## About the Authors

Nejib Elkhelifi is an IT engineer and team lead for the Air Stat initiative at Tunisia's NSI. Moncef Jarboui and Tarek Tkitek are IT engineers and members of NSI's Air Stat initiative. Omar Gaafar is the technical marketing manager at Graphtech, Esri's official distributor in Tunisia.



## Crossing Borders

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

# Geography, GIS, and Gerrymandering

## Former US Attorney General Eric Holder Calls This an All-Hands-on-Deck Moment at AAG's Annual Meeting

On behalf of the American Association of Geographers (AAG), I'd like to publicly thank former US attorney general Eric Holder for joining 9,000 geographers and GIS specialists in April at the AAG Annual Meeting in Washington, DC. He chairs the National Democratic Redistricting Committee (NDRC), which seeks to combat unfairly gerrymandered districts leading up to 2021, when districts will be redrawn after the decennial US census.

AAG meetings are attended by geographers and GIS professionals from a wide range of backgrounds. Our field unites some of the best minds to tackle today's toughest issues—including gerrymandering and redistricting—always through a spatial lens. In regard to the United States' social challenges, such as divided politics and fair representation, thinking spatially can have a huge impact. For better and for worse, geography and GIS have revolutionized how congressional districts are now created and manipulated—and how they impact our national and state elections.

Holder's career in public service began long before his appointment as the eighty-second attorney general of the United States. After graduating with a law degree from Columbia University, he started out as a trial attorney in the Public Integrity Section of the US Department of Justice's Criminal Division. Under the administration of former president Bill Clinton, he served as deputy attorney general, and under former president Barack Obama, he became the attorney general. He was the third-longest-serving attorney general in US history and the first-ever African American to hold that position.

His lifetime of public service has been unflinchingly dedicated to the pursuit of civil rights and equal justice. Under his leadership, the Department of Justice pursued the defense of voting rights, federal criminal justice reform, environmental protection, and national marriage equality, just to name a few highlights. He has fought tirelessly for equality under the law and fair representation for all Americans, and his current project does not stray from these themes.



↑ Former US attorney general Eric Holder discusses gerrymandering and redistricting with geographers at the AAG Annual Meeting in Washington, DC, on April 4, 2019.

Since the end of his tenure as attorney general, Holder has turned his focus toward an issue of high national importance: gerrymandering. Together with support from Obama and a number of other national leaders, the NDRC is a coordinated effort to make maps fair and ensure that votes count.

GIS is now an indispensable and ubiquitous tool in this process of redistricting. When combined with transparency, public involvement, and statistical measures of fairness, it offers much-needed solutions to addressing the distorted and biased voting districts that now characterize many US elections. Gerrymandering occurs when the geographic boundaries of electoral districts are manipulated, often producing oddly shaped geographic areas, to provide an advantage to one political party over another.

### GIS Can Make Redistricting More Efficient and Transparent

Every decade, the lines that determine congressional, state legislature, and local government districts in the United States are redrawn based on new decennial census data. Although historically the process has been opaque, often politically charged, and largely ignored by the public, it is a vitally important exercise because it tremendously affects who can—and will—be elected to represent citizens on the local, state, and federal levels.

Each year, the geographic distribution of the population changes. People are born, retire, die, or relocate. When that happens, it often necessitates redrawing districts to accommodate these changes. The redistricting process is made more challenging because governments must balance competing considerations when redrawing boundary lines.

Congressional and state legislature districts must have equal population to comply with the US Supreme Court's "one man, one vote" rulings. To abide by the Voting Rights Act of 1965, districts should reflect racial and ethnic diversity. States and local governments can add other constraints as well, such as contiguity and compactness relating to district shape, respect for political boundaries, geographic features, communities of interest, and political fairness.

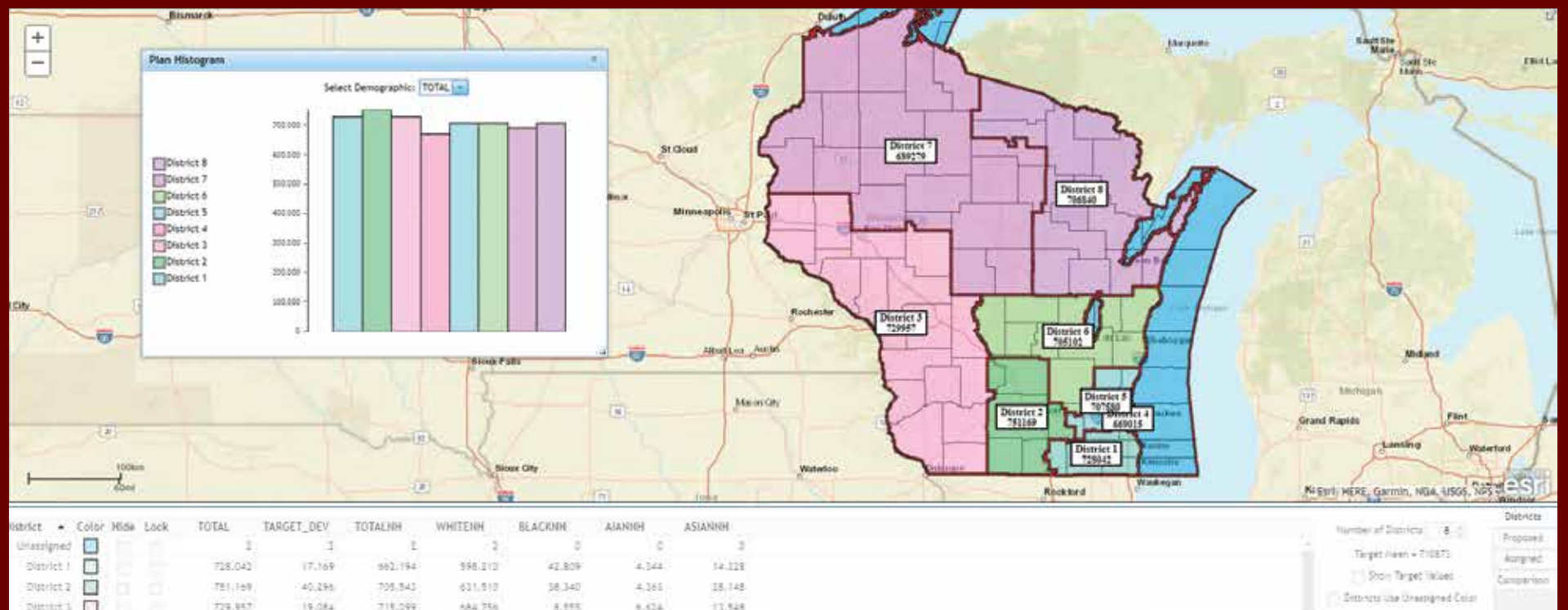
Because the redistricting process involves who lives where, it is an intrinsically geographic undertaking that requires the integration of many factors, which can be addressed efficiently using GIS. For example, the online Esri Redistricting app is a software-as-a-service (SaaS) subscription that gives state and local governments, the public, and advocacy groups access to the redistricting process while providing government transparency. Interactive Web GIS is a promising technology for drafting redistricting maps because the effects that boundary changes will have on associated populations can be tested interactively and worked on collaboratively.

Redrawing legislative district and precinct lines to determine fair electoral representation is a crucial and complex task. Geographers and GIS specialists can and must engage in this process by bringing their knowledge and essential redistricting information into a transparent and publicly collaborative spatial context.

I concur with what Holder told the thousands of geographers and GIScientists at AAG's Annual Meeting: "I truly believe this: The work that you do can play a really critical role in the future of our democracy," he said. "Our democracy has been manipulated through racial and partisan gerrymandering. [...] I think that we have an all-hands-on-deck moment for the United States of America."

To listen to Holder's full talk, visit [bit.ly/AAG2019Holder](http://bit.ly/AAG2019Holder).

Contact Doug Richardson at [drichardson@aag.org](mailto:drichardson@aag.org).



↑ GIS users can comprehensively view the status of the statistics associated with each district in a plan.



*“Both the MBA and GIS courses required scientific processes, while providing an exceptional framework for exploration and creativity.”*

**—Karisa Schroeder '18**  
MBA—Location Analytics  
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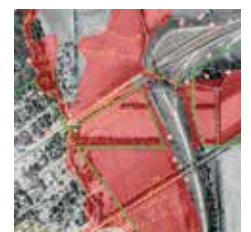
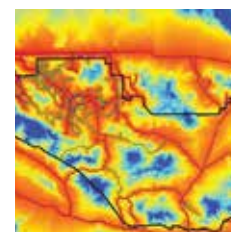
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# Portugal's Security Services

## SHARE DATA AND CONFIGURABLE APPS TO HELP

## Ensure Public Safety

In recent years—and largely after the September 11, 2001, terrorist attacks in the United States—national security has become more important for governments around the world. Many of them realized how critical it is to create a collaborative environment that various security organizations and agencies can use to ensure citizen safety.

Portugal's Ministry of Internal Administration (known by its Portuguese acronym MAI) is responsible for public security and emergency management, in addition to supporting the electoral administration, road safety agency, and immigration and refugee affairs. With this increased focus on national security, the MAI was compelled to get Portugal's security forces and services to work in a more coordinated and integrated manner.

To that end, Esri Portugal—Sistemas e Informação Geográfica, S.A.—and telecommunications company Altice, in collaboration with MAI, built a geospatial platform called GeoMAI that allows security personnel from a range of organizations to integrate data so they know where dangerous situations are happening, how these incidents are unfolding, and what to do to quickly and ap-

propriately quell them. The platform aggregates Esri technology—including ArcGIS Enterprise, ArcGIS Online, ArcGIS Pro, and several apps—along with solution engineering and consulting and training services to make gathering, combining, and visualizing disparate data swift and simple.

GeoMAI's main objective is to make data from multiple sources and systems (both internal and external) available to the MAI and to have various solutions on hand to help staff analyze and act on that data. Through this, the system supports the country's planning, prevention, and operational security and safety services, including the National Republican Guard, the Public Security Police, the National Authority for Civil Protection, the National Road Safety Authority, and the Immigration and Borders Service.

But GeoMAI is more than an information platform. It makes available tools and solutions that increase the efficiency and effectiveness of data integration when it comes to analyzing risk and understanding social criminal phenomena. It is also a tactical support tool that ministry staff, the police, and the general public can use to combat crime and create public security policies.

At the start of the project in 2014, Esri Portugal's sector lead manager for defense and security conceptualized that, due to MAI's very specific needs and requirements, GeoMAI would need a strong app development component. But as the ArcGIS platform evolved, making available better templates and configuration tools, the team, together with the client, changed the focus of the project to have GeoMAI rely more on configured information products. This would significantly increase the speed at which data and apps could be delivered to meet the demands of the ministry and its public safety and security agencies.

One of the big challenges with this project was that Portugal's security forces and services were at different maturity levels in the ArcGIS platform. To remedy this, the team selected various ArcGIS software components—including web apps, dashboards, and story maps—to adapt to each organization's needs. For instance, Esri Portugal worked with key MAI personnel to create geoprocessing services published in ArcGIS Enterprise that can be used to report all sorts of information about various incidents, such as which species and economic sectors got damaged in a specific wildfire burn area. With this data, the National Republican Guard can generate maps, story maps, and printed materials to give to other entities that do environmental evaluation. These organizations can then use those visuals to showcase environmental statistics and come up with viable wildfire prevention measures.

The MAI and security forces also share a secure network, called the National Homeland Security Information Network (known by its Portuguese acronym RNSI), that provides network and telecommunications services, as well as map services with basic geographic information for Portugal. So ministry officials and security forces alike can use the same orthoimagery, administrative boundaries, and street networks as the basis for their maps.

As the project progressed, Esri Portugal collaborated with key personnel at all the agencies, in coordination with the ministry, to analyze their capabilities, needs, and potential.

With the National Authority for Civil Protection, for example, Esri Portugal started by building up its operational capacity. The team then implemented Operations Dashboard for ArcGIS so the agency could monitor incidents and assets in the field, instituted Web AppBuilder for ArcGIS so staff could create web apps that would aid with team coordination, and set up Collector for ArcGIS and Survey123 for ArcGIS to make it easier for staff to gather information in the field. Once these components were in place, the National Authority for Civil Protection could configure its own solutions, using ArcGIS Pro to harvest, sort, and manage incoming data.

For the Public Security Police, Esri Portugal set the organization up with Operations Dashboard and ArcGIS Enterprise Sites. Although neither of these is fully functional yet, the police will be able use them in conjunction with Web AppBuilder to create tailored web apps and pages that show criminal statistics and various kinds of business information.

In working with the National Road Safety Authority, Esri Portugal started by using ArcGIS API for Python to develop algorithms that could standardize and validate information gathered about accidents. The team then made it possible to present this data using Operations Dashboard. Now, the agency can monitor traffic incidents on a dashboard, making it easier to manage traffic and road safety.

Through GeoMAI, Portugal's internal administration ministry and all the safety and security agencies under its auspices are able to more easily and comprehensively visualize data, which helps them contextualize security challenges and obtain better results.



↑ Among other solutions, the National Authority for Civil Protection uses a dashboard, built with Operations Dashboard for ArcGIS, to monitor incidents and assets in the field.



↑ The National Road Safety Authority can monitor traffic incidents using Operations Dashboard.

# Neurodiversity in the GIS Workplace

By Kathryn Brewer, Spatial Relationships, LLC

## Managing GIS

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



During the plenary session at the GIS-Pro & CalGIS 2018 conference in Palm Springs, California, Esri president Jack Dangermond inspired the audience with vivid descriptions of the big-picture purpose of the GIS profession and GIS professionals' role in what's next for the world. He endorsed the Urban and Regional Information Systems Association (URISA) as a champion in successful GIS implementation, noting that it sets the vision for understanding the mission, provides leadership to geospatial professionals, and creates opportunities for collaboration within—and outside—the geospatial community. At the conclusion of his speech, Dangermond challenged the audience to use its collective success in applying GIS to help create and inspire what's next.

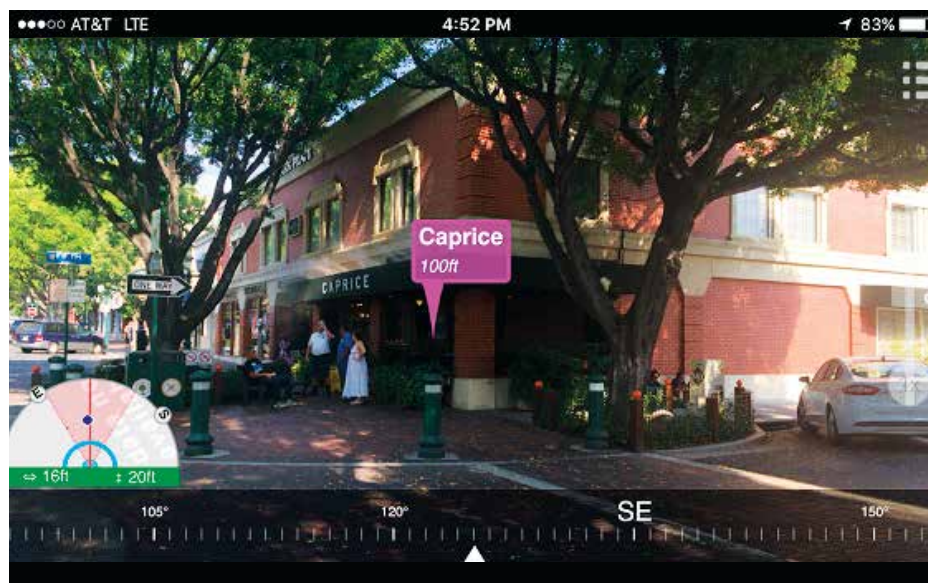
No pressure, right?

Still very much inspired on my trip home, I had plenty of time to reflect on all this. In considering where this transformative technology could be most impactful for many people, I decided that the intersection of neurodiversity and geospatial technology was what's next.

The Oxford English Dictionary defines *neurodiversity* as "the range of differences in individual brain function and behavioral traits, regarded as the part of normal variation in the human population (used especially in the context of autistic spectrum disorders)." While the focus of this article is on high-cognitive autism and similar profiles, it should be noted that neurodiversity includes all types of brain differences, such as attention deficit disorder (ADD), attention deficit hyperactivity disorder (ADHD), Tourette's syndrome, dyslexia, and dyscalculia.

### About the Author

Kathryn Brewer, GISP, is a partner at Spatial Relationships, LLC, and has more than 20 years of experience leading change in the geospatial technology field. Her game-changing contributions with organizational partners include holding key roles in operational and process improvement, project management and implementation, and instructional design and training delivery. While working diligently in the geospatial technology field, Brewer is bridging her professional and personal lives by championing neurodiversity in many areas, including the workplace. Her goal is to lead—and be—the change needed to create workplaces where neurodivergent individuals are not only welcome but sought after as well for their expertise and unique perspectives.



↑ Augmented reality (AR) tools, like AuGeo from Esri Labs, are a great way to help neurodivergent people lessen the anxiety they might feel when trying to navigate around town.

## An Attractive Field for a Growing Population

In a 2018 report, the Centers for Disease Control and Prevention (CDC) revealed that the prevalence of autism in the United States is estimated at 1 in 59 births. The Autism Society of America reports that more than 3.5 million Americans live with an autism spectrum disorder. The prevalence of autism spectrum disorders also increased by 6 to 15 percent each year from 2002 to 2010, according to biennial numbers from the CDC.

Thus, most people probably know neurodivergent individuals. They may already be in your workplace, or, if not, they likely will be soon.

The geospatial field can be very attractive to neurodivergent job seekers who process visual information much more easily than aural information, want concrete work with tangible outcomes, and prefer limited social interaction with other professionals who are known for looking at people and data in unique and powerful ways. Additionally, more than guiding a career choice, geospatial technology has the potential to be the tools needed to help neurodivergent people change the world in ways that are important. Just as it is best practice to include an experienced utilities subject matter expert on utility projects, it is important to have neurodivergent people shepherd the development of solutions that support their own lives and livelihoods. When included, these individuals often provide a much-needed new perspective that takes projects and/or products to the next level.

Inspiringly, large corporations, such as Microsoft, SAP, and Dell, are showing that they understand the power of neurodiversity by not only hiring neurodivergent employees but also by taking the lead in manifesting just how valuable the neurodivergent population is to business success. This positive and transformational trend has the potential to expand in the geospatial technology arena.

To get started, organizations just need to implement a few measures to create what's next for neurodiversity in the GIS workplace.

### First, a Cultural Shift

Before diving into technical solutions, workplaces need to institute cultural shifts to successfully integrate inclusive practices into their workspaces and workflows. A few examples of how to do this include the following:

- **Workplace Training**

Including neurodiversity topics in orientation trainings for new staff and workshops for existing staff is an easy way for an organization to get its workforce up to speed on inclusion practices. This can be done in-house by trained staff or by outside experts.

Many organizations exist to provide support for neurodiversity training in the workplace. In New England, Massachusetts General Hospital is leading the way with its Aspire Works program, which offers training to both neurodivergent individuals and employers. Learn more at [massgeneral.org/aspire](http://massgeneral.org/aspire).

- **Update Diversity Statements**

A great way for an organization to let prospective and existing employees know that it embraces neurodiversity is to update its diversity statement. This helps organizations distinguish themselves as safe and inclusive workplaces for people of all kinds, which in turn attracts great talent. Check out SAP's wonderful diversity and inclusion statement at [p.ctx.ly/r/9dx2](http://p.ctx.ly/r/9dx2).

- **Modify the Interview Process**

Sometimes a neurodivergent person struggles with the interview process due to differences in social competency, anxiety, and other related challenges. With this in mind, many organizations are changing their interview processes to focus more on showcasing applicants' abilities rather than putting their social competencies on display. Once an organization has neurodivergent people on staff, project and program managers can work together to augment their social competencies based on the work environment.

### Ready for Geospatial Solutions

After a culture shift, which includes gaining a deeper understanding of neurodiversity and how to partner with neurodivergent professionals, organizations can then work on creating technical solutions.

- **Augmented Reality**

Some neurodivergent people have a hard time discerning certain details in their environments. Others experience all the details at once, which can be very overwhelming, especially when combined with anxiety. As a result, navigating around town to run errands or traveling to a worksite can be formidable.

When combined with robust geospatial data, augmented reality (AR) is a great tool to use to offer neurodivergent individuals specific information about points along a route, such as restaurants and post offices, but only when that information is in proximity. This type of location-dependent visual information is easier to process, thus lowering anxiety while creating a situational win for the user.

Esri Labs has an AR mobile app called AuGeo that allows ArcGIS users to bring point data into the app's AR environment. To learn more, read the recent GeoNet blog post, "AuGeo: An Augmented Reality Mobile App for Your GIS Data," at [p.ctx.ly/r/9dx3](http://p.ctx.ly/r/9dx3).

- **Virtual Reality**

One of the most important uses of virtual reality (VR) is to help neurotypical people understand what a neurodivergent person's experience might be like. This virtual "stepping into someone else's shoes" is very valuable for gaining insight into and building empathy for the amazing perceptions that the neurodivergent population brings to the world.

The bridge that connects the neurotypical and neurodivergent experiences to a familiar shared space, such as a public park or a common street intersection, is 3D geospatial information. From that bit of common ground, VR users can begin to appreciate the differences in experience.

- **Indoor and Campus Navigation**

Some neurodivergent people have a very difficult time figuring out where they are and get lost easily. Using traditional street-based navigation helps, but only if the user is going from point A to point B off of a street, rail, or other transportation network. Once that person arrives at the proverbial point B, navigation becomes much trickier, especially inside large, complex buildings and in campus settings.

Software such as ArcGIS Indoors could be used to create needed solutions for neurodivergent people with this problem. To find out more about this new mapping system, visit [go.esri.com/indoors](http://go.esri.com/indoors).

### So What's Next for You?

Geospatial technology holds the key to what's next for a very transformative and growing neurodivergent population. Are you inspired to help create what's next?

# The Relevance of Cartography

## A Cartographer's Perspective

A column by Menno-Jan Kraak

President of the International Cartographic Association



## WHERE TO GO FROM HERE

All good things come to an end. This is my last "Relevance of Cartography" column in *ArcNews*, closing out my part of this series, which coincided with my four-year term as president of the International Cartographic Association (ICA). That makes this a good moment to reflect.

I have written these columns with a wink. The aim of the ICA is to promote the discipline and profession of cartography internationally. The organization offers its expertise and knowledge of technical developments in the field of cartography to others via events, meetings, workshops, and publications. We can only do this, though, with input from ICA members, who share their knowledge via commissions and working groups.

Over time, the discipline of cartography has changed considerably. Not long ago, the map was considered an artifact, a static object visible on paper or a fixed screen. But today, with the Internet, there has been a huge increase in data access and generation, which has resulted in many more maps being produced and used. Thus, maps are no longer artifacts. They instead serve as digital map services. And tomorrow, what constitutes a map will change again.

Currently, we are able to sense and monitor the world ubiquitously and in real time, including human users' spatial skills, emotions, and needs. With developments in interface design linked to virtual and augmented reality, maps are getting even closer to our human processing system (i.e., the brain and how it processes things). Maps will increasingly become human-centered, highly interactive, dynamic, and adjustable smart visual displays. Based on these technological advances—and their social acceptance, of course—cartographic education and research will be called on once more to adapt.

To face this future, it is important that the ICA has an integrated research agenda in place, along with an established body of knowledge.

A good research agenda asks pertinent questions related to both contemporary and future domain-specific problems within a societal context. ICA's first research agenda, available at [icaci.org/research-agenda](http://icaci.org/research-agenda), was published in 2009. For some subdomains, such as location-based services, geovisualization, and cognitive and user issues, several ICA commissions have produced extensions and updates to this research agenda. However, the original idea to create a truly living research agenda has, so far, not been realized.

According to Wikipedia, a body of knowledge (BOK) "is the complete set of concepts, terms, and activities that make up a professional domain, as defined by the relevant learned society or professional association." A BOK can be used to plan new curriculum or position existing curriculum among the rest of the geospatial disciplines. The most well-known BOK in the geospatial realm is the Geographic Information Science & Technology Body of Knowledge (accessible at [gistbok.ucgis.org](http://gistbok.ucgis.org)) from the University Consortium for Geographical Information Science. Other initiatives exist as well, but none of them covers the whole cartographic domain.

So, are we cartographers ready for the future of mapping? The answer is ambiguous. As a discipline, we do have a kind of infrastructure in place, given that we have a research agenda and that fragments of a cartographic BOK exist. But both have to be kept up-to-date, which requires time and attention to make improvements. And, most importantly, we have to link the research agenda and the BOK.

The ICA does not own the cartographic discipline, but it does exist to promote and facilitate the discipline and profession of cartography internationally. Our global network allows us to bring together researchers and educators from all over the world who can, together, offer a broad perspective on our discipline. We might not be able to cover everything, but our commissions cover most of the cartographic topics that garner interest around the globe, which can enable the ICA to work on an updated research agenda.

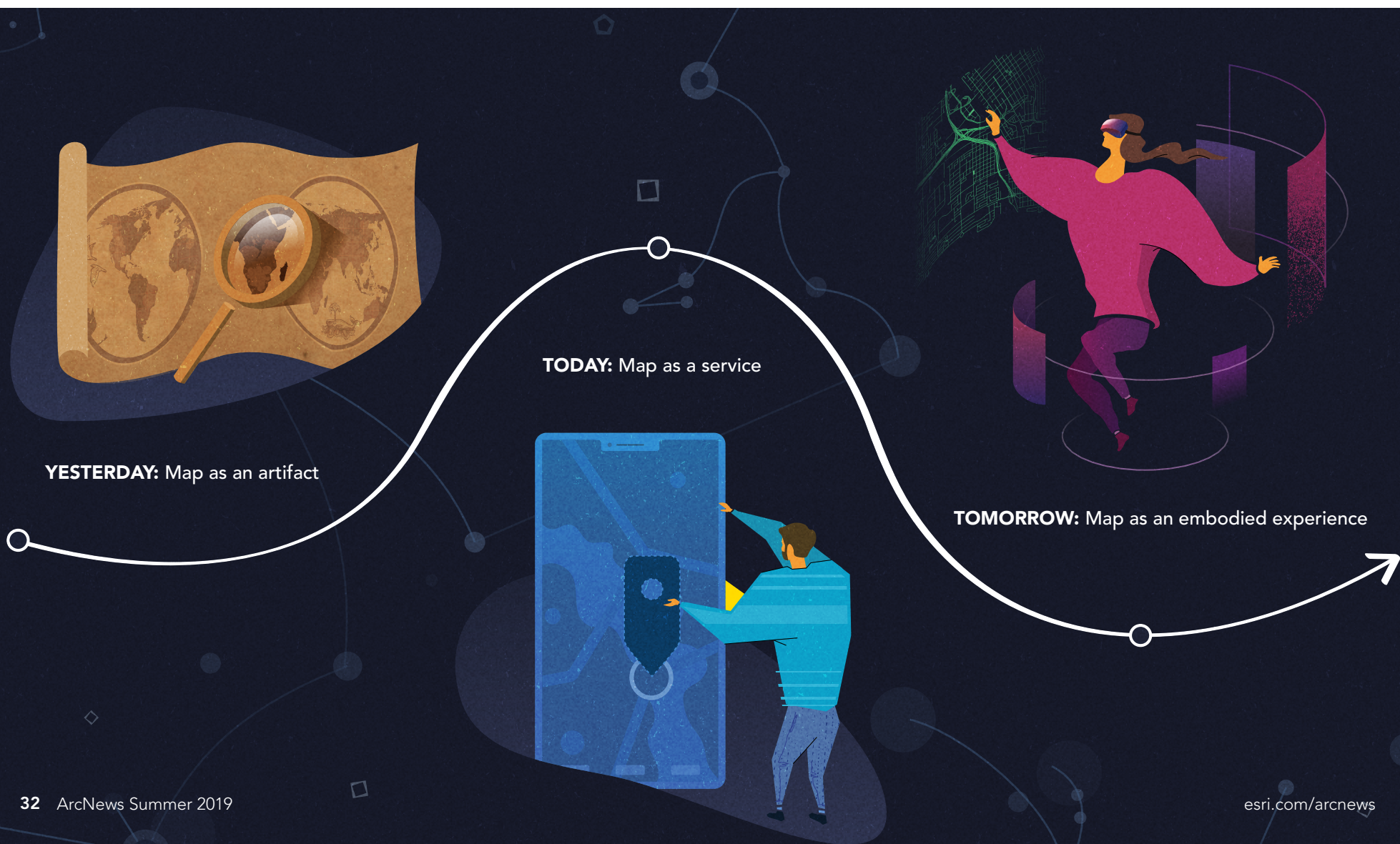
Regarding the BOK, the ICA's role is to further integrate and extend any current cartography-related BOK initiatives and allow the ensuing BOK to cover the discipline as extensively as possible. For anyone looking to find true global cartographic knowledge, the ICA's website would be a logical entry point.

How can all this be accomplished, though? Both the research agenda and the cartographic BOK should be living documents that follow the principles of the semantic web, which enables users to easily find relationships among key words and terms in the BOK, as well as alternative but related expressions, by having data sources adhere to common formats. Additionally, both the research agenda and the BOK should be extensible and link to all relevant new publications and textbooks.

If all this can be realized, then the ICA is ready for the future.

### About the Author

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





# Startup's Mobile App Creates a New Standard for Hiking

At Mount Diablo State Park, east of San Francisco, California, visitors can explore almost 200 miles of trails, reveling in the therapeutic sounds of crunching rock and dirt underfoot. A few years ago, hikers were often seen stopped midtrail, orienting themselves with paper maps in hand. Today, however, they can use a mobile app to see where recent rains have wiped out trails, for example, or park managers have cautioned visitors not to trek.

The Easy2Hike app, built by Esri startup partner **Easy2Hike** (easy2hike.com), shares up-to-date information on park conditions and potential hazards, and it's made available offline for users in areas with low cell reception. Since the app was released in 2015, tens of thousands of hikers, bikers, and equestrians have downloaded Easy2Hike and are using it to plan park visits, enhance their hiking experiences, and learn more about their surroundings while out on the trail. In addition, park rangers use the app to share updated park information and engage with visitors.

"Park visitors want accurate park information to be able to plan and enjoy their visits, and they appreciate when it's current," said Uri Bar, the CEO of Easy2Hike, who cofounded the company in 2015 after getting lost on a hiking trail in Japan.

An avid hiker, Bar understood the need for an app that would show real-time hiking conditions and safe routes. He worked with Esri to develop the Easy2Hike app for California State Parks.

"By combining Easy2Hike with Esri tools, state parks can leverage their existing GIS

data, maintain a single data source, and expose the most updated information in real time," Bar said.

## Getting More out of Park Visits

With Easy2Hike, visitors have accurate and up-to-date park information with them throughout their excursions, even if cell reception is spotty. The app can be used offline, and when reception reconnects, any reports or changes made within the app automatically get updated. The app uses location services to detect where users are and then displays nearby hikes in a list or on a map. When users select specific hikes, they can read more about them and view photos and videos related to each hike. Users can also enable push notifications within the app so they get alerts when they approach points of interest, encounter historic sites, and even veer off route.

Park managers, who work to ensure that visitors know about and can locate all available trails, use the app to share and update information, such as whether certain trails are closed or there are hazards in the park. In addition, visitors can use the app to report trail obstacles, damaged facilities, and more as they explore.

The app also helps park managers track visitation stats to see where visitors go and stop to rest, as well as how long they spend on-site. Users remain anonymous, but the ability to track visitor behavior patterns helps park managers better plan where to designate resources. For example, they can use visitor tracking reports to determine where signs

need to be refreshed more often or which underutilized rest stops need to be updated.

"It's kind of a group effort type of app," said Vincent Anibale, the public safety superintendent for California State Parks of the Bay Area District. "The more people who use it, the better it becomes. We learn from each other how to use the app better."

## Sustained Access to Updated Information

Before deploying Easy2Hike, state park managers determined that launching a mobile app could help more people safely experience nature and enjoy park offerings to the fullest. From a business standpoint, they also decided that an app would foster a personalized visitor experience, improve park management, and increase revenue to keep parks in good condition.

"A great feature of Easy2Hike is that we can send out notifications to park visitors," said Anibale. "If there is a trail closure for some reason—like because of a mudslide from a recent rainstorm—and we had to close the trail, we can put that into the Easy2Hike map. So when visitors show up at the park, they are sent a notification, and they are able to see in real time that the trail is closed that day."

If there is an emergency inside a park, notifications are sent to park visitors letting them know to be aware or avoid certain areas. Anibale said this enhances park security and provides a better visitor experience.

Before the Easy2Hike app, finding a park employee to get directions or more information about specific hikes was difficult for visitors, especially when out on a trail.

"Parks would have brochures with paper maps inside, but sometimes those would run out," said Bar. "You can't see your location on a paper map, [and] park rangers can't print or indicate trail closures on these brochures. It just didn't give a great or detailed look at the park like we now can do with the app."

With Easy2Hike, if visitors need information, they can just pull the app up on their phones and be up-to-date with what's happening inside the park they're visiting.

"This app puts downloadable maps, information, and routes in the palm of their hands," Anibale said. "It's easy to access, and it keeps updated information right on hand."

## Collaboration Improves Experiences and Data Accuracy

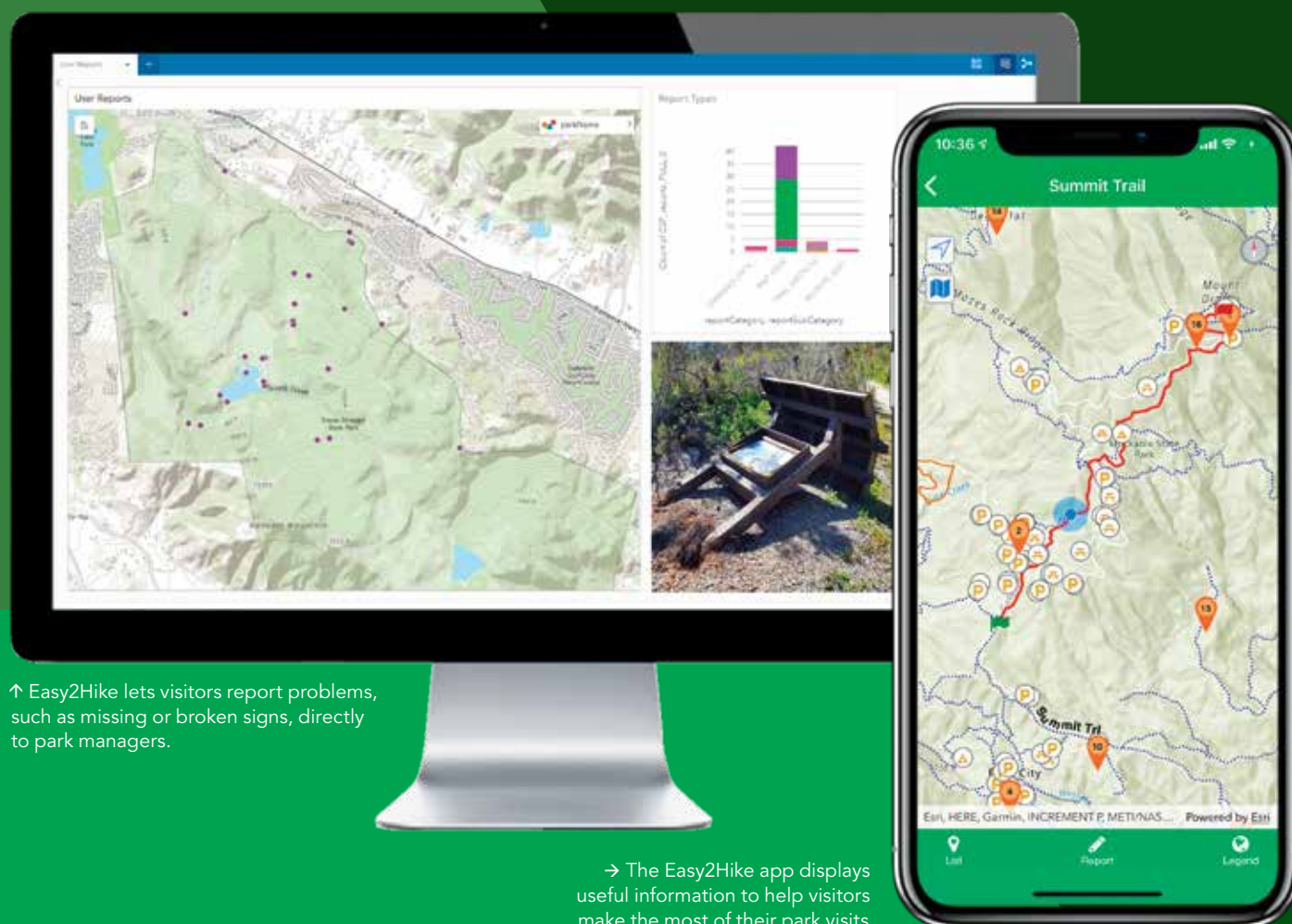
Easy2Hike uses ArcGIS Enterprise to maintain its extensive GIS database of park trails and facilities. The GIS team for California State Parks publishes feature services in ArcGIS Online to make the data—which includes the locations of trails, restrooms, parking lots, and picnic tables—available. The Easy2Hike native mobile app, built with ArcGIS Runtime SDKs, consumes these feature services.

"The app displays layers on a map, showing park trails and facilities and allowing visitors to easily navigate all over the park," said Bar. "The offline map is also implemented using the SDK."

At the same time, the California State Parks GIS team uses visitor input to improve data accuracy and update its GIS database. As Easy2Hike users report missing facilities and incorrectly marked trails via the app, information is delivered to the GIS team via the Easy2Hike park portal. The GIS team then runs further analysis on visitors' suggestions and incorporates the necessary changes into the GIS database.

Continued collaboration between park managers, visitors, the GIS team, and Easy2Hike results in an even better experience for visitors. This means hikers, bikers, and equestrians can now focus on the sights and sounds of their park visits instead of spending too much time searching paper maps.

"We are creating a new standard for hiking," Bar said. "Park visitors will get the same high-quality and great experience in each park we operate in."



↑ Easy2Hike lets visitors report problems, such as missing or broken signs, directly to park managers.

→ The Easy2Hike app displays useful information to help visitors make the most of their park visits.

There are currently 13 California state parks available on the Easy2Hike app, along with more than 200 other parks. The app is free to download and available in the App Store for iOS devices and from Google Play for Android devices.

The Esri Startup Program gives emerging businesses an edge by helping them integrate spatial functionality into their products and services. Learn more at [developers.arcgis.com/startups](https://developers.arcgis.com/startups).

# Esri Partners Acknowledged for Leveraging ArcGIS in Exceptional Ways

At the Esri Partner Conference, held each year in March in Palm Springs, California, Esri recognizes extraordinary partners that create phenomenal solutions and services using geospatial analytics tools.

"I'm honored to have the opportunity to provide recognition to those partners that have gone above and beyond to apply GIS to some of the toughest issues our customers face today and lay the groundwork for a brighter future," said Esri president Jack Dangermond at the conference.

For 2019, Esri acknowledged partners in 13 award categories as a reflection of their expertise and impressive implementations of the ArcGIS platform. Get to know a little bit about them and their offerings below.



## Delivering Release-Ready Solutions

**Schneider Electric**

[schneider-electric.us](http://schneider-electric.us)

Schneider Electric is a leader in orchestrating digital transformation for electric and gas utilities around the globe. The company's ArcFM Solution XI Series, built on the latest release of ArcGIS Pro and the ArcGIS Utility Network Management extension, allows users to access streamlined workflows. As an early adopter of ArcGIS Utility Network Management, Schneider Electric not only ensured that the software worked with the company's ecosystem of partners, but it also established a cohesive approach to helping customers implement and migrate to the new system.



## Delivering Solutions with ArcGIS

**GPS-it**

[gpsit.co.nz](http://gpsit.co.nz)

A software development company that focuses on aerial farm mapping, GPS-it configures the ArcGIS platform to provide high-quality, customized geospatial solutions and apps for this market. GPS-it's flagship product AgBox (agbox.me)—built on top of ArcGIS using ArcGIS API 4.x for JavaScript and AppStudio for ArcGIS—is empowering farmers to manage their land smartly. The solution gives users complete control over data sharing, and its simple navigation makes it easy to record farm assets, including crops and infrastructure, as well as activities such as fertilizing.



## Going Global by Going Local

**Cityworks | Azteca Systems, LLC**

[cityworks.com](http://cityworks.com)

Cityworks, from Azteca Systems, LLC, is a leading asset management system that is fully integrated with the ArcGIS platform. It allows users to track, analyze, and score infrastructure assets to streamline the administration of public infrastructure and property. *Going global by staying local* is the strategic, targeted approach to asset management used by Cityworks, Esri, and Esri distributors, and that approach is foundational for Cityworks in supporting its local government, public works, and utility clients in seven different countries.



## Realizing Virtual Objects

**Meemim | vGIS**

[vgis.io](http://vgis.io)

Meemim empowers users to experience virtual objects as if they were part of the real world by transforming GIS technology into augmented reality. The company's leading product, vGIS, is designed to give utilities and municipalities the ability to display infrastructure—such as pipes, lines, and cables—in augmented reality to get real-time insights. Integrating vGIS with ArcGIS allows users to convert 2D GIS data into 3D visuals, increasing efficiency and saving time and money. Recently, a group of high school students from Buffalo Island Central High School in Monette, Arkansas, helped improve services in the surrounding community by mapping 50,000 feet of the underground utility line using vGIS. The students then shared the data with the city's public services department. (Read about how the Toms River Municipal Utilities Authority in Toms River, New Jersey, also leveraged vGIS to simulate underground utilities in *ArcNews* at [p.ctx.ly/r/9dx9](http://p.ctx.ly/r/9dx9).)

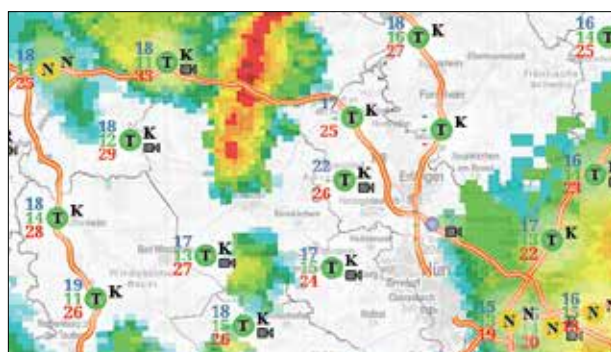


## Driving Enterprise Platform Adoption

**con terra**

[conterra.de/en](http://conterra.de/en)

With more than 20 years of experience, con terra is integrating Geo-IT into customers' business processes and helping them implement the ArcGIS platform across their entire organization. The company's proficiency in spatial data modeling and infrastructure is meeting the needs of users in a diverse set of markets, including natural and environmental management, insurance, telecommunications, real estate, and community development. In Germany, the Bavarian Road Administration's motorway and road maintenance teams used con terra's map.apps framework—a modular system for creating easy-to-use geoapps that's based on ArcGIS API for JavaScript—to assess and address road conditions during extreme weather. The system allowed the teams to start tracking 600 public and 700 private service vehicles in near real time to keep traffic moving along Bavaria's 22,000 kilometers (13,670 miles) of road. (Read more about this in *ArcNews* at [p.ctx.ly/r/9dx7](http://p.ctx.ly/r/9dx7).)



## Improving Field Operations

**ikeGPS**

[ikegps.com](http://ikegps.com)

ikeGPS is boosting mobile productivity in the field with Spike, a smart laser measurement solution for geospatial apps that allows fieldworkers to measure objects—such as building features, roads, signage, disaster sites, and natural features—by capturing a photo using a mobile device equipped with Spike. Spike questions in Survey123 for ArcGIS, which cover offset GPS location, distance to target, length, width, height, and area, enable field crews to take measurements and photos that persist in ArcGIS along with the rest of the survey data. Thus, a geodatabase can be updated easily from the field. Spike can also be implemented with Collector for ArcGIS, which is what the Carbon County, Utah, roads department did to conduct an inventory of all its road signs. This helped the county gather data on 322 signs per day, which amounts to 1,610 signs per week. That resulted in a cost savings of \$45,000 and a staggering 568 percent return on investment (ROI). (Read the full story in *ArcNews* at [p.ctx.ly/r/9dx6](http://p.ctx.ly/r/9dx6).)



## Partnering for Success Award

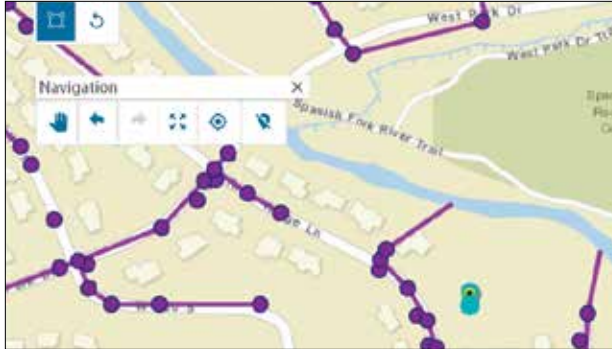
UtiliSync

utilisync.com

Cityworks | Azteca Systems, LLC

cityworks.com

Partner-to-partner collaboration is a well-established model for success in the Esri partner ecosystem. Recently, Esri startup partner UtiliSync and Esri platinum partner Cityworks teamed up to deliver complementary work order and documentation solutions to fieldworkers and asset managers. The integrated system makes it easy for fieldworkers to open, modify, and close Cityworks work orders and update UtiliSync documentation, all from a single mobile app, increasing accuracy and saving time and money. Several cities in Utah leveraged UtiliSync to initiate 811 underground utility locate tickets, which were submitted and dispatched in Cityworks so operators could complete these tasks as part of their daily workflow.

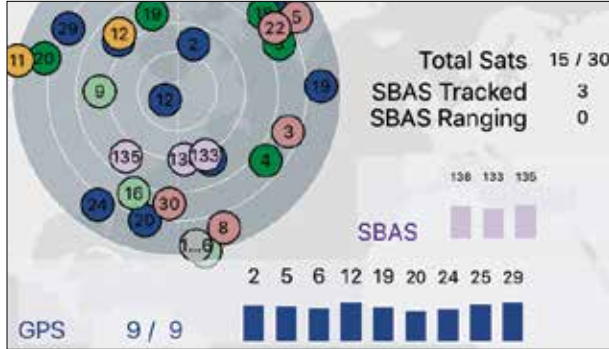


## Energizing the Market with a Bundle

Eos Positioning Systems

eos-gnss.com

A pioneer in GPS receiver technology, Eos Positioning Systems provides affordable, high-accuracy Global Navigation Satellite System (GNSS) receivers for use with any device, giving users real-time positioning that integrates with mobile workflows. Combining its Arrow Series GNSS receivers and Eos Tools Pro for iOS and Android with Esri apps, such as Collector, is making it easy for field staff to connect to satellite navigation networks and monitor position accuracy in real time. For example, as a result of Eos's work with Sulphur Springs Valley Electric Cooperative (SSVEC) in Arizona, two linemen were able to inspect 7,640 locations in just 32 days, routinely collecting more than 600 data points a day with an accuracy of 4 centimeters or less. (Read more about this in ArcNews at [p.ctx.ly/r/9dx8](http://p.ctx.ly/r/9dx8).)



## Expanding into the Cloud

3-GIS

3-gis.com

Founded by industry veterans in 2006, 3-GIS develops and delivers cloud-based fiber network management solutions to support all aspects of planning, building, and managing fiber networks. In 2007, the company was one of the first to deliver a web-based fiber network management solution with full editing capabilities. Today, 3-GIS offers a suite of solutions, including 3-GIS Web, an enterprise solution in the ArcGIS platform that reduces the complexities of fiber network management by helping providers understand the location and relationship of assets, identify common points of failure, do signal tracing, and ultimately make smart decisions about restoring and extending service to customers. When 3-GIS Web is integrated with 3-GIS Mobile, fieldworkers can edit entries in real time, increasing both accuracy and ROI.



## Telling Stories with Maps

Datastory

datastoryconsulting.com

Combining sophisticated data analysis and insight with narrative text and images that harness the power of maps and geography, Datastory helps businesses make better decisions. Recently, Datastory collaborated with Montgomery County, Maryland, on its ThinkMoCo/Strength in Numbers initiative, which encourages businesses to open new offices or expand their operations in the area. Implementing Datastory's MapDash solution along with Esri Story Maps apps transformed how the county visualizes, supports, and acts based on business analytics. Additionally, when Amazon was evaluating bids for where to open its second corporate headquarters, Datastory made it possible for the e-commerce company to experience data interactively. Featuring colorful maps and photos of neighborhoods that exhibited workforce information, transportation routes, and housing trends, the story map that Datastory put together showcased Montgomery County's commitment to growth and sustainability. (Read more about this project in ArcNews at [p.ctx.ly/r/9dx4](http://p.ctx.ly/r/9dx4).)



## Growing with Mapping and Location Intelligence

DataCapable

datacapable.com

For DataCapable, eliminating communication gaps in real-time information is vital—especially when those pauses could impact people's safety. DataCapable's cloud-based solution for community engagement is powered by artificial intelligence (AI) and machine learning. The software-as-a-service (SaaS) platform, which is fully integrated with ArcGIS technology, analyzes unstructured data sources such as text messages and social media to provide real-time mapping and event detection. DataCapable is a recent graduate of the Esri Startup Program and the first Esri partner to bring a series of near real-time event data apps to ArcGIS Marketplace. Find out more about these apps at [p.ctx.ly/r/9dx5](http://p.ctx.ly/r/9dx5).

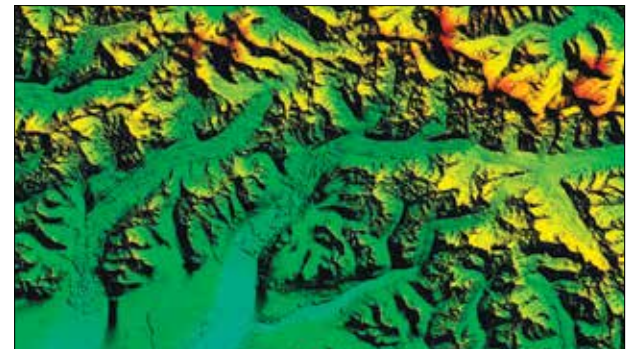


## Maximizing ArcGIS in Service Offerings

Dewberry

dewberry.com

As an Esri partner for nearly two decades, Dewberry's exceptional team of subject matter experts has been leveraging the ArcGIS platform to deliver innovative services that solve complex problems in a range of markets, from federal, state, and local governments to energy, infrastructure, health, education, and other private sector companies. In 2018, Dewberry worked with the Federal Emergency Management Agency (FEMA) to respond to the California wildfires that devastated eight counties. Dewberry's team provided geospatial support for response and recovery and applied image analysis for damage assessments.



## Predicting Outcomes

Fracta

fracta.ai

As an early adopter of AI, Fracta uses machine learning to deliver advanced analytics through a SaaS solution that assesses and predicts complex issues, such as the likelihood of failure in aging water mains and pipelines. When water utilities integrate Fracta's solutions with the ArcGIS platform, they get access to accurate data so they can assess conditions, visualize potential hazards, and make smarter decisions, enabling them to potentially save hundreds of thousands of dollars.



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



## Jack Dangermond Honored in the Netherlands

Esri founder and president Jack Dangermond was appointed an officer in the Order of Orange-Nassau in the Netherlands on April 2, 2019, at a ceremony following his speech at the Geospatial World Forum. The honor recognizes Dangermond's special merit in the national and international geoworld. The order is rarely given to someone who lives outside the Netherlands, but Dangermond's work, combined with Esri's collaborations with Dutch Kadaster and the country's national planning service—plus the Netherlands being the birthplace of both his parents—were factors in bestowing this honor.

# New Training and Certification Offerings

## Training

### New Instructor-Led Courses

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

Whether you're a new but enthusiastic mapmaker, an experienced intelligence analyst, or someone who wants to transform inefficient field workflows using ArcGIS apps, there are ArcGIS tools and capabilities that you can employ to improve productivity and get better results in less time. Take a look at the following courses:

- **Creating Maps and Visualizations with ArcGIS**

Explore cartographic design principles and techniques that help users tailor maps to specific audiences, media, and purposes. Working with the latest ArcGIS Pro tools, participants will learn how to produce a variety of information products, including print maps, web maps, 3D scenes, charts, and infographics.

- **Using ArcGIS for Geospatial Intelligence Analysis**

Geared toward analysts in the defense, intelligence, and national security communities, this course provides a strong foundation in the geospatial concepts and recommended workflows needed to produce timely, accurate, and actionable intelligence. Learners will be taught how to create and share mission-specific products that align with industry best practices.

- **Field Data Collection and Management Using ArcGIS**

This course is for GIS managers, analysts, and others who want to modernize data collection workflows by deploying ArcGIS field apps. Attendees learn how to best configure the apps so they can maximize efficiency in the field and increase the accuracy of their organizations' GIS data.

### ArcGIS Spatial Analysis Course Bundle

Esri is offering a course bundle for GIS professionals who want to harness the latest ArcGIS tools and capabilities to efficiently transform data into actionable information. Courses included in the bundle cover ArcGIS Pro, Insights for ArcGIS, and Python scripting. Participants learn how to apply standard workflows to produce reliable, repeatable results that support data-driven decisions rooted in analytics. Learn more about the bundle at [go.esri.com/spatial-analysis-training](http://go.esri.com/spatial-analysis-training).

## Certification

### A New Exam Delivery Model

Are you looking to start your Esri Technical Certification journey but don't have the time or means to get to a testing center? Esri has launched a new, flexible exam delivery model called Online Proctored. Offered in conjunction with Esri testing partner Pearson VUE, Online Proctored allows individuals to conveniently take an exam in the comfort of their own home or at the office while being monitored by an off-site proctor. Certain system requirements must be met. Learn more at [esri.com/training/certification-take-exam](http://esri.com/training/certification-take-exam).

### July Certification Giveaway

If your professional development plans include achieving your first-ever certification or adding another Esri certification to your list of accomplishments, be sure to enter the July giveaway for a chance to win an Esri Technical Certification exam voucher (US\$250 value). Four winners will be randomly selected and notified via email. The giveaway opens July 8 and runs through July 19. Head to [go.esri.com/certgiveaway](http://go.esri.com/certgiveaway) to enter.

### A New Study Guide

Esri Press published a new study guide for the ArcGIS Desktop Professional exam. The *Esri ArcGIS Desktop Professional Certification Study Guide*, authored by senior Esri instructor Mike Flanagan, combines information about each section of the exam with practical applications of ArcGIS Desktop to provide a complete yet consolidated exam preparation resource. The study guide is available in print and as an e-book from major book retailers.

To explore the latest Esri Technical Certification exams, visit [esri.com/training/certification](http://esri.com/training/certification). Also join the Esri Technical Certification groups on LinkedIn and GeoNet to connect with other professionals and discuss all things certification.

Go to [esri.com/training](http://esri.com/training) for more information. Find courses at [esri.com/training/catalog/search](http://esri.com/training/catalog/search). Keep up with Esri training news by subscribing to the newsletter ([go.esri.com/preferences](http://go.esri.com/preferences)), visiting the *Esri Training Matters* blog ([esri.com/trainingblog](http://esri.com/trainingblog)), connecting with the Esri Training Community on GeoNet ([go.esri.com/training-community](http://go.esri.com/training-community)), and following @EsriTraining on Twitter.

## Esri T-shirts Reach New Heights and Depths

Kathryn Scott, retired from Washington State Parks, and Brian Hall, a GIS coordinator with Washington State Parks, took to the Caribbean Sea in their Esri T-shirts! As Earthwatch volunteers with the Central Caribbean Marine Institute on Little Cayman Island, they were assisting with a study of coral reef populations.

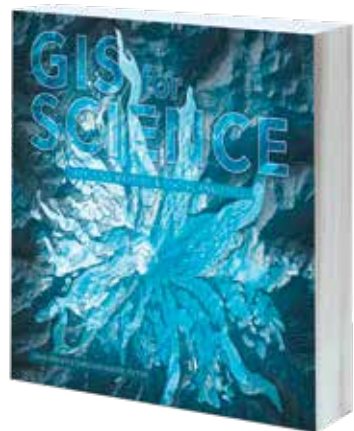


After battling snowstorms and significant travel delays, City of Wheaton, Illinois, GIS specialist Keith Darby—along with his Esri T-shirt and a group of friends—made it to Peru's Machu Picchu, the famous Incan citadel that rests atop the Andes Mountains at almost 8,000 feet.

## GIS for Science: Applying Mapping and Spatial Analytics

Edited by Christian Harder  
and Dawn J. Wright

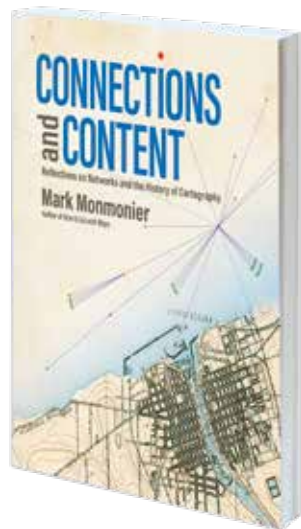
A collection of real-world stories about modern science, *GIS for Science: Applying Mapping and Spatial Analytics* highlights a cadre of scientists who use mapping and spatial analytics to expand their understanding of the world. The accounts in this book are written for a broad audience, including professional scientists, the swelling ranks of citizen scientists, and people with a general interest in science and geography. The volume shows how GIS technology brings scientific data to life, allowing both scientists and nonscientists to study a range of issues that are relevant to Earth's natural functions, as well as the impacts of human activity. In a race against the clock, the scientists profiled in this volume are using remote sensing, web maps, Esri Story Maps apps, and spatial analysis to document and solve big problems that have a geographic dimension—from climate change, natural disasters, and loss of biodiversity to homelessness, lack of green infrastructure, and resource shortages. The geospatial ideas presented in these stories can be applied across disciplines, making *GIS for Science* relevant to a diverse audience. June/July 2019, 300 pp. E-book ISBN: 9781589485310 and paperback ISBN: 9781589485303.



## Connections and Content: Reflections on Networks and the History of Cartography

By Mark Monmonier

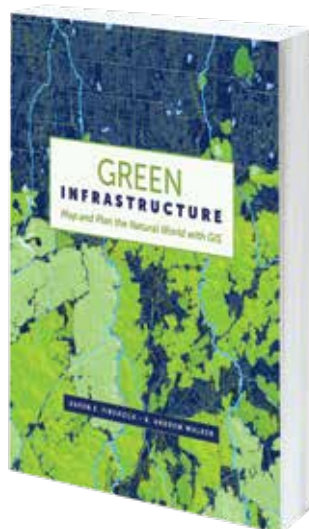
Behind every great map is a network, and behind every great network is a map. In *Connections and Content: Reflections on Networks and the History of Cartography*, cartographic cogitator Mark Monmonier shares his insights about the relationships between networks and maps through a collection of essays. Relying on historical maps, he explores the triangulation networks used to establish the baselines of a map's scale; the astronomical observations, ellipsoids, geodetic arcs, telegraph networks, and GPS constellations that establish latitude and longitude at control stations; the cartographic symbols that portray network features on a map; the survey networks used to situate and construct canals, railways, roads, and power lines; and the topological networks that underlie modern census enumeration and satellite navigation systems. Connecting the past to the present via maps and reflection, Monmonier extends his contributions to cartographic scholarship by demonstrating the network as a unifying concept for understanding and using maps. August 2019, 250 pp. E-book ISBN: 9781589485600 and paperback ISBN: 9781589485594.



## Green Infrastructure: Map and Plan the Natural World with GIS

By Karen E. Firehock  
and R. Andrew Walker

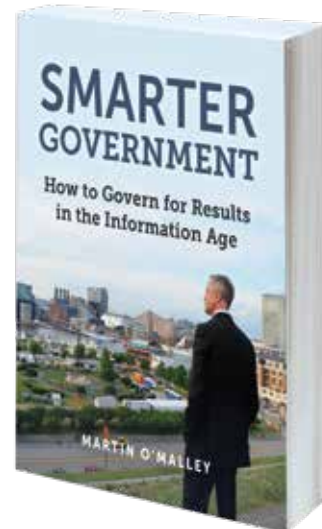
To conserve our natural assets—our green infrastructure—we need to map them and plan for their protection. *Green Infrastructure: Map and Plan the Natural World with GIS* describes the why and how of green infrastructure (GI) mapping and implementation through text, maps, and online illustrations. Authors Karen E. Firehock and R. Andrew Walker explain how to employ the national green infrastructure model that Esri has built with the Green Infrastructure Center's (GIC) methodology. Using print and online map layers, the book demonstrates how to develop a prioritized strategy for conserving or restoring the highest values to natural resources. It also outlines how this analysis is then employed to inform a host of planning applications, from protecting drinking water and conserving endangered species to designing recreation areas and preserving culturally significant landscapes. The book uses actual data to create two case studies—one for a western landscape and the other for an eastern one—that show how the Esri model can be adapted with local data to create a custom GI plan. *Green Infrastructure* also illustrates how data from ArcGIS Living Atlas of the World can be included and used to customize maps. June/July 2019, 350 pp. E-book ISBN: 9781589484924 and paperback ISBN: 9781589484863.



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

By Martin O'Malley

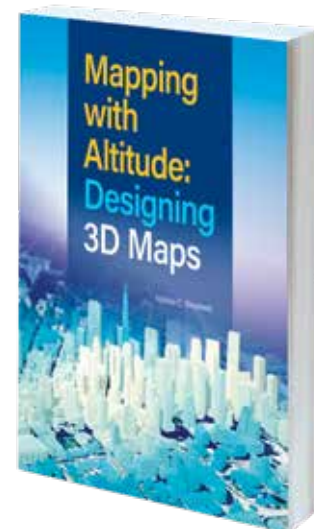
What if health-care providers and public health officials could securely share all patient records and hospital admissions information? What if city officials knew where crime was happening in real time and could deploy more police officers there to prevent it? What if every parcel of land could be ranked for its ecological value to better protect critical natural lands and open spaces? That's all possible, and this is the new way to govern. The time has come for the rise of the tech-savvy executive: an individual who understands the need to elevate the use of technology within and throughout an organization, all to the same level, all at the same time. As mayor of Baltimore and then governor of Maryland, Martin O'Malley did that—and more. In *Smarter Government: How to Govern for Results in the Information Age*, O'Malley looks at how using GIS technology can provide real solutions to real problems while guiding readers through how to develop a data-focused management strategy that will profoundly change any organization. June/July 2019, 420 pp. E-book ISBN: 9781589485259 and paperback ISBN: 9781589485242.



## Mapping with Altitude: Designing 3D Maps

By Nathan C. Shephard

Explore and master another dimension. Buildings, topography, and subsurface geology are inherently 3D, and this spatial information can now be displayed on maps in a way that's both intuitive and measurable. What's more, with ArcGIS technology, 3D representations can be used to model structures before they are built, resolving potentially costly mishaps before they occur. *Mapping with Altitude: Designing 3D Maps* helps users deliver clear, compelling cartographic representations in 3D that are both great to look at and informative. Author Nathan C. Shephard helps readers understand scale, surfaces, base heights, texturing, and lighting models. He also offers new takes on well-defined 2D cartographic principles, such as size, color, and text, and examines various ways to convey time. *Mapping with Altitude* focuses on the decisions users will make and the specific techniques they can use to delve into the world of 3D map authoring. July/August 2019, 350 pp. E-book ISBN: 9781589485549 and paperback ISBN: 9781589485532.



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## Career Opportunities

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

### Software Development and ArcGIS Product Engineering

**Software Developer—GeoAnalytics:** Help build big data access technologies that allow server, desktop, and mobile apps to work with a rich spatiotemporal information model that includes features, relationships, networks, and topologies.

**Software Developer—UI/UX Web GIS API:** Join Esri's team of exceptional software engineers to design and implement new user interface (UI) components in ArcGIS API for JavaScript.

**Software Developer—Cartography:** Build software that lets a broad range of Esri users—from professional cartographers to beginning students—create and publish professional-quality mapping products using ArcGIS Pro.

**Exploratory 3D Analysis Product Engineer:** Are you passionate about the interactive exploration of GIS data in 3D? Help the ArcGIS Pro software development team design and deliver software that enables users to better filter and examine their GIS data.

**Technical Writer—Geodata Management:** Create new documentation to communicate methodologies and best practices for managing geospatial data. In this role, you'll study design documents, interact with core developers, verify software functionality, and advocate for users.

**Search and Geocoding Product Engineer:** Do you want to build cutting-edge software, design compelling user interfaces, support critical workflows, and work with clients and partners to ensure their success? Work with a diverse group of engineers and developers to implement the next generation of geocoding for the ArcGIS platform.

**Web Production Engineer—Learn ArcGIS:** Collaborate with instructional designers and be the point of contact for the documentation web development team that manages the Learn ArcGIS website. Ensure the quality and frequency of lessons being published through the team's content management system.

### Product Management

**Product Manager—Android and Java APIs:** Inspire Esri's developer community while driving the vision and technical road map for Android and Java APIs. Exercise your technical knowledge and set the strategy for how these products are used across the ArcGIS platform.

**Product Marketing Specialist—Data Science:** Collaborate with the product management, development, and sales teams to create and execute marketing campaigns that drive awareness, demand, and adoption of Esri's analytics products.

### Business Development

**Account Executive—AEC:** Apply your interest in architecture, engineering, and/or construction and your experience with geospatial technology to help Esri customers use geoanalytics to find unique patterns and trends in their complex business data.

**Account Manager—State Government:** Be at the forefront of promoting and selling unique GIS solutions to both new and existing Esri users. Help move governments forward by encouraging them to employ innovative digital technologies that can transform their organizations.

### Presales and Solution Engineering

**Solution Engineer—Defense:** Help tackle domestic and global issues. Use satellite technologies, real-time sensors, the latest scientific and analytic tools, and 2D and 3D visualization technologies—all within the ArcGIS platform—to innovate and create solutions for the defense industry.

**Solution Engineer—ArcGIS Urban:** Combine your urban planning background and passion for GIS to promote ArcGIS Urban. You'll help shape and deliver strategies on how to effectively adopt and employ the ArcGIS platform so users can push the boundaries of urban design and planning.

### Educational Services and Technical Support

**Instructor—GIS (multiple locations):** Apply your teaching skills and GIS knowledge to help users be successful with Esri software. Provide a rich learning environment via hands-on training, engaging instructional delivery, and facilitated activities.

**Course Developer:** Leveraging your GIS experience, work with the latest Esri software and subject matter experts to design, develop, and maintain instructor-led and web-based training materials that are both educational and effective.

**Project Manager:** With your background in project management and customer service, lead the planning and implementation of training-related projects to successful completion. Work with team leads to understand department processes, workflows, and business directives.

**Knowledge Management Lead:** Overseeing a team of web content editors and technical writers, develop and maintain an online content support system with multiple media channels.

**Support Analyst—IT and Enterprise:** Can you solve any problem through research? Do you love helping others? Provide high-quality technical support and customer service to Esri users through effective communication and efficient troubleshooting.

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# DISCOVER THE HIDDEN VALUE IN YOUR DATA: LOCATION INTELLIGENCE

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