Summer 2022

ArcUser

The Magazine for Esri Software Users

Celebrating a Voyage of Discovery 60

Mapping the Future We Want 42

Supporting Midwives Worldwide 66

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On the Cover

The cover image is a cross section map showing the area around Challenger Deep, the deepest point in the world ocean. This 3D cube extracted from the Earth provides an opportunity to visualize, annotate, and appreciate the map as a tangible object with volume and depth. It was created by John Nelson in ArcGIS Pro using bathymetric data from the GEBCO Compilation Group. Visit https://bit.ly/3B4X929 to learn how to make a map like this.

Creating a Sustainable Future Together

The theme of the 2022 Esri User Conference (Esri UC), GIS—Mapping Common Ground, encapsulates the most pressing task of GIS professionals today: working together to meet the challenges of climate change and biodiversity loss. Doing this will require a far better understanding of the Earth and its processes than we currently possess. However, the real question is can enough be done—fast enough—to make a difference in the end?

Esri president Jack Dangermond has emphasized that effective action will require scaling up the geographic approach, which "is integrative in nature. It's science based and holistic, and emphasizes collaboration."

Rapid advances in IT, such as machine learning, cloud computing, and unstructured data analysis, benefit GIS technology as it becomes more tightly integrated with mainstream IT. These advances have been incorporated into GIS technology and were highlighted at Esri UC.

With more powerful tools, GIS is helping to close the gap in our knowledge of the Earth. With the help of machine learning, an abundance of information is being extracted rapidly from imagery captured via satellite, lidar, and aerial photography.

Mobile GIS apps, such as ArcGIS Field Maps and ArcGIS Survey123, improve data collection by increasing accuracy and sharply decreasing the interval between data collection and availability

Sites built with ArcGIS Hub centralize the maintenance of data and the creation of information products such as web maps and apps, which enhance collaboration within and between organizations. The adoption of data standards makes data more discoverable and useful. Creating a geospatial community of practice (CoP) within an organization strengthens its processes, increases collaboration, and supports the use of GIS in that organization.

The augmented analysis tools available in ArcGIS GeoAnalytics Engine and ArcGIS Knowledge, both announced at Esri UC, provide new ways to ramp up the conversion of data into knowledge. ArcGIS GeoAnalytics Engine, an independent product, is a Spark-native library that allows organizations to deploy spatial analysis tools alongside data in the cloud. With ArcGIS Knowledge, users can explore and analyze spatial, nonspatial, unstructured, and structured data to perform analyses more quickly and comprehensively.

However, these and other expanding capabilities of ArcGIS won't be sufficient, according to Dangermond. "But just the technology aspects or even the data aspects won't be enough," said Dangermond. "It's about you and how we can together create effective solutions, learn how to collaborate across some of the dividing lines that separate us and—above all—act with urgency to create a more sustainable future."

Monica Pratt
ArcUser Editor

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

Read the article submission guidelines at **https://bit.ly/3mwMRxc**.

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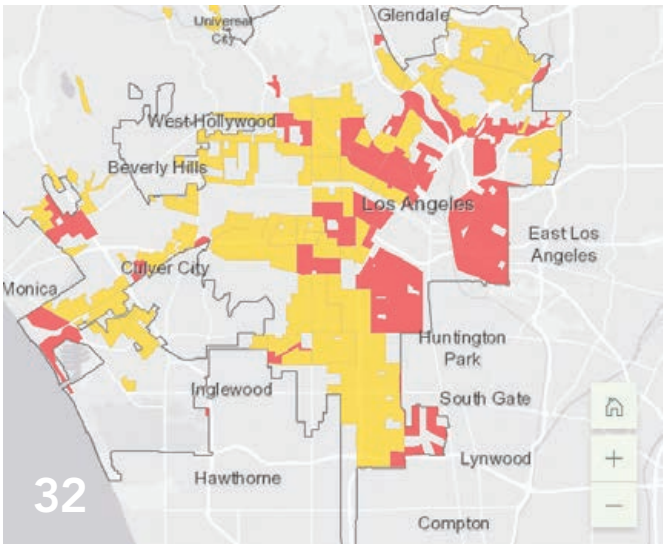

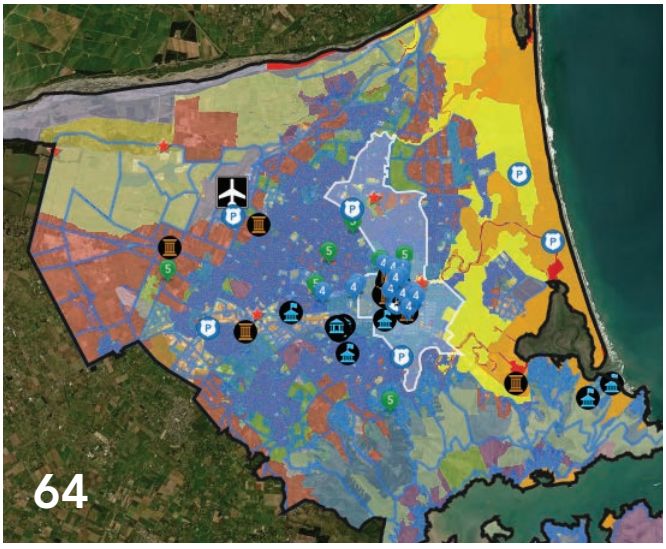

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Briefly Noted

→ Esri Chief Scientist Now a Member of the National Academy of Sciences

Dr. Dawn Wright, Esri's chief scientist, was inducted into the National Academy of Sciences (NAS). NAS is a private, nonprofit organization of the leading researchers in the United States. Membership in NAS is one of the highest honors a scientist can receive.

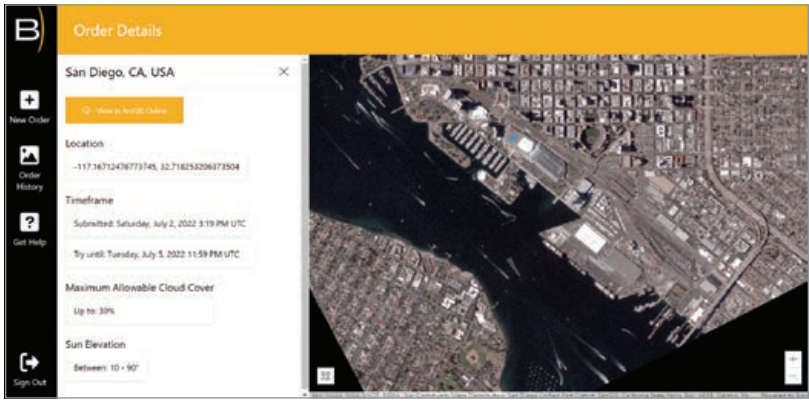
Wright is a respected leader in the science community and has led Esri's science initiatives for more than a decade. As a graduate student at the University of California, Santa Barbara, she became aware of the challenges of applying GIS to deep marine environments. Throughout a varied career, she was a seagoing marine technician for the international ocean drilling program and a postdoctoral research associate at the National Oceanic and Atmospheric Administration (NOAA). She has been a professor of geography and oceanography at Oregon State University since 1995.

Under Wright's direction, Esri created the ecological marine units (EMUs), a 3D digital ocean. She also contributed to the development of the ecological land units and World Terrestrial Ecosystems map. She has worked on enhancing GIS geomorphology analyses and workflows for the ocean floor. Wright has also edited and co-edited many GIS books and has strongly supported science, technology, engineering, and mathematics (STEM) education.

↑ Dr. Dawn Wright, Esri chief scientist, was inducted into the National Academy of Sciences.

→ App Allows Satellite Tasking through ArcGIS Online

A new cloud-based app, called BlackSky Tasking, allows Esri users to task a BlackSky satellite and have dynamic, on-demand, ready-to-use imagery delivered directly to their ArcGIS Online organizational account. Available in the Esri ArcGIS Marketplace, the app allows imagery to be leveraged using ArcGIS Image for ArcGIS Online to perform analytic workflows. BlackSky's high-revisit constellation and its underlying Spectra AI platform make it possible for users to seamlessly incorporate near real-time imagery into projects without additional processing or manipulation. The process is fully automated. Once images arrive in a user's ArcGIS Online organization, they can immediately be used in other Esri apps. BlackSky Technology Inc. is a partner in the Esri Partner Network.



↑ The BlackSky Tasking app makes dynamic, on-demand imagery directly available from ArcGIS Online.

New Broadband Solution Aims to Close Digital Divide

The Federal Communications Commission (FCC) estimates that 35 percent of Americans lack access to reliable internet service, which can impact their job and educational opportunities and health-care options. To help state and local governments better understand broadband coverage in their communities, Esri released a new ArcGIS Solution called Broadband Outreach. It delivers a set of capabilities that enable government staff to inventory broadband resources and take action to close this digital divide. Find out more at go.esri.com/new-broadband-solutions.

↑ Broadband Outreach is an ArcGIS Solution released by Esri to help close the digital divide.

Esri Expands Partnership with the Sustainable Development Solutions Network

The Sustainable Development Solutions Network (SDSN) and Esri will work to provide better and more timely data and improve engagement with public and private sector decision-makers to accelerate progress on the Sustainable Development Goals (SDGs).

The partnership is set within the framework of the new SDG Transformation Center, which will be launched by SDSN ahead of the United Nations' SDG Summit 2023. The SDG Transformation Center will become a first-of-its-kind platform for learning and exchange on SDG data, policies, and financial instruments to help restore and accelerate SDG progress globally. The center will build on SDSN's global network, thematic expertise, and instruments.

The goals for the new multiyear partnership between SDSN and Esri are to

- Enable the discovery, use, and reuse of openly available SDG data.
- Develop new indicators and datasets to fill critical information gaps that build on georeferenced information.
- Create a hub for sharing information and knowledge for the SDG Transformation Center.
- Advance a geographic approach to the SDGs through community engagement, training, and events with international institutions, governments, and other partners.

Most Current ACS Data Is Ready to Use

The latest American Community Survey (ACS) data from the US Census Bureau is available in ArcGIS Living Atlas of the World. It contains five-year estimates for 2016–2020 on income, housing, internet access, education, disability, and health insurance. Federal agencies, local governments, businesses, and nonprofits typically use the data for planning and resource allocation. It can be accessed from ArcGIS Pro and ArcGIS Online and incorporated into Esri's configurable mobile apps and dashboards.

Make Your Data FAIR

By Jill Saligoe-Simmel, Michael Gould, and Satish Sankaran

Everyone benefits from easy access to interoperable data for decision-making.

In the spirit of improved data management among researchers, the FAIR (Findable, Accessible, Interoperable, and Reusable) data principles were published in *Scientific Data*, a peer-reviewed, open-access journal. Researchers depend on data that is FAIR. Beyond researchers, these same principles are of universal value to a broad range of data managers and users.

The spirit of the FAIR principles is to improve the discoverability of interoperable datasets. If a person or a machine/agent does not know about a dataset, how can it be found, connected to, or reused?

FAIR data is not the same thing as open data. FAIR data and open data are complementary concepts. Open data can be freely used, shared, and built on by anyone. The FAIR data principles provide a set of best practices for sharing data in ways that can respect ethical, legal, or contractual restrictions. They do not state that data must be free of charge or unencumbered by license conditions. Instead, the FAIR principles focus on the future interoperability of data and infrastructure, within which data sources are properly documented and accessible. Implicitly, FAIR principles help providers understand how to handle shared data so that it can be truly useful.

The principles refer to three types of entities:

- Data (or any digital object)
- Metadata, which is information describing the data
- Infrastructure, which consists of tools and systems

FAIR Principles

FINDABLE: Making data findable is the first step toward reusable data. Machine-readable data and metadata, combined with search engine optimization (SEO) techniques, help make data findable by web search engines like Google and can be explored by humans.

ACCESSIBLE: Making data accessible means letting potential users know how data they find can be accessed, including any authentication and authorization required. Data can be made accessible whether it is open public data or private and secure data that will be available only to authorized users.

INTEROPERABLE: Data is interoperable when it can be integrated with other data and systems to leverage open standards and specifications.

REUSABLE: Data that is richly described by metadata, is released with a transparent data usage license, and adheres to domain-relevant community standards is reusable data. Reusability is a primary goal of the FAIR data principles.

FAIR principles are further broken down into subprinciples that are listed on www.go-fair.org/fair-principles/. Under Findable, principle F4 stipulates that metadata and data are registered or indexed in a searchable resource, the infrastructure component.

According to the GO FAIR Initiative, a stakeholder-driven self-governed initiative to implement FAIR data principles, the vision is to foster the coherent development of the global Internet of FAIR Data and Services (IFDS). This vision focuses on early outcomes for the European Open Science Cloud (EOSC) and building a competitive data and knowledge economy in Europe. However, FAIR principles are of interest worldwide.

Industry Adoption of FAIR

The geospatial community has embraced FAIR data principles and has long appreciated the need for accessible and interoperable data. In 2021, Open Geospatial Consortium, Inc. (OGC), a standards development organization, updated its mission statement and embraced FAIR principles.

As a principal member of the OGC, Esri is united in supporting this vital mission to help users who produce, publish, collaborate, share, and (re)use the world's location-based data. Esri's goal is to ensure that the ArcGIS system enables FAIR data with appropriate geospatial infrastructure.

Esri has a history of supporting the spirit of the FAIR principles through its incorporation of open data and industry standards in software design and its emphasis on interoperability. It builds software that encourages the maintenance of metadata creation and the sharing of datasets, maps, and apps.

ArcGIS Helps Implement FAIR Principles

It's important to understand that data does

↑ The ArcGIS system supports the production, publication, collaboration, sharing, and (re)use of FAIR data in ArcGIS.

not become FAIR magically or automatically and that data FAIRness is not a binary but rather a range or spectrum. Put into practice, FAIR data results from an organization's efforts and the tools that support them. For example, organizations must publish data as web services and ensure that content has proper metadata and carries appropriate licensing. Tools must support these efforts through user interfaces, automation, workflows, infrastructure, and compliance that help make FAIR data easy to implement.

ArcGIS helps you to execute FAIR data principles throughout workflows that span different software and software as a service (SaaS) products. Let's look at an overview of these FAIR principles in practice:

With ArcGIS Enterprise and ArcGIS Online, you publish human- and machine-readable web services that have closely coupled metadata in well-known formats, such as JSON and XML, with international open standards and open specifications. API keys *[or application programming interface keys, which are codes that get passed in by computer applications]* allow requisite authentication for quick access to popular locations services such as basemaps, routing, and geocoding.

ArcGIS identities provide the necessary authorization mechanism for controlled access. This enables collaboration among individuals and organizations, so you can work with your partners more easily. Content is shared with appropriate audiences as open or private data, based on the permission granted by the data owner, and described with clear license terms of use.

FAIR principles come to life as you share content through ArcGIS Hub. Shared data and web services are easily found, accessed, and federated using the Hub catalog. In addition, Hub helps you engage with your communities.

GIS professionals, analysts, and developers use and reuse interoperable web services using ArcGIS REST API and various mapping tools from ArcGIS, open-source, and third-party APIs. ArcGIS low-code and no-code app builders ensure that web services are easily reused and accessible to nonspecialists through information products that answer questions and convey understanding.

Join the conversation about FAIR principles on the SDI blog on Esri Community (https://bit.ly/3ys14o2).

About the Authors

Jill Saligoe-Simmel is the Esri principal product manager for SDI and INSPIRE. For more than 20 years, Saligoe-Simmel has championed open data and led statewide and national spatial data infrastructure (SDI) initiatives. She is passionate about helping organizations to use and share geospatial information to further vibrant, healthy, and sustainable communities.

Michael Gould, an education manager at Esri since 2009, works with 80 Esri offices and through those offices, 10,000 universities from around the world. He supports global capacity development projects in collaboration with partners and the wider community. He has also been a part-time GIS professor at Universitat Jaume I in Spain since 1998.

Satish Sankaran has been a product manager at Esri for more than 20 years.

Linear Referencing Comes to ArcGIS Field Maps

By Jeff Shaner

Linear referencing is a geographic approach for storing and describing the location of physical features in terms of measurements from a fixed point along a road, pipeline, or railroad. For example, the location of a yield sign along a highway can be described as "50 feet past mile marker 100." Linear referencing is used to describe and locate assets by their distance from a fixed location.

Measurement values are stored as numeric values (doubles) in the m-value component of a linear geometry. M-values do not have a well-defined unit of measure but are often calibrated in US survey feet or meters.

Linear referencing is commonly used to describe location in the engineering, construction, and management of infrastructure that is tied to linear features. With the newly added support for linear referencing in ArcGIS Field Maps, mobile workers can locate—and even capture—measurements when inspecting assets along roads, railways, or pipelines.

Find Measure

Field Maps includes the Find Measure feature action, which supports the discovery of measurement values (m-values) along a selected linear feature. After selecting a measured linear feature, the Find Measure action appears. Tapping it will present the closest m-value perpendicular to the mobile worker's current location. A search dialog box will appear. Simply tapping OK will place a pin at the interpolated, measured location. However, you can type an alternate measurement if you want to search for a location farther away from you.

Discover, validate, and capture measurements from any m-value-aware linear feature. The pin's location can be used with the Compass or Directions tool for navigation, or the pin's location can be used with Collect Here to capture a new feature. New features will store the measurement value if the layer is m-value aware.

Using Linear Referencing in Field Maps

The Find Measure action can be used with any measured line feature. The measured line feature does not need to participate in ArcGIS Roads and Highways or ArcGIS Pipeline Referencing, but features managed by those products will also work with this action..

Field Maps presents interpolated measurements the same way they are stored (numeric values without units). They are presented in the subtitle of the panel where details of the selected feature are shown. For display purposes only, measurement values are rounded to three decimal places.

Searching for measurement values will use all decimal values entered in the Find Measure dialog box. If the line feature geometry includes z-values, elevation will be used to interpolate the nearest perpendicular measure to your current location.

It is possible to label measurement values and even store measurement values in stationing notation using ArcGIS Arcade expressions. Copy and paste code from the Esri/arcade-expressions GitHub repository (https://bit.ly/3wXIwdj) to label features using stationing notation. You can apply the same expression to store the station value as an attribute of a point feature.

To find measurement values within a feature, they must adhere to these monotonic rules:

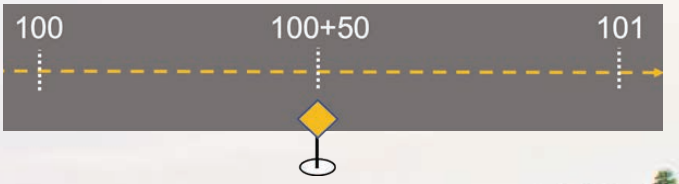
- All measurement values must be ascending or descending in value.
- Measurement values need to be strictly ascending or descending within a part, but duplicate m-values can exist at the ends of parts.
- Invalid routes will display an alert message, and details will be added into the Field Maps troubleshooting log.

What's Next

The Find Measure feature action introduces support for linear referencing capabilities in Field Maps. Several enhancements, such as support for stationing notation and m-value editing of linear features, are under consideration. Esri wants to grow the linear referencing capabilities in ArcGIS Field Maps based on user feedback. Submit your ideas to Esri Community (community.esri.com), or contact Esri directly through your account manager or by sending an email to ArcGISFieldMaps@esri.com.

About the Author

Jeff Shaner is a product lead with the software development team at Esri. Delivering GIS tools and apps that enable users to work more productively, safely, and effectively has translated into 23 years of inspired work with Esri's talented development team and dedicated ArcGIS users around the world. In his spare time, he enjoys few things more than playing a good round of golf or hockey followed by a stop at his favorite craft brewery.



← Linear referencing is used to describe and locate assets by their distance from a fixed location. Using ArcGIS Field Maps, measurements from any m-value-aware linear feature can be discovered, validated, and captured.

Hydrocarbon Transmission Pipelines Managed with GIS Dashboard

By Thamer Tarabzouni, Nawaf Bakr, Iftikhar Ahmed, and Kamran Hussain

← The Saudi Arabian Oil Company (Saudi Aramco) operates and maintains an extensive network of hydrocarbon transmission pipelines that stretch across Saudi Arabia and exceed the Great Wall of China in length.

The Saudi Arabian Oil Company (Saudi Aramco) operates and maintains the extensive network of hydrocarbon transmission pipelines that carry oil, natural gas, natural gas liquids (NGL), and even products such as diesel. The total length of these pipelines exceeds by 15 percent the 13,000 miles spanned by the Great Wall of China.

This huge network of buried pipelines connects refining facilities, domestic customers, and export terminals. Pipelines cross the entire Saudi Arabia territory from east to west and north to south, encompassing an area of diverse terrain and harsh environmental conditions. An enormous number of assets of various types are part of this pipeline network.

Operating the network and its related assets poses many challenges, which often necessitate implementing normal and emergency modifications to maintain the safety, reliability, and integrity of the whole transmission pipeline network.

The status of changes to the network and its assets must be tracked to ensure they comply with requirements. The transmission pipeline network, its related assets, and all modifications to the network and assets are maintained as an as-built pipeline network layout that is monitored by a comprehensive GIS application. The data for that GIS application is managed by a dedicated unit within the Pipelines Department of Saudi Aramco called the Pipelines Data Management Unit (PDMU).

Because the pipelines and assets are distributed over a wide area, geographic zones or areas of responsibility were created for the three main subdepartments within the Pipelines Department and for all operating units that report to each department. This ensures project completion and compliance for normal and emergency changes.

Project staff come from different disciplines, such as operations, maintenance, or inspection. They submit change requests, update progress data, and confirm the completion and implementation status of changes in the corporate enterprise resource planning (ERP) system.

PDMU staff are not a permanent part of this process. To obtain information and data related to any changes implemented on the transmission pipeline network, intensive email communication between PDMU and Pipelines Department staff was necessary. These messages provided Pipelines Department management with status updates.

Developing the Pipelines Management of Change Application

To address the challenges of monitoring the pipeline network, a GIS dashboard solution was developed. This solution, the Pipelines Management of Change (MOC), enhances the tracking and monitoring of changes to the network and establishes a complete data update workflow for capturing and maintaining current pipeline asset data.

MOC is a GIS dashboard with two main components. The first component displays tabular data and change locations on a map. Selectable analysis charts and tables enable managers and key stakeholders to browse various types of information about normal and emergency changes. Managers can track the progress of changes and their status versus planned changes that have been scheduled.

The dashboard displays status charts or tables on the map georeferenced to its area of responsibility. By browsing charts and tables, changes that have passed the scheduled implementation date can be identified. The distribution of both normal and emergency changes is easily discerned because their locations are georeferenced on the map. This allows staff members to more immediately arrive at conclusions and supports decision-making.

The other main component of the GIS dashboard is a data update workflow. GIS was employed to improve the overall

process. Because the ERP system is used by different Pipelines Department staff members for submitting MOC change requests based on geographic areas, this component initially fetches any new normal or emergency changes that have been entered in the ERP system. These changes are entered daily.

PDMU staff, using the analyses implemented in MOC, can focus on submitted requests for changes—classified as either emergency or normal—that will modify transmission pipelines and related asset data. A location tag on the map is created to reference the MOC request in case it can't be referenced using an existing GIS asset. This is important for locating new assets that have been added or existing assets that have been relocated.

Based on the status of changes or their completion, a data update workflow is triggered. This workflow is monitored by PDMU staff and the PDMU supervisor, who ensure that the data is updated in a timely fashion and passes quality assurance/quality control (QA/QC) processes. The GIS technology employed in this workflow enables users to zoom to asset locations affected by the MOC request and perform QA/QC on updated data by either approving it or rejecting it and redoing the data update action.

With the solution, staff can identify assets that have been removed or reallocated or newly added assets. Innovative GIS editing tools, email notifications, and QA/QC levels with appropriate levels of review and approval maintain up-to-date pipeline GIS data.

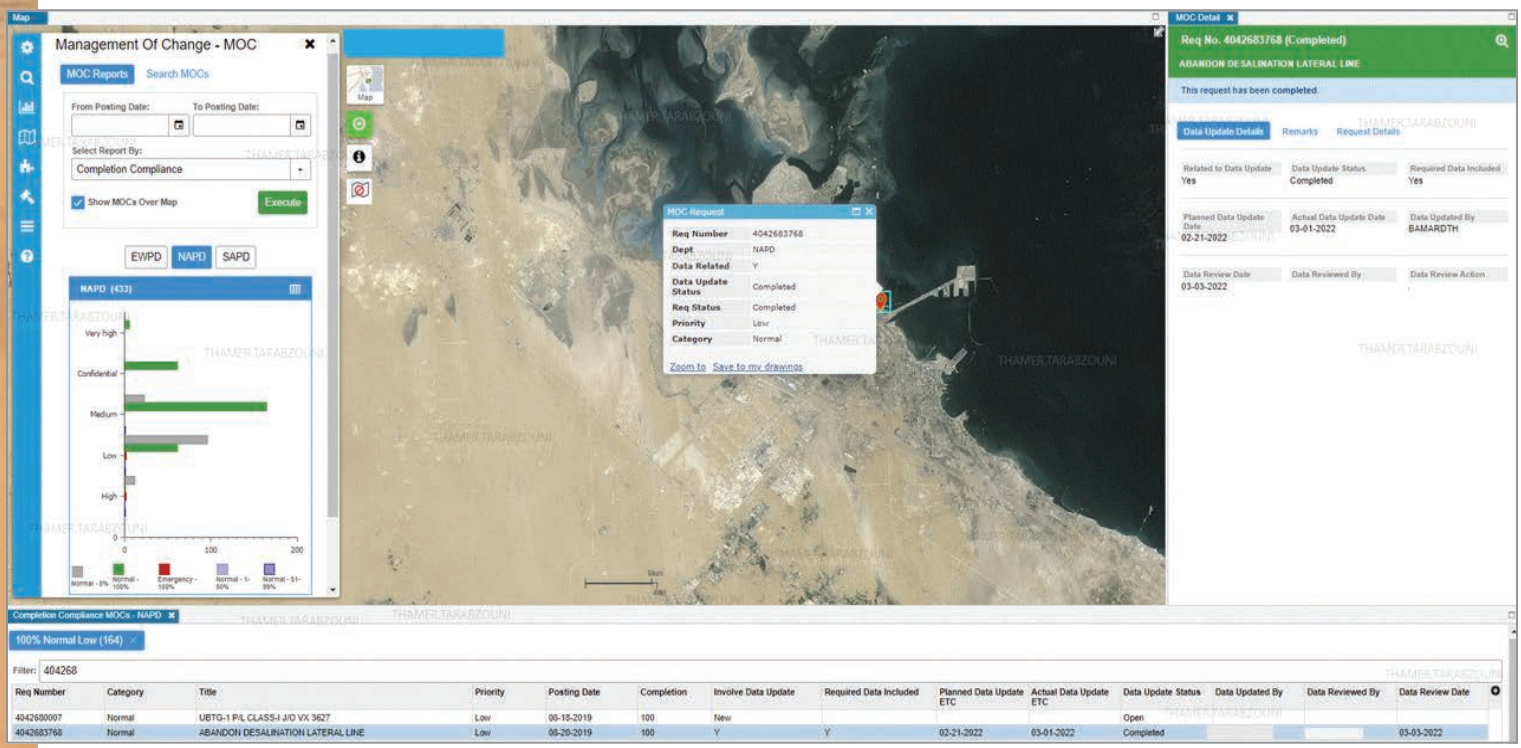
Through a dashboard, MOC employs GIS technology to enhance visualization and track the location of normal and emergency changes submitted by staff members who have different areas of responsibility. The app is integrated with the corporate ERP change management system and email gateway. The solution consists of a data synchronization agent that periodically updates the change request data in ArcGIS Enterprise by importing data from the corporate ERP system through a REST endpoint.

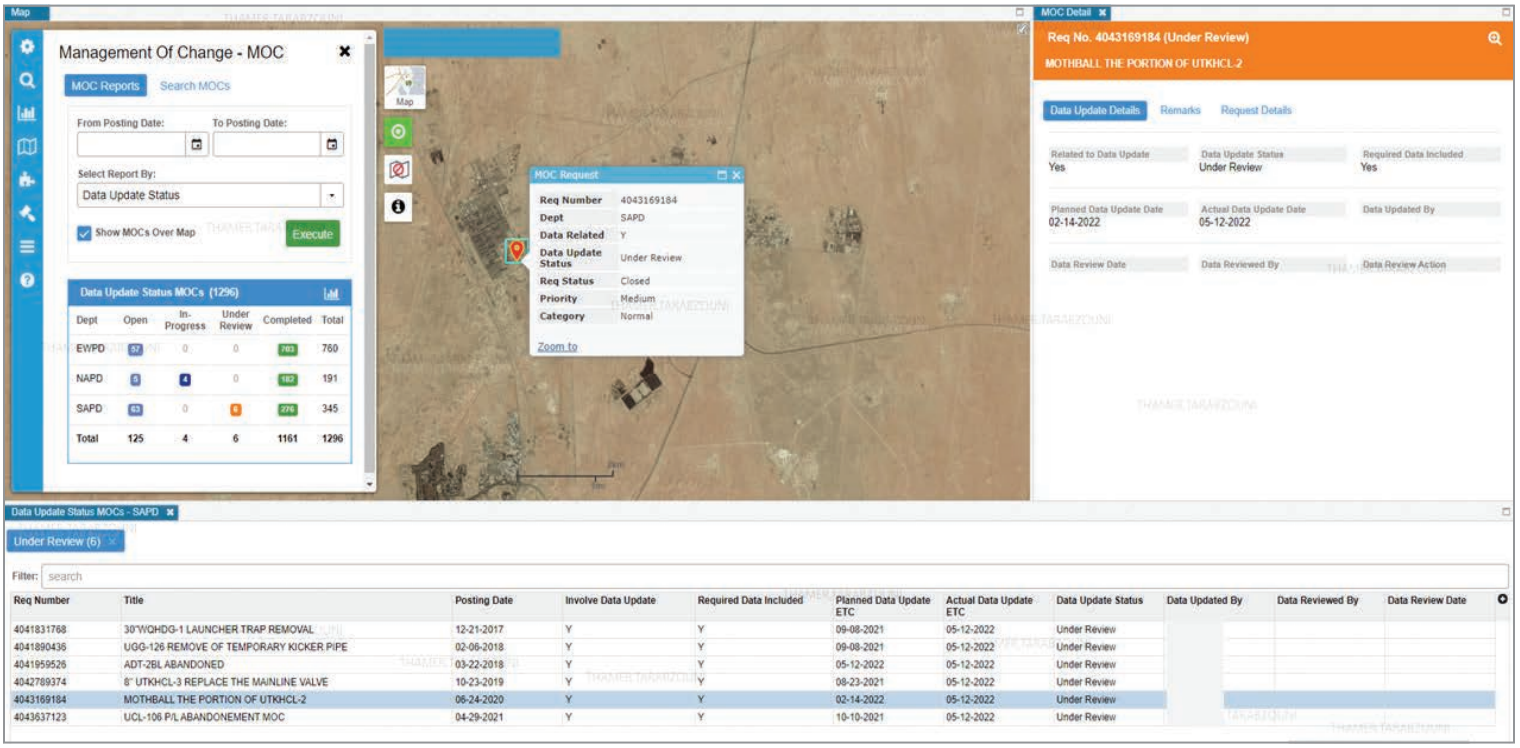
MOC was developed using ArcGIS API for JavaScript and other enterprise technologies. It was designed with flexibility in mind. Different user roles have access to specific functionalities such as data updates. There is a designated user role that grants access only to PDMU staff. The supervisor role determines who can approve or reject data updates.

Benefits Realized

The MOC application provides requested functionality and addresses concerns raised by management and technical staff. The GIS dashboard provides management with selectable charts and tables, so the progress of normal and emergency

↓ The MOC application displays information about the completion and compliance of changes to the pipeline network.





↑ The MOC application shows the data update status of a normal change request.

changes can be immediately monitored, and compliance can be ensured. These changes are extracted from the ERP system so that MOC acts as a gateway for browsing information without logging in to the system.

MOC enables the classification of changes that involve data updates to the pipeline as-built network and tracks the completion of changes, ensuring data is updated accordingly. PDMU staff can monitor and track all changes implemented on the pipeline by various operation and maintenance staff. The custom GIS-based workflow greatly assists in keeping GIS data up-to-date. It also eliminates major work related to customizing the corporate ERP system, which directs all pipeline-related changes to PDMU for review. ERP system customization would have delayed the project considerably and imposed major delays in executing changes.

For more information, please contact Thamer Tarabzouni via email at Thamer.tarabzouni@aramco.com.

About the Authors

Thamer Tarabzouni is a GIS and remote sensing consultant with more than 30 years of experience in IT technologies. He has managed many IT application and solution projects related to energy domains.

Nawaf Bakr is the supervisor of the Pipelines Data Management Unit within the Saudi Aramco Pipelines Department.

Iftikhar Ahmed is the main MOC application developer. He has comprehensive experience developing GIS web, mobile, and desktop applications and integrating GIS with many systems such as ERP and real-time systems.

Kamran Hussain, PDMU, is a senior staff member who has experience in several IT domains. He has more than 17 years of experience with GIS technology and has coordinated and facilitated many GIS applications for pipelines and geospatial data projects.

OMAN'S UNIFIED ADDRESSING SYSTEM WILL HAVE BROAD BENEFITS

By Jim Baumann

The Sultanate of Oman is developing a unified addressing system (UAS) that will benefit the government's operations, support the country's residents, and help Oman achieve its long-term goals.

Oman is strategically located on the southeastern corner of the Arabian Peninsula, bordered by the Arabian Sea and Gulf of Oman. It is governed by a sultanate. During the nearly 50-year rule of his late Majesty Sultan Qaboos bin Said Al-Said, Oman achieved impressive government reforms, infrastructure development, and economic gains.

One of his programs provided Omani citizens with free parcels of land. This program increased the workload of the government's surveying and planning departments. In response, Oman adopted Esri technology nearly 30 years ago to develop a basemap and database for better land records management.

"The Ministry of National Economy was another of the early adopters of GIS in the Sultanate," said His Excellency Dr. Khalifa bin Abdullah Al Barwani, CEO of the National Center for Statistics and Information (NCSI). "We first used it in our 1993 census."

In 2020, Sultan Haitham bin Tarik

succeeded as the head of government and launched Oman Vision 2040, the road map for economic and social development in the Sultanate for the next 20 years. One of its primary goals is the digital transformation of government services in the country. The implementation of a GIS-based UAS is a key driver for that transformation.

The Need for a UAS

Although Oman has a population of more than 4.5 million people, current address data existed only for the cities of Muscat, Sohar, and Salalah. This impeded the development of the location intelligence needed by decision-makers in government and business.

NCSI has been given the mandate to implement a UAS for the Sultanate of Oman in coordination with Municipalities, Ministry of Interior, Ministry of Housing, and Royal Oman Police. The capture of trusted, accurate, and regularly maintained address data in Oman will underpin the nationwide UAS. This system will support Oman's Vision 2040 goals to facilitate a strong, prosperous, and knowledge-based economy.

"The Oman National Spatial Data Infrastructure initiative is the key driver of our National Unified Addressing System," said Hassan bin Alawi Al-Ghazali, an engineer and the director general of the National Spatial Data Infrastructure at NCSI. "The initiative provides a framework for geospatial standards, policies, institutional arrangements, and technology infrastructure. The framework is necessary to coordinate, facilitate, and support the sharing and utilization of geospatial information across multiple government organizations in the Sultanate of Oman. The UAS is part of a larger plan in Oman to achieve geo-enabled digital transformation throughout the Sultanate. The UAS will include the addresses of all buildings and residences in the country, and we are currently in the process of completing this step."

↓ Oman is strategically located on the southeastern corner of the Arabian Peninsula, bordered by the Arabian Sea and Gulf of Oman. The capital city of Muscat is located on the Gulf of Oman.

Creating the UAS

The UAS project was divided into separate phases: development, testing and verification, and implementation. The development phase is complete, and the system has been handed over to Municipalities for field verification, implementation, and ongoing maintenance.

The system makes use of a wide range of Esri products. The ArcGIS Desktop suite has been used to develop and perform data quality control procedures. The versioned geodatabase is maintained in ArcGIS Enterprise. Data is disseminated using ArcGIS Enterprise and Enterprise portal and utilizes the Esri Leaflet Geocoder, which is a series of API helpers and UI controls that interact with ArcGIS Online geocoding services. In addition, ArcGIS API for JavaScript was used to develop several applications for the address system. Several government agencies have worked together to develop the related centralized address database.

"The database will be integrated with government applications that require the

↑ Residents as well as the government and businesses will benefit from the unified addressing system (UAS).

addresses of individuals or buildings. These agencies include Oman Post; National Centre of Statistics and Information; Royal Oman Police; the Ministries of Technology and Communications; Regional Municipalities and Water Resources; Housing, Interior, and Transport; and the Municipalities of Muscat, Sohar, and Dhofar. In addition, we have developed an address locator app for the general public," according to Saud bin Salim Al-Nofali, the director of Spatial Strategy at NCSI.

NCSI anticipates many benefits from the addressing system. As a valuable source of statistical data and information, the UAS will enhance national security by providing information to better integrate intelligence, plan operations, manage national security threats, and improve disaster preparedness. It will be an essential first step in the development of Oman's Smart Cities plan.

UAS will support national and regional planning and decision-making processes related to urban expansion. This data will help with planning public services, such as postal delivery, education, health services, sanitation, public transport, and utilities. It will also improve the tax collection and utility payment systems, thus increasing government revenues. Eliminating duplicated paper work will improve government efficiency and reduce operational costs for transportation and logistics sectors. The UAS will help attract high-tech industries to the region, creating new investment opportunities, and it will also be attractive to tourists visiting Oman.

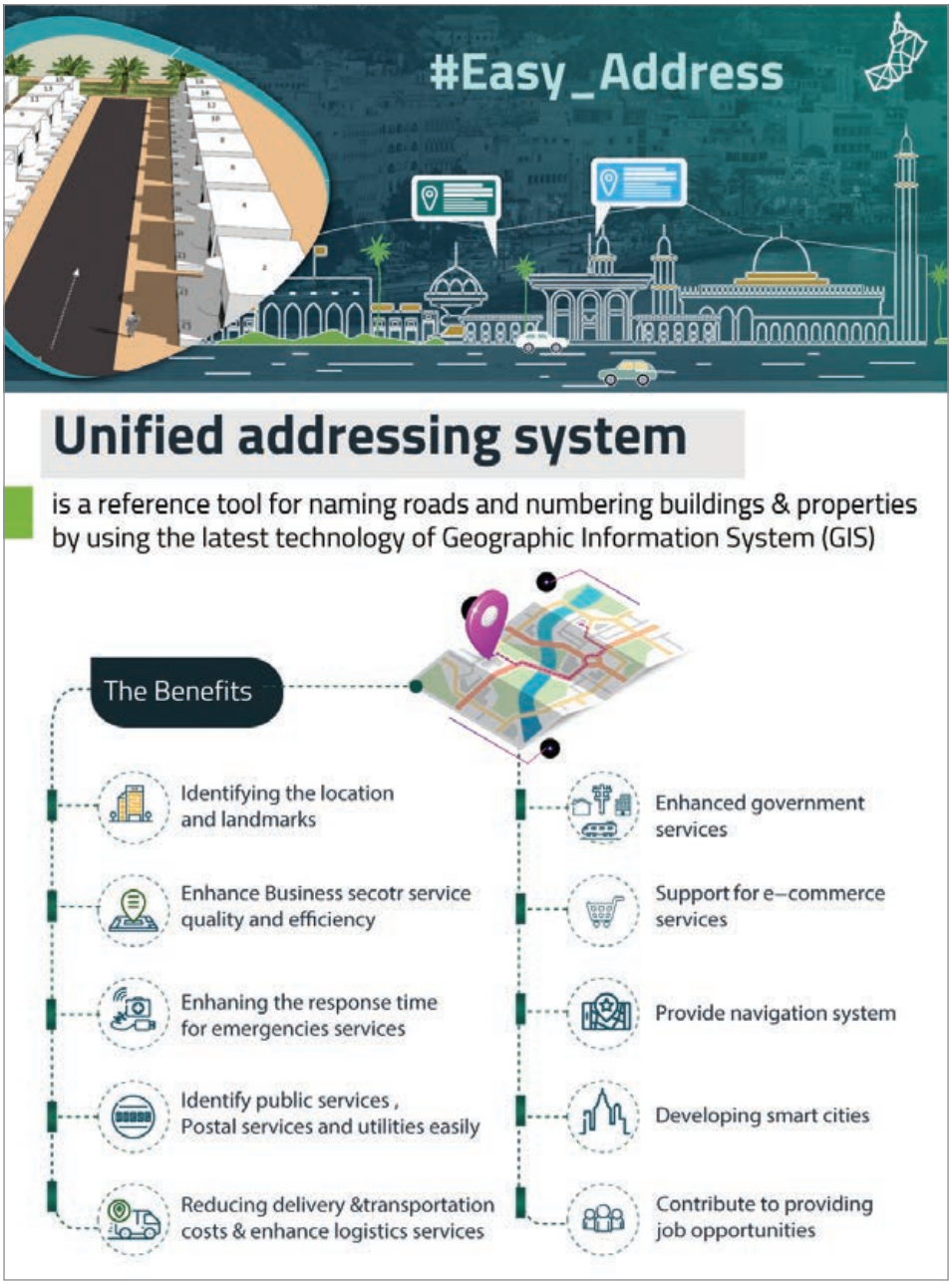
Oman's national UAS will also bring numerous benefits to its residents. By more reliably routing ambulances and the police in towns, cities, and rural areas, emergency services response will improve, saving lives and property. Reduced travel times also will improve the delivery of goods. Official records, such as ID cards, residence permits, driver's licenses, and other government-issued documents, can now include addresses.

"At the National Spatial Data Infrastructure, we have many plans in the pipeline for the promotion of GIS technology in Oman at various scales," concluded Al-Nofali. "We are working with a defined road map, which aims to strengthen the national GIS capabilities, promote use of shared services, and focus in exploiting the power of GIS for national planning and e-transformation initiatives."

About the Author

Jim Baumann is a longtime employee at Esri. He has written articles on GIS technology and the computer graphics industry for more than 30 years.

↓ The unified addressing system (UAS) is based on GIS.



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[1]Based on IDC Quarterly Workstation Tracker, CY2021 (units)

↓ Cary coordinates the activities of the Utilities and Transportation Departments so that utility upgrades occur prior to street paving in the same area.

Dashboard Makes Street Rating Data More Valuable

By Coray Davis

The Transportation Department for Cary, North Carolina, leverages GIS to assist with the collection, dissemination, and analysis of the annual street rating data it maintains for more than 500 miles of streets.

Streets are prioritized for improvements based on pavement condition ratings. The town's staff members apply GIS to analyze, map, and compile street ratings in a central location. The data is used in a dashboard to support internal decision-making and in a map for the public that identifies streets that will be repaved. Cross-departmental coordination provides an opportunity to create efficiencies in many areas and supports residents.

Maintaining Streets

With more than 170,000 residents, Cary is a thriving community in the heart of the Triangle area of North Carolina, between Raleigh and the renowned Research Triangle Park. *[Research Triangle Park is home to more than 250 businesses and is the largest research park in North America.]*

Cary is committed to keeping the town's street assets clean, safe, and well maintained. A twofold approach is necessary to make data on these assets available to managers and officials, who use this information to make critical decisions and inform the public.

Part of Cary's street improvements process seeks to rehabilitate and resurface streets during early stages of deterioration while also looking for cost-effective ways to increase the life of streets. Streets are resurfaced during the early stages of cracking and deterioration or patched, or the asphalt is rejuvenated. The street improvement process also includes replacing or installing new ramps that comply with the Americans with Disabilities Act (ADA), as well as sidewalks, traffic calming devices, and pavement markings.

Pavement Analysis and Selection

The Transportation Department uses an independent, third-party consultant to survey the condition of public streets. Streets are surveyed by block or segment to collect information, which includes physical characteristics and pavement distress types. Types of pavement distress include alligator cracking, raveling, rutting, block or transverse cracking, patching, bleeding, and any reflective cracking.

The information collected across these distress types supports the calculation of each street segment's pavement condition rating (PCR). Street segments are assigned to one of five rating categories that range from very good to very poor. All data is compiled into a database to determine which pavement maintenance technique is appropriate for each street.

Within the last five years, Cary created Paving Groups to analyze streets. These 166 Paving Groups consist of neighborhood streets used to support the selection and grouping of poorly rated streets

for improvements and to simplify construction. As data continued to be compiled, the Transportation Department needed a way to analyze pavement rating data across multiple years to support better informed decision-making.

History Informs Decision-Making

To simplify data management and increase accessibility to data across multiple departments, the Transportation Department used ArcGIS Dashboards to create a pavement condition data dashboard. Once the data was cleaned, validated, and published, the dashboard revealed the condition of streets within each paving group. The dashboard displays pavement condition data collected over nearly 10 years. Stakeholders across multiple departments could perform interactive querying and have access to all attributes originally contained in the database, but now in a more visual format.

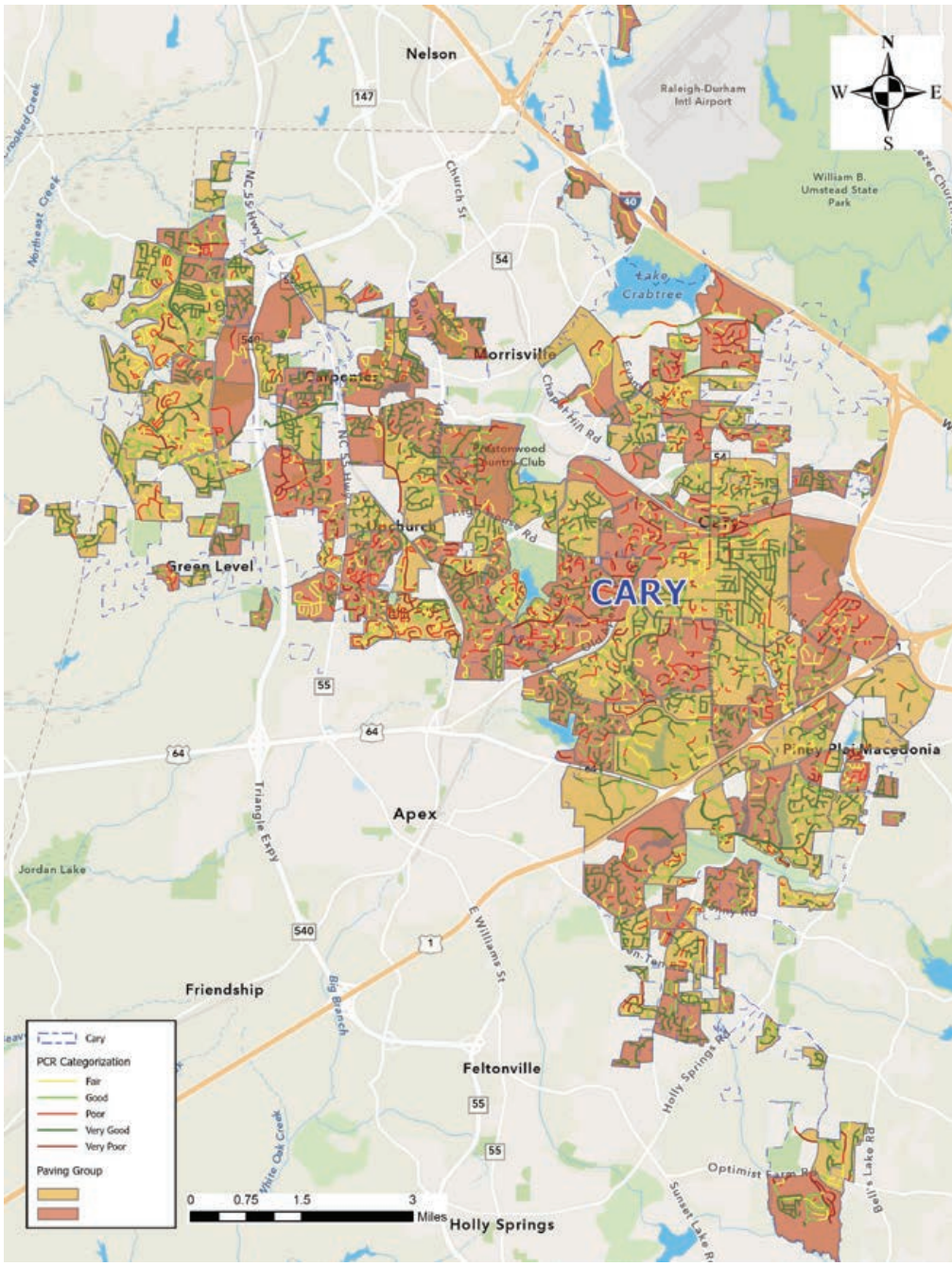
The Pavement Conditions Survey (PCS) provides annual data that is used by the PCS Data Dashboard, which enables staff to visualize this information. Statistical values for pavement distresses can be selected for each year and their distribution analyzed geographically.

Queries can be run on multiple years of data and efficiently summarized using the dashboard. The real power of the PCS Data Dashboard is its ability to summarize one attribute based on another. This wasn't possible previously because multiple layers of annual street rating data were held separately. Spatially accurate, attributed data is now centrally located and updated annually, with the most recent pavement attributes appended to the database.

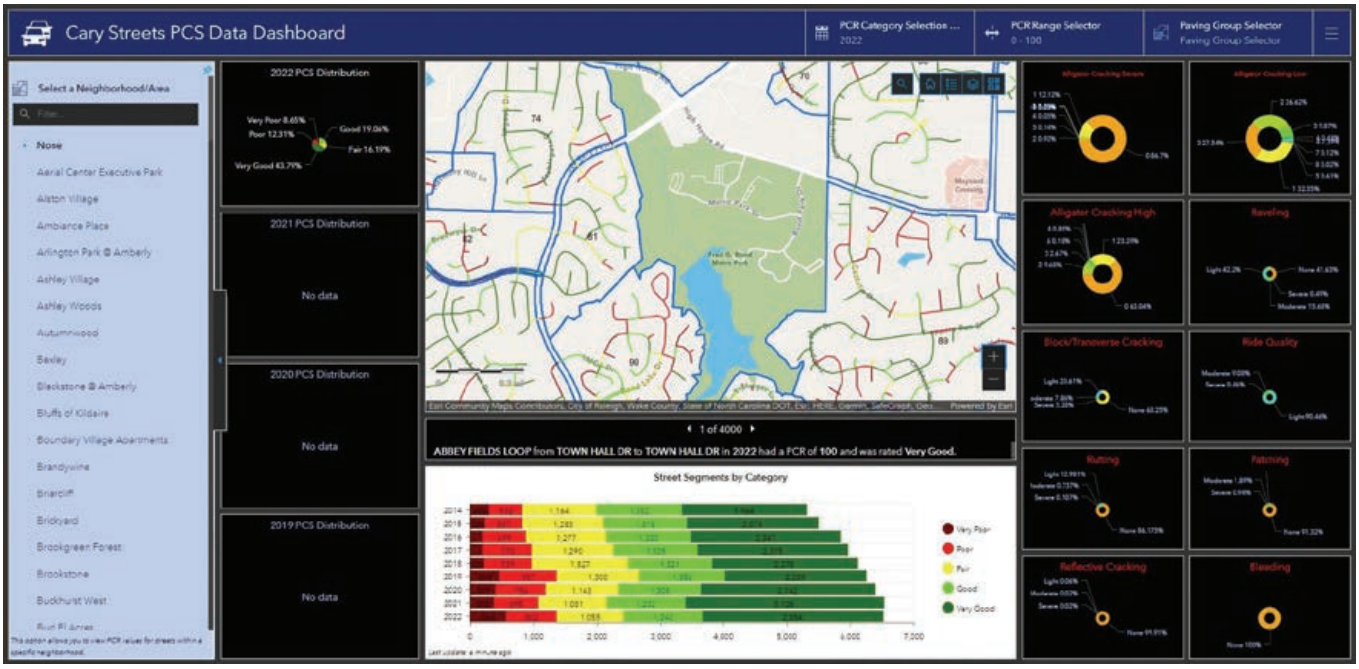
Sharing Is Caring

The PCS Data Dashboard is a very shareable resource. At any time on any day, departments across Cary are coordinating the delivery of important services at the high standards that residents have come to expect. For example, the PCS Data Dashboard directly supports the street improvements project manager by helping to determine which streets need upgrading while streamlining that list based on budgetary constraints.

The Utilities Department maintains the underground infrastructure of waterlines, sewer lines, and storm drains. The dashboard supports planning utility upgrades and project coordination. In the past, large, printed maps were used to coordinate efforts and identify and manage utility and street improvement conflicts. Although these maps had some advantages, the growth in the number of assets Cary manages required visualizing statistics—such as the demand for a service or demographics—more effectively. With the ArcGIS web-based platform, a user has a wide range of options for designing and incorporating decision-based maps. This has resulted in collaboration between the Utilities and Transportation Departments so that utility upgrades occur prior to street paving in the same area.



→ Pavement groups represent neighborhoods and provide for better analysis of street segments.



↑ The Pavement Conditions Survey provides annual data that is made available and visualized through the PCS Data Dashboard.

The Transportation Department has found the PCS Data Dashboard particularly useful in the analysis of street data. By having all data in one place, users can easily view a particular pavement distress type along a street, across multiple years. Since streets are chosen for improvement efforts by segment, the data now allows for more longitudinal analysis of the entire street's length. This is valuable when considering distress types, such as alligator cracking, that indicate more structural pavement issues when appearing across longer street extents.

The PCS Data Dashboard helps in disseminating information to concerned residents. Cary's 311 system lets residents easily make nonemergency requests for service or obtain answers to general questions. Residents can find out if their street is on the current list for improvements or when streets in their neighborhood were last resurfaced. They may also inquire on issues such as parking along streets, garbage pickup, landscaping repair, and weather-related delays. The dashboard lets Cary staff members quickly identify areas of concern and respond to resident queries with current information to address their concerns.

Depending on the query, Cary staff members can click on a particular year to obtain statistical data for streets by paving group and a range of rating values and analyses based on a neighborhood name. The dashboard allows zooming in to view the color-coded street segment ratings. Charted data is displayed by segment, year, and rating. Pavement distress types provide statistical data, indicating the major catalysts of street deterioration. Selecting a specific paving group or neighborhood provides a focused approach to analyzing pavement ratings across multiple street segments. These performance metrics will influence the selection of streets in the future.

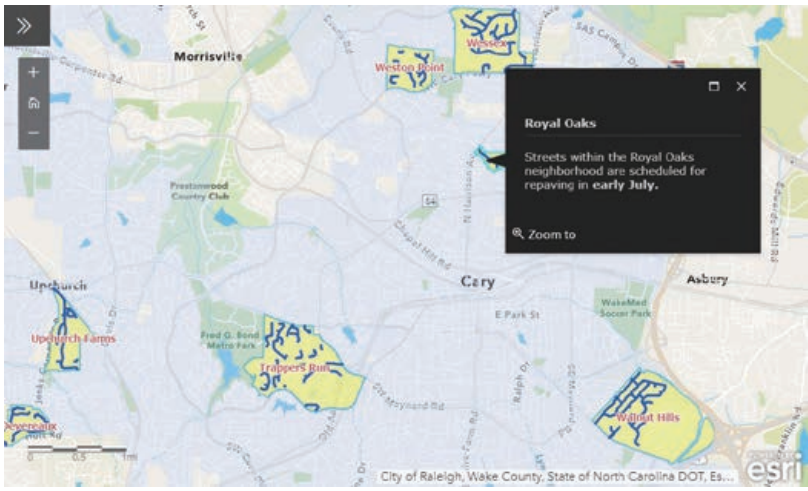
Since implementing the dashboard, the Transportation Department has continued to expand the way this data is viewed and used. Every communication with the public can be augmented with geospatial intelligence. The next effort will be to develop additional geospatial intelligence for Cary's assets, allowing residents to share in the street improvement process for the current year from start to finish.

For more information, contact Coray Davis at coray.davis@townofcary.org.

About the Author

Coray Davis is a civil designer for the Town of Cary. He earned a doctor of engineering degree in civil engineering, focusing on modeling transportation systems and GIS, from Morgan State University, Baltimore, Maryland. He is fascinated with technology and passionate about using GIS and data science to improve workflows and operations in local government.

↓ Cary residents can find out if their street is on the current list for improvements using a public-facing web map.

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Mapping Past Contamination Helps Cities Plan for Renewal

By Sydney Rich

The growing demand in the United States to return to manufacturing and add warehouses to shore up supply chain gaps has made past-industrial land more interesting, particularly in and around the major port city of Bridgeport, Connecticut.

Developers in the area want to take advantage of proximity to both New York City and Boston as well as the connectivity available along the heavily traveled Interstate 95 corridor. But they also know that are bare or run-down sites are unused because they are likely hazardous due to past uses.

"Connecticut has a very rich industrial past, which was great in the early-to-mid-1900s, but it left a significant contamination issue we're still struggling to climb out of," said Matt Fulda, executive director at the Connecticut Metropolitan Council of Governments (MetroCOG). "Bridgeport had Remington and other munitions and heavy industrial activities, which has left a lot of the city undevelopable. Roughly 30 percent of the parcels in the city are vacant or underutilized."

City planners and developers needed a way to understand the opportunity cost of so-called brownfield redevelopment sites, and a smart map helped them see where the turnaround could happen quickly.

MetroCOG created the Brownfields Inventory Site Selector tool to fill in knowledge gaps, using GIS to visualize, analyze, and prioritize sites based on contamination, connectivity, and resilience to climate change.

"We're trying to eliminate as many impedances as possible," said Patrick Carleton, deputy director at MetroCOG. "Getting information out there and accessible makes an easier path forward for redevelopment."

Reconnecting along the Northeast Corridor

Brownfield redevelopment provides a potential win-win-win for municipalities because remediation and reuse address environmental contamination, offer jobs to residents, and generate corporate tax revenue. Removing brownfields has psychological value: it shows that a city isn't mired in its past.

MetroCOG has a history of redeveloping brownfield sites, having secured grants from the US Environmental Protection Agency (US EPA) and state agencies for both assessment and remediation.

"The scale of remediation varies dramatically across different properties," Fulda said. "Some just need a million dollars to remove contaminated soils or building asbestos. Other sites are far more complex, with different industries on the same property over the course of 100 years with all sorts of legacy contaminants."

The first step of assessments involved inventorying sites. Staff got busy gathering background details and adding them to the map. Documents were scanned from municipal and state records, detailing past facilities that occupied each site, the type of contaminants, and where hazardous materials were likely located.

MetroCOG also conducted some spatial analyses to look across the region and see where remediation work would have the greatest impact. Communities around some sites are in areas with persistent poverty as well as education and health disparities that mark the need for environmental justice.

"We've tried to target specific corridors in Bridgeport and Stratford, the two most urbanized and disadvantaged communities and with the most problematic sites," Carleton said.

Next, MetroCOG hired environmental remediation experts to sample and analyze the soil, groundwater, and any remnants of structures to measure contamination and make cleanup plans for priority sites. GIS is a commonly used tool for collaboration on these kinds of projects. It's used to map where the work needs to be done and report where—and to what extent—each site is contaminated.

MetroCOG's Brownfields Inventory Site Selector tool unleashes all the historical records—many of which were previously only available on paper and tucked away in file drawers—and provides access to the latest environmental assessment reports.

Showing Redevelopment Potential

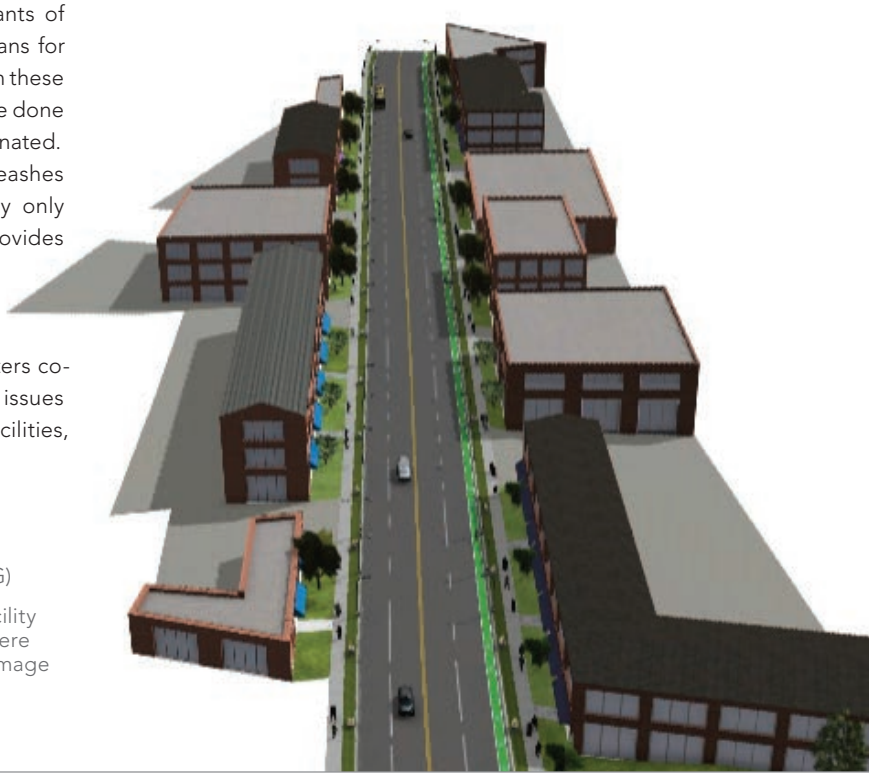
Brownfields aren't the only focus of MetroCOG. It administers cooperative planning in one of nine regions in the state for issues related to land use, transportation, housing, public facilities, open space, environment, energy, and economic development. Increasingly, MetroCOG staff members have been applying and promoting their GIS capacity to the member communities of Bridgeport, Easton, Fairfield, Monroe, Stratford, and Trumbull. This includes creating issue-oriented tools similar to the brownfield site selector and creating 3D visualizations to help city planners visualize the changes they want to foster. With several brownfield sites in the area moving through remediation, planners have shifted from making assessments to selling the transformation.

In Stratford, MetroCOG worked with city planners to visualize different development options for a former metal plating facility currently going through cleanup. Using ArcGIS Urban to visualize the area in 3D, MetroCOG staff created a digital twin of the immediate area. The immersive visualization that showcased several redevelopment scenarios, accompanied by the deep-dive details in the brownfields tool, impressed the US EPA, which chose to showcase the project during its annual brownfield conference.

"The metal plating site in Stratford is next to another site undergoing extensive remediation with the help of US EPA," Carleton said. "They are both close to the interstate and close to commercial and industrial corridors within the town, and the visualization helps the town market those properties."

Meeting Industrial Demands

MetroCOG recently completed a comprehensive economic development strategy for the region that identified industrial space as the



↖ MetroCOG recently completed a comprehensive economic development strategy for the region that identified industrial space as the highest demand for real estate. This abandoned factory is ready for reinvention. (Image courtesy of MetroCOG)

→ These visualizations of the site of a former metal plating facility in Stratford, Connecticut, created using ArcGIS 3D Analyst, were used to generate interest in what could be built on the site. (Image courtesy of MetroCOG)

↑ Developers in the MetroCOG area want to take advantage of proximity to both New York City and Boston but realize many run-down sites are hazardous due to previous uses. (Image courtesy of MetroCOG)

← This ArcGIS 360 VR visualization shows the former metal plating site in Stratford in 3D. (Image courtesy of MetroCOG)

highest demand for real estate. There is a growing interest from companies in the transportation, logistics, and supply chain industries to have their own space, and it's difficult to find that in the region.

With the port, the interstate, and a state highway that originates in Bridgeport and moves north to connect to Interstate 84, the region is well positioned for advanced manufacturing. Defense contractors—such as Sikorsky Aircraft headquartered in Stratford—reinforce the viability of the area for other manufacturers. With more than 300 small-to-multinational manufacturers in the region, MetroCOG and the municipalities it serves are hopeful that new industrial uses will lead to renewal and drive the economy forward.

"Mapping the vacant or underutilized parcels in Bridgeport has helped us work with the city and with developers to prioritize locations for remediation," Fulda said. "We're hopeful those locations will have a cascading effect—to get more properties cleaned up, advertised, and developed so they will attract other developments."

About the Author

Sydney Rich is an account executive on the Esri smart city solutions team, who develops strategies to effectively use GIS technology

and solutions to overcome local government planning challenges at city, county, and regional levels. An urban ecologist by training, she now specializes in applying 3D GIS for planning workflows. Rich supports local governments and regional planning authorities in the Northeast and north Midwest regions of the United States, in Latin America, and the United Arab Emirates.

← MetroCOG used ArcGIS 3D Analyst to create views of the site of a former metal plating facility in Stratford to generate interest by visualizing what could be built there in context.

Expanding Geospatial Capacity in Connecticut

In 2013, the Connecticut Metropolitan Council of Governments (MetroCOG) began its regional GIS program to provide municipalities with a data-driven approach to development.

At the time, the concept of coordinating spatial information across municipalities was somewhat unique. Every town had geospatial data, but it took considerable effort to standardize and integrate it for a regional perspective. By pushing what's possible with GIS, MetroCOG has become a trusted partner, providing data and tools to answer planning, economic development, and land-use questions.

Now, the State of Connecticut is taking a similar approach. In 2021, it hired its first geographic information officer (GIO), Alfredo Herrera, to bring data together for better statewide understanding.

"Across the state, there are 169 towns that all maintain their own data," said Mark Hoover, GIS director at MetroCOG. "The GIO will help standardize and share datasets and spearhead recurring investment in statewide imagery and lidar collection. That's going to make it much easier for municipalities to utilize GIS and developers to work across town boundaries."

As MetroCOG has found with its own GIS capacity building, success in one town can quickly be replicated in others.

"Since the initiation of our regional GIS program, we've tried to almost beta test what the state could do with GIS by showing its impact across our region," said Matt Fulda, executive director at MetroCOG. "We've set out to show state agencies how useful and valuable integrated GIS can be for planning, economic development, land use, and public safety. We continue to show through our actions what can be done when you coordinate geospatial information across municipalities."

Why You Need a Geospatial Community of Practice

By Allen Williams and Sarah Hughan

One of the most effective ways to develop geospatial skills across your organization is to establish a geospatial community of practice (CoP). GIS professionals need to use the power of community to share knowledge and develop thought leadership, and a CoP is one way to do just that. Learn how you can build a CoP that will unlock new possibilities for GIS within your organization.

As we've worked with customers over the last few years to help them design geospatial strategies and governance programs, we've learned that businesses are changing dramatically in terms of what they expect of geospatial technology professionals. The knowledge, skills, and responsibilities of GIS teams are evolving in response to the growing demand for location intelligence.

Today, more than ever, organizations realize the power of real-time monitoring, spatial analysis, and location-based analytics. Organizations that leverage geospatial technology and analysis across many business functions can extract much greater value from their GIS-related investments, and a big part of that value equation is people—namely, GIS professionals.

GIS professionals work with many different areas of an organization. They're increasingly forced to understand various business lines to apply their geospatial knowledge and implement spatial solutions to address unique business problems.

Location is at the center of all community and urban planning practices. Planning professionals determine how, where, and when their designs can have the greatest impact on smart communities and improve the quality of life for residents. GIS professionals help to analyze, visualize, and evaluate the demographic needs of the community, and planners can design and measure the impact of different design scenarios. For GIS professionals to be effective in this example scenario, they must have a working knowledge of urban planning practices and analyze community patterns and trends to offer valuable insight to urban planners.

This is only one example, but in many situations, a well-rounded GIS professional needs geospatial competencies as well as business acumen, management expertise, good communication abilities, and analytical skills. Nurturing the combination of geospatial competencies and business skills is critical for a spatially intelligent organization.

One of the most effective ways to develop these skills across your organization is to establish a CoP—a forum where geospatial technology practitioners (including GIS professionals, information technology staff, and business experts) share knowledge, collaborate on issues, and develop resources for all members to use. The hope is that by engaging and connecting practitioners throughout your organization, you'll have more dialogue on how to effectively use GIS to solve important business problems in ways that nonspatial technology simply can't. Ultimately, the goal of a geospatial CoP is to develop a high level of spatial thought leadership in the organization, which raises the level of geoliteracy and unlocks innovative ways in which GIS can strategically contribute to the organization's success.

Establishing a geospatial CoP takes time, but it can lead to tremendous benefits for your organization. To all members who participate, the community offers the opportunity to collaborate, share ideas and identify challenges. As geospatial adoption increases across the organization, dedicating time to connect with other GIS stakeholders creates an internal network of experts who can share information on how GIS is being used today.

One of the customers we work closely with uses the term GeoExcitement. We love this term and having a CoP can help generate this excitement about geospatial throughout the organization. Sharing successes, celebrating, and innovating together can reinforce positivity within the group and drive your geospatial program forward.

Here are a few of the most common benefits of establishing a CoP:

- It empowers the organization's top GIS talent to act as an authority on geospatial business issues.
- It provides a level of shared accountability and oversight to govern the delivery of a GIS strategy.
- It reduces the risk of losing valuable geospatial-related business knowledge and processes.
- It establishes a focus on improving spatial data integrity and data management practices.

- It promotes innovation and spatial thought leadership throughout the organization.
- It connects the organization's GIS users and leadership groups.

To develop a geospatial CoP, you'll need buy-in from leadership. Identify leaders whose business lines are active in using spatial data, solutions, and services. They have a vested interest in developing the geospatial skills of their people to improve their own operations. With an active and engaged leadership group providing strong support, the CoP is much better positioned as an authority that will define how your organization will maximize the value of geospatial technology, your geospatial processes, and your workforce.

Next, you'll need the proper arrangement of founding members from across the organization. Staff who use geospatial data and solutions in their jobs, ranging from technicians to leadership, should participate. Understand that a CoP shouldn't be confused with the operational GIS team that supports and delivers geospatial services day to day. The power of a CoP is that members can come from a broad cross section of business lines and different levels of the organization. This not only supports collaboration across many department functions but helps tremendously with the outward communication of geospatial practices developed by members.

At first, you may start with a small group of users across various departments and gradually increase participation from others as interest grows. Inviting guests to participate from outside the organization is encouraged, as it would allow your CoP's participants to gain perspectives from others.

Take the time up front to socialize the idea of a geospatial CoP. Gather input on the topics and issues your GIS team and business users find valuable and exciting. To consolidate and organize the information you have collected, we recommend creating a community charter. A charter is a document that outlines important information on the community's purpose, objectives, and scope. It can also describe roles and responsibilities for the community chair, members, and potential working groups; decision-making processes; voting rights; and specific issues for the community to address.

The purpose of the charter is to formalize the levels of authority, the expected outcomes, and how the community will operate. Communities that have established clear, well-designed charters that have been accepted and approved by their organizations' leadership tend to be more successful than those that are informal, which often flame out quickly because of a lack of focus and support.

Once you've established your charter, we recommend reviewing and updating your charter annually as your practice grows and matures. This way, you'll ensure that the community is focused on the most pressing geospatial issues and business problems.

In the first year of your newly formed CoP, start with a narrow mandate and gradually expand the scope of responsibilities as the practice grows and matures. In the beginning, focus on the value and adoption of

To develop a geospatial CoP, you'll need buy-in from leadership.

Strategies to Keep Your CoP Thriving

Here are a few simple tactics that can go a long way to keep your CoP engaged and active:

- Collaborate with local business partners, neighboring municipalities, Native American nations, or First Nations to showcase how they are using geospatial technology.
- Invite vendors to present and showcase what's new with GIS products and technology.
- Connect with local universities or college programs to get invited to GIS student showcases.
- Include time in the schedule to celebrate achievements and success stories.
- Start a mentorship program in the CoP to pair junior staff with more experienced personnel.
- Record presentations to build a library of resources that others can use in the future.
- Register for industry webinars or virtual events, and watch sessions together.
- Rotate the chair role annually to share the administration effort among core members.
- Host sessions in different locations to change the atmosphere and scenery.
- Perhaps even organize a geospatial CoP social event.

Keep things current and interesting. Don't leave it to one person to determine the agenda and spearhead the sessions. Your CoP will struggle if it becomes time-consuming and administratively burdensome for one or two organizers. It's a community, so share the work. Empower all your COP's members to contribute; delegate administrative tasks; and create an atmosphere of learning, sharing, and mentorship.

traditional geospatial patterns of use such as mapping, visualization, and data stewardship. Over time, expand the scope to include more advanced use cases involving asset management, real-time monitoring, and spatial analysis.

Below are a few areas that your CoP can focus on initially. Which one you choose will depend on your organization.

- Focus on the development or execution of the organization's GIS strategy.
- Define a geospatial skills matrix to better understand competency strengths and weaknesses.
- Establish guidelines, procedures, and processes for spatial data management and maintenance.
- Define a list of policies and guidelines that need to be developed by the community.
- Consolidate a list of business needs so the community can plan for new technical capabilities.
- Coordinate cross-community working teams to investigate new industry practices and solutions.
- Monitor and report on the effectiveness of engagement practices, processes, and initiatives.
- Track and promote the long-term benefits realized from geospatial investments.
- Organize a lessons learned repository to harvest insight from past GIS projects.

Over time, your CoP will develop its own culture. As new individuals become introduced to and participate in the community, the dynamics of the group may adjust. That's when your charter will come into play, as it will help you enforce the rules of engagement for the community. Different personalities, backgrounds, and communication styles will be present. However, rooting the community in core values of inclusion, diversity, a sense of belonging, trust, openness, and a shared purpose can help it succeed in the future.

Lastly, one of the most critical success factors is to keep people engaged over the long run. The secret is that you need to keep your CoP's activities fun and relevant. We've all been in those recurring meetings that start strong and become dull when the same agenda is used consistently. Get input on future topics for discussion and collect feedback on sessions to get a sense of what went well and what needs improvement.

Remember that building a flourishing geospatial CoP is a long-term journey. Develop a charter and then use that document as a guide to set agendas, record decisions, and publish outcomes like CoP-endorsed standards that all GIS users across the organization can use and find valuable. Report to leadership on issues, make recommendations, and lead the organization to evaluate new geospatial solutions and services.

Over the long term, a thriving CoP will become the hub of geospatial thought leadership in your organization. Its members will become trusted advisers that collaborate with all areas of the organization to address unique business problems with practical geospatial solutions. The power of our community is what makes GIS such an exciting field to be part of. It's an important job to harness that community and put it to work to make a real difference for your organization.

About the Authors

Allen Williams is a management consultant for Esri Canada. His focus is on helping organizations build transformative geospatial strategies and road maps, with practical steps to maximize the value of location intelligence. Respected as a trusted adviser, Williams has worked with organizations in the public and private sectors to develop long-term geospatial strategies and governance programs resulting in modernization and innovation.

Sarah Hughan is a management consultant for Esri Canada. Her focus is on working with organizations to develop geospatial strategies to grow and mature their GIS program, broaden the adoption of geospatial capabilities, and maximize their investment in GIS. She enjoys collaborating with others and finding new, innovative ways of using geospatial technology. Hughan has more than 20 years of experience assisting organizations in embracing GIS to drive innovation and generate location intelligence.

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Open Data Boosts Community Collaboration

By Nick O'Day

The City of Los Angeles has long been an open data pioneer. It was the first city to launch a site dedicated to exploring, visualizing, and downloading location-based open data, via the city's GeoHub.

Los Angeles' annual Open Data Day, held in March 2022, provided the impetus to catch up with Eva Pereira, the city's chief data officer, and learn about new areas the city is focusing on. There are many new initiatives to address equity and social justice. Geospatial analysis plays a large role in addressing these challenges. *[This interview has been edited and condensed.]*

O'Day: Los Angeles is well recognized as a leading data-driven city. What role does the yearly Open Data Day play?

Pereira: We try to do something new every Open Data Day. This year, on March 5, we hosted a citywide competition to improve the quantity and quality of our open data. We had city departments look at their open data and improve their descriptions, improve their metadata, and—in some cases—publish new datasets.

Last year, we focused the event on the pressing issue of food insecurity in Los Angeles, which was heightened by the pandemic. We partnered with researchers from the University of Southern California's Keck School of Medicine, the L.A. Food Policy Council, and *[we had people]* from L.A. County to talk about the topic. Then we had a hackathon where we shared the data, and participants developed solutions.

O'Day: How do you leverage open data to engage with community stakeholders?

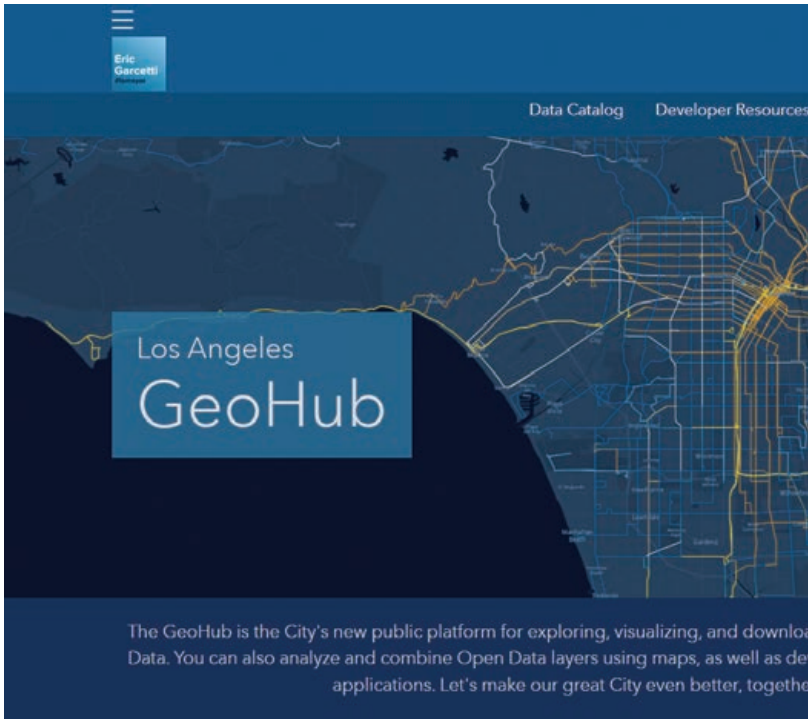
Pereira: I try to get partners involved that are mission aligned. There are problems that the city is trying to tackle, and we have our data, but there are community-based organizations, research institutions, nonprofits, *[and]* advocacy groups that all are trying to solve the same problems. Whenever possible, we bring partners to the table by sharing data and showing our interest in their data. There's a lot of value to be gained by working together with organizations that are tackling similar problems.

O'Day: What are some issues the city addresses using a geographic approach?

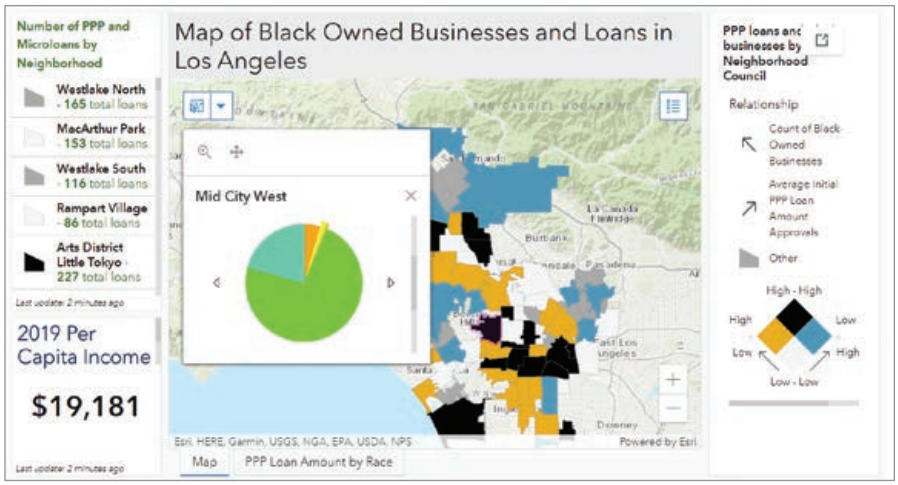
Pereira: For everything from land-use planning to transportation and broadband access, we use geographic data to pinpoint areas of need. This Open Data Day, we gave the Department of City Planning the Department Data Champion Award for updating the data they share publicly through the GeoHub. They share a lot of interesting map-based data around issues such as enhanced bicycle networks. The department has a huge repository of data and maps that they keep fresh, related to zoning, pedestrians, vehicles, and transit.

If we maintain our open data, then we're able to dive into these issue-specific problems and tackle them effectively. It starts first and foremost with departments maintaining what they've posted, publishing new data, and continuing the commitment to open data. Future initiatives are built upon open data.

↓ GeoHub is the City of Los Angeles' new public platform for exploring, visualizing, and downloading location-based open data.



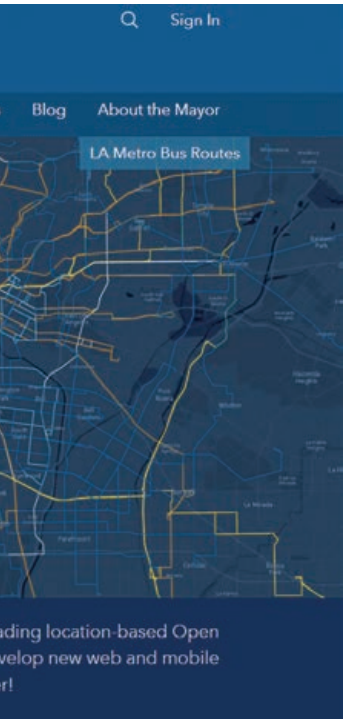
→ This ArcGIS StoryMaps story examines the distribution of microloans and paycheck protection program (PPP) loans made to businesses owned by Black people and other racial and ethnic groups by neighborhood.



O'Day: What are you doing in the area of examining equity?

Pereira: We're currently working on an equity site that explores the history of racial injustice in Los Angeles and connects residents to information and resources related to city services. We've divided it by issue area, such as housing and built environment, economic opportunity, education access and attainment, justice and policing, and health and well-being. It's going to be a great information tool to understand our history and how we got to where we are today. I'm hopeful that residents will use it to connect with resources and get involved.

For another project on health equity, we've used CalEnviroScreen 4.0 data to visualize pollution and health impacts for L.A. neighborhoods. *[CalEnviroScreen is a screening tool used to help identify communities disproportionately impacted by multiple sources of pollution. Its data is updated by the California Office of Environmental Health Hazard Assessment.]* The city is a partner on a NASA air quality grant. Just yesterday we mapped the location of all the sensors maintained by the Bureau of Streetlights and were looking to identify where we need to place more sensors to capture more accurate air quality data. We're very committed to environmental justice, and that's a problem that data can help solve.



O'Day: We've seen a great increase in the use of dashboards to track progress. Has that been a trend for you too?

Pereira: Dashboards are particularly helpful when you want to provide an information tool to policy leaders. We produce a lot of operational dashboards to let them know how a particular issue is trending. We need to understand the baseline and build data collection strategies to see whether we're on or off track. Dashboards help us keep an eye on things and see whether we're hitting the goals that we've set for ourselves.

We create a lot of story maps too, when we want to provide context around an issue, such as improving digital inclusion in Los Angeles, mapping Black-owned businesses and *[paycheck protection program]* PPP loans, evaluating emergency rental assistance, and analyzing equity for capital improvement projects.

O'Day: How would you describe the role of data and maps for decision-making?

Pereira: Data can help us improve city programs, services, and operations and inform policy change. We always start by defining the problem. A problem well-defined is a problem half solved. And from there, we explore the available datasets and the outcomes we hope to accomplish by visualizing and diving into the data.

A lot of our problems can be solved by mapping to pinpoint the areas of the greatest need and then connecting those areas with resources. Our data projects typically fall into three buckets: resource allocation projects, gap analysis, and equity analysis projects.

The city is changing all the time, which is why it's important to have access to quality information and current mapping data. There are a lot of different problems that mapping can help solve.

Learn how GIS users leverage open data to help drive municipal decisions (https://bit.ly/39hE4Ob) and adopt a hub approach. Use these tips to help migrate data to hubs to improve engagement with residents (https://bit.ly/37MziYI).

About the Author

Nick O'Day is a senior consultant on Esri's professional services team. He focuses on helping municipal customers with community engagement and organizational collaboration tools. He enjoys building cool stuff with really smart people using the best GIS tools on the planet. Before joining Esri, he worked as a chief data officer. When he's not working, he's usually cooking, eating, and learning about sunny Los Angeles.

Tips for Managing Members in ArcGIS Online

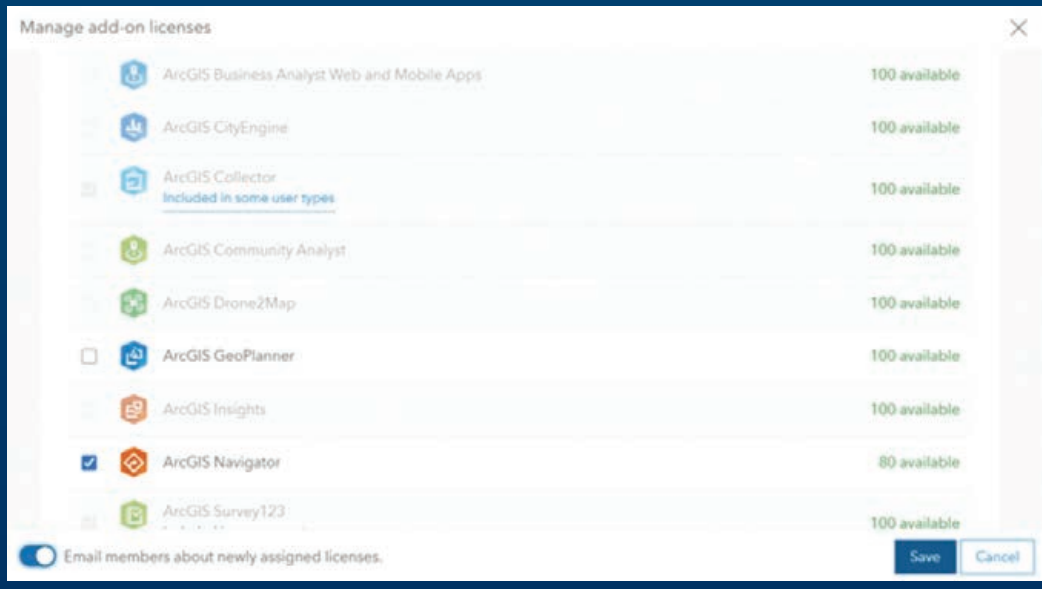
By Jennifer Wrightsell-Hughes

If you're an administrator of your ArcGIS Online organization, member management is likely an important part of your work. To ensure you have enough time for everything on your to-do list, efficiency is key.

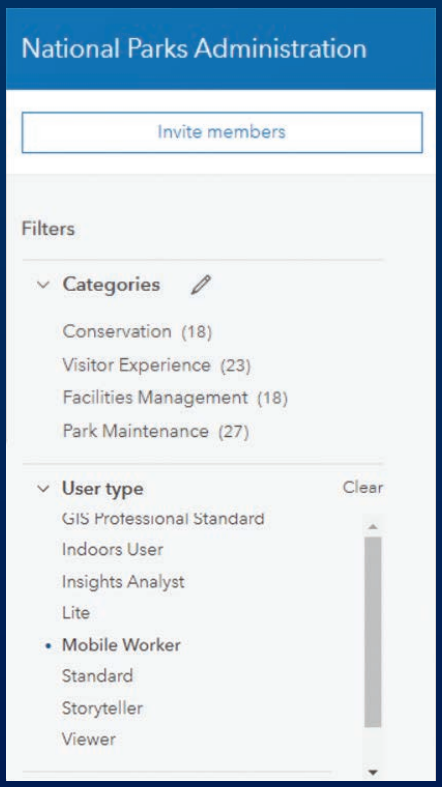
The organization page Members tab provides a central location for managing members. Whether you need to assign add-on app licenses, add members to groups, or perform any other member management task, ArcGIS Online includes time-saving capabilities, such as filters and bulk actions, to help you get the job done.

The following examples illustrate common member management tasks that can be streamlined such as managing app licenses and groups for members with a specific user type, allocating more credits to members who need them, and changing the ownership of items owned by members in a specific member category.

For a demonstration of these capabilities, watch the video *Time-saving tips for managing members in ArcGIS Online* (https://mediaspace.esri.com/media/t/1_zlfmbllx).



↑ Use Groups to assign licenses to members.



↓ Use the filters on the left to find the mobile workers. Under User type, select Mobile Worker to filter the list of members.

Manage App Licenses and Groups

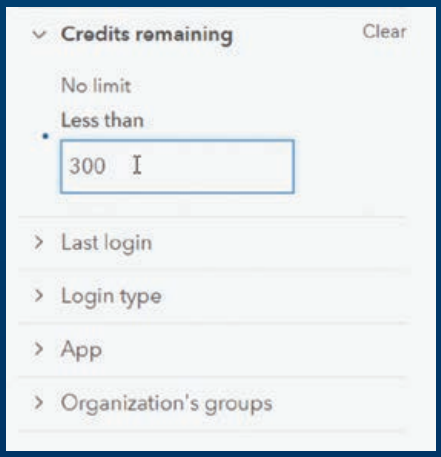
Suppose you want to assign ArcGIS Navigator licenses to the mobile workers in your organization. To get started, sign in as an administrator, click Organization at the top of the site, and click the Members tab to see a list of members in your organization. Now take advantage of the filters on the left to find the mobile workers. Under User type, select Mobile Worker to filter the list of members.

Assign Licenses

With only the mobile workers listed, you can quickly assign ArcGIS Navigator licenses to these members. Check the box at the top to select all the members and click Manage add-on licenses. Find and select ArcGIS Navigator, click Save, and you're done. All mobile workers in the organization now have a Navigator license.

Assign Groups

Now let's say you want to add these members to a group you created for managing mobile staff and data collected in the field. With the mobile workers still selected, go to the More menu, and click Assign groups. Search for the group, select it, and click Save. The mobile workers are now members of the group. In just a few clicks, you assigned Navigator licenses to mobile staff in your organization. You assigned the members to a field collection group.



↑ You can set limits on the number of credits assigned to members.

Managing Credits

Now you can move on to managing credits and allocating them to members who need them. Credit management is a common task for many organization administrators, but it doesn't have to be a time-consuming one.

As members of your organization complete their daily work in ArcGIS Online, the number of credits allocated to them may become low. Before you start receiving a slew of email requests for more credits, you can proactively update the credit allocation for members who are running low.

Again, the filters on the Members tab are your best friends. If necessary, start by clearing the existing filters and selection to return to the full list of members. Now expand the Credits remaining filter. You want to find members who have fewer than 300 credits remaining so you can increase them to 500 credits. Under Less than, type 300 and press Enter to filter the members list. Select all the members in the filtered list using the check box at the top and click Manage credits. Increase the credit allocation and click Save.

Changing Item Ownership

Change the ownership of items owned by members in a specific member category is common task for organization administrators. For example, suppose several interns will soon be leaving your company, but you want to maintain the valuable content they own. Reassigning their content to another owner allows the organization to continue maintaining these items. ArcGIS Online offers an easy way to transfer these items in bulk.

If your organization has set up member categories, you can use them to find the members whose content you want to transfer. Simply choose the member category to filter the list, select the members, click the More menu, and click Transfer content. In the Transfer content window, select a new owner and a target folder for the items and click Transfer. That's all there is to it.

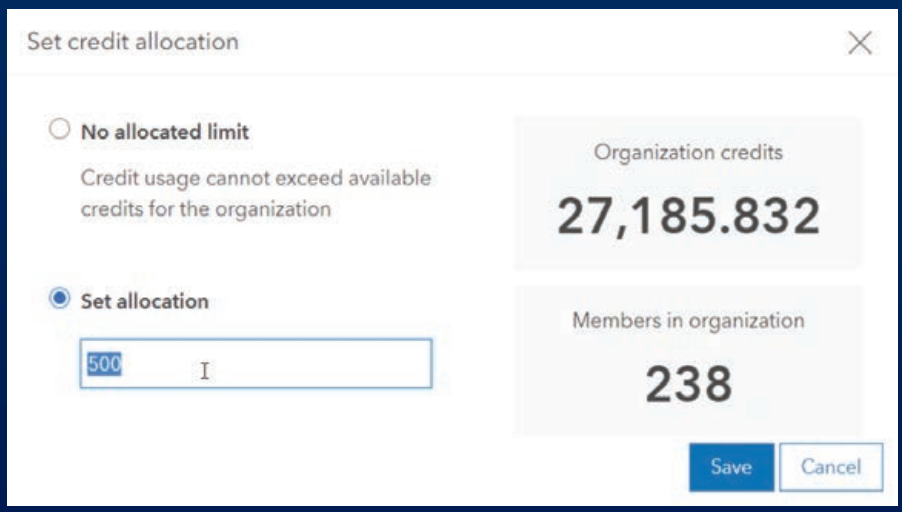
About the Author

Jennifer Wrightsell-Hughes is the documentation lead for ArcGIS Online. She has a bachelor's degree in journalism and more than 20 years of experience writing and editing product documentation, lessons, and other content. In her spare time, she enjoys practicing yoga, painting, and spending time at her cottage.

Learn More

- Watch videos, read blog posts, and take lessons at the Administer Your ArcGIS Online Organization discovery path (https://bit.ly/3P97vlU).
- Download the *ArcGIS Online Implementation Guide* https://bit.ly/3kVWfvC).
- Visit Esri Community (https://bit.ly/3FzS2Hs) to exchange ideas, solve problems, and build relationships with the ArcGIS Online community.

↓ Emails will automatically be sent to members when new licenses are assigned to them.



Testing Geospatial APIs Ensures Performance

By Chad Cooper

Access to data is as important as ever. In the GIS field, data has traditionally been accessed through file system-based methods, such as coverages, shapefiles, and file geodatabases, and through direct connections to relational enterprise geodatabases on engines such as Microsoft SQL Server, PostgreSQL, and IBM Db2. These methods of connecting to data served the needs of a desktop GIS world for decades, but then in the mid-1990s, the information superhighway came along, and everything changed. By the early 2000s, a new era of geospatial data dissemination was dawning: the era of Web GIS.

What Is an API?

The topic of application programming interfaces (APIs) is very broad. APIs enable applications to easily and securely exchange data and functionality. Today, the term *API* typically refers to web APIs. They are a modern approach—using the internet—to provide access to machine-readable data in formats such as JSON or XML, usually over HTTP. Simply put, APIs make it possible for digital services and applications to easily talk to each other.

This article introduces the topic of APIs, why they are important, how they are used in GIS, and why they should be tested. Building and executing tests is a broad topic that is beyond the scope of this article. It could easily be the topic of an entire book. However, this article introduces high-level examples of tests that will (hopefully) engage and interest the reader to pursue more information on the topic.

Why Are APIs Important?

Arguably, APIs have been around since the earliest days of computing. Modern APIs began their rise to stardom in the early 2000s with the commercialization of the internet by companies such as Salesforce, eBay, and Amazon. These pioneers used APIs to make their products and services available to their customers on a single site while also providing partners and third-party resellers with the ability to interact with and extend their platforms. Fast-forward to today and APIs are the backbone of virtually all the digital services people use daily. APIs power desktop applications with data, fetch data from databases for websites, provide the building blocks of mobile applications, and allow for the Internet of Things (IoT) to exist.

Where Do APIs Fit In with GIS?

This brief introduction to APIs highlights the value of APIs in disseminating data. Currently, the world is dependent on the fast and reliable delivery of data. GIS is no different. By effectively eliminating barriers to data dissemination, APIs allow the outgoing delivery and sharing of all types of data both inside and outside an organization while allowing data from outside organizations to be consumed and utilized.

In the late 1990s to early 2000s, GIS data sharing within an organization typically occurred in the form of a digital or printed map. Outside an organization, datasets were either emailed (if they were small enough), transferred via FTP, or transferred using physical media such as CDs or ZIP disks. This was, at times, a painful process.

There were predecessors to Web GIS software, such as ArcIMS. However, in 2004, ArcGIS Server was released with ArcGIS 9.0 and it revolutionized the way GIS data was used both inside and outside of organizations. Web GIS powered by ArcGIS Server allowed maps to be published as services that could be distributed via an API and consumed in web mapping applications that were viewable in a standard web browser. Since then, products such as ArcGIS Enterprise rely on internal APIs for all their constituent parts such as Enterprise portal, ArcGIS Server, and ArcGIS Data Store. APIs provide the foundation for modern Web GIS. Nowhere is the use of APIs more prevalent in ArcGIS Enterprise than in the ArcGIS REST APIs.

Other Uses of APIs in GIS

APIs are not limited to those that come out of the box in commercial off-the-shelf software such as ArcGIS REST APIs or the ArcGIS API for Python. APIs can be built from scratch to serve up virtually any type of data from any source. Although the ArcGIS REST APIs are incredibly powerful and can often serve the needs of most organizations, sometimes additional capabilities are required. In these cases, a custom API can be written in languages such as Java, .NET, or Python and deployed either on premises or in the cloud using methods such as Koop, Flask, AWS Lambda, Azure Functions, or application containerization with Kubernetes. Building custom APIs is a broad topic, and the reader is encouraged to research it further.

Testing APIs

What is API testing? Simply put, testing an API checks its functionality, reliability, performance, and security to ensure that it works as intended. For example, if an ArcGIS Enterprise feature service is configured in a search widget within a web mapping application, users can enter text in a search bar to get results that are displayed on the map.

How can this endpoint be tested to ensure that, for a given search term, the user will get back the intended and correct results?

Searches can be manually executed by a human using the web application search bar, but that's not very efficient. A more efficient, repeatable, and faster method would be to test just the API's REST endpoint by submitting known requests and ensuring that the responses are as expected. This is an example of a smoke test.

Smoke Testing

The term *smoke testing* has an interesting history. Some say it originated in electronics and computer hardware development, where a board passed a smoke test if it was plugged in, and it didn't start smoking and catch fire due to failure. However, the plumbing industry has long conducted smoke tests on systems. Smoke is put into pipe systems and used to find leaks in the system.

Regardless of where the term came from, it is easy to see how it transferred to software testing, specifically API testing. Smoke testing an API checks that its basic functionalities work and that it performs as intended. It allows major errors and flaws to be quickly discovered. Smoke tests are some of the simplest of tests. They are often performed in the postdeployment of an API, sometimes from within continuous integration/continuous deployment (CI/CD) pipelines. Once API functionality has been tested and validated, it's time to put stress, or load, onto the system.

Load Testing

In load testing, demand—in the form of expected usage—is put on a software system. The response of the system is measured to gauge performance and ensure stability before deployment. Unlike smoke testing, which tests whether something works or not, load testing:

- Helps determine if current infrastructure is sufficient for the expected load.
- Tests if the system is sustainable under peak load.
- Allows for concurrent user simulation.
- Allows for scalability testing.

Why Testing Is Important

Generally, testing any software system can determine whether it works. However, *works* is a vague term and doesn't fully describe levels of functionality, and performance. Smoke testing checks for basic functionality while load testing can assist in assessing performance.

Software development continues to evolve and progress at a rapid pace. Developers—like everyone else—are pressured to do more with less. As a result, no one has time for improperly functioning or broken software systems. Testing software, including APIs, identifies flaws and bottlenecks that can be addressed before deployment to other systems and end users.

How Testing Can Be Used in GIS

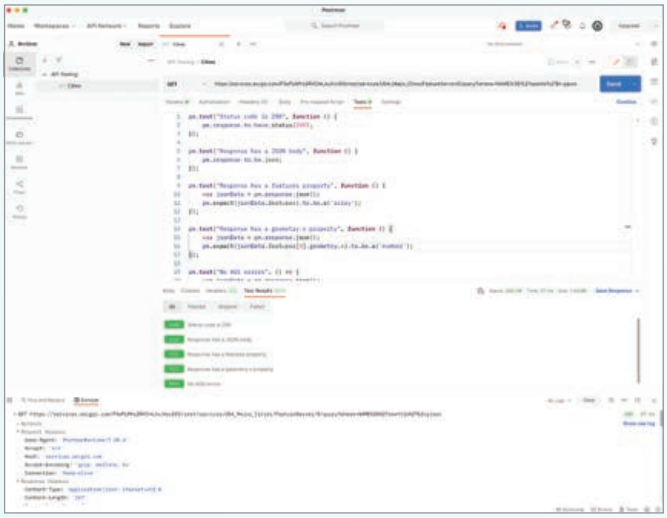
Smoke tests check for basic functionality. Often this is done by testing that a particular API request returns the intended and correct response and ensuring that the API is functional and provides the correct data to applications and end users. This can be accomplished through a variety of methods, ranging from simple manual testing in a web browser to scripted and automated testing.

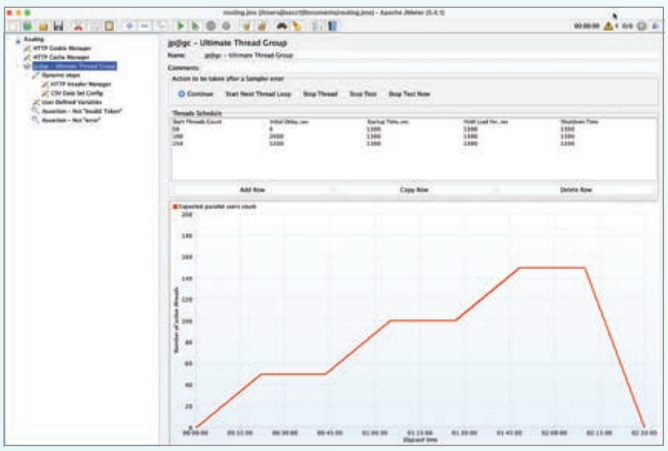
Chances are that many readers have done manual smoke testing in a browser without even realizing it. If you have ever gone to a /query REST endpoint of an ArcGIS Server map or feature service and submitted a query to see if the expected response is returned, you have conducted a simple manual smoke test. For quick ad hoc tests, that is fine, but there are tools that can help make this task easier and more efficient.

There is no shortage of API smoke testing tools available. Some tools are open source, but most tools have free or multiuser and enterprise pricing plans. From a smoke testing perspective, these tools can help organize, parameterize, and automate tests. Many packages are designed around collaboration and allow tests to be shared among users. Some popular smoke testing tools include Postman, Katalon Studio, and SoapUI.

↓ Tests in a Postman request that check for response content, types, and status codes.

↓↓ JMeter load tests can simulate varying user loads and also include assertions that test for response content.





```
https://services.ArcGIS.com/P3ePLMYs2RVChkJx/ArcGIS/rest/services/
USA_Major_Cities/FeatureServer/0/query?where=NAME%3D%27seattle%27&f=pjson
```

↑ Listing 1

```
{
  "objectIdFieldName" : "FID",
  "uniqueIdField" :
  {
    "name" : "FID",
    "isSystemMaintained" : true
  },
  "globalIdFieldName" : "",
  "geometryType" : "esriGeometryPoint",
  "spatialReference" : {
    "wkid" : 102100,
    "latestWkid" : 3857
  },
  "fields" : [],
  "features" : [
    {
      "attributes" : {
      },
      "geometry" :
      {
        "x" : -13616617.948885441,
        "y" : 6039155.5722018136
      }
    }
  ]
}
```

↑ Listing 2

A Smoke Testing Example

For example, when testing a web application that searches a point feature layer of US cities and zooms the map into the area in which the city is located, the where query might look like Listing 1.

Note that the WHERE clause has been URL encoded from where=NAME='seattle' to where=NAME%3D%27seattle%27, because browsers don't like special characters in URLs. When the query in Listing 1 is executed, the JSON response returned should resemble Listing 2.

In a smoke testing framework such as Postman, assertions can be executed against response content. For example, an assertion can test to ensure that there is a feature object within the response and that within features there are x and y geometry values. When automated, smoke tests with assertions are powerful tools that can be used to routinely validate the functionality of a REST API.

Load Testing

While smoke testing verifies API functionality, load testing puts the system under stress to either mimic production user load or exceed user load to test performance, scalability, and robustness. Load testing can also be used to push a system to its limits to see if, when, and why it breaks. This makes load testing very different from smoke testing. Creating effective, realistic, and useful load tests is somewhat of an art form, and it takes experience to master.

Load Testing Tools

There is a plethora of load testing tools available. One of the most popular is Apache JMeter, which was initially released in 1998. It is open-source, platform independent, and highly documented, so it is an ideal tool for both beginners and experts.

In its simplest form, a load test might simulate requests to an API at certain rates over time to stress the system and see how response time is affected. More complex load tests might include simulating users logging in to a site and performing many user actions such as filling out forms. User counts can be ramped up and down to simulate peak usage times.

A Load Testing Example

Use load testing to measure the performance of querying a hosted feature layer on a company's ArcGIS Server instance under user load. Network services, such as routing and geocoding, can also be load tested. Smoke testing or very light load testing with a minimal number of users simulated can provide an idea of optimal response times. Load testing with a higher number of simulated users can help assess performance and determine if current infrastructure can sustain acceptable response times under the stress of additional users.

With a load testing framework, such as JMeter, requests can be configured as tasks to be run by simulated users. For example, it can be configured to simulate a query to a hosted feature layer REST endpoint to measure performance when 50 users are sending one request per second over a 30-minute period. Assertions can be utilized in load tests to ensure that responses meet expectations in both content and response time. Detailed reports can be generated to help analyze results and determine where potential weaknesses exist within a system.

Integration with Development Pipelines

Smoke tests can be integrated into many CI/CD pipeline systems such as those available with Amazon Web Services, Microsoft Azure, or even Jenkins, although for many smaller organizations this may be out of scope. In a CI/CD pipeline, smoke tests can be run after code deployment, ensuring that no unintended consequences arise. The code referenced here does not necessarily have to be API code. It can be code that calls or is dependent on an API. If the smoke test fails, the pipeline can even be configured to roll back the deployment to a previous working version, thus minimizing user impact and disruption.

Best Practices

API test suites can range from simple to incredibly complex.

Regardless of the type of tests being performed or their complexity, there are a few simple best practices that can always be followed.

Perform negative tests along with positive tests. While it's important to know that the API returns correct, valid responses as expected, it's also important to know that it should fail when expected. Test to ensure that invalid requests yield the proper expected responses.

Smoke test early in the development process. The earlier testing begins, the sooner bugs can be caught and dealt with.

Always try to simulate production conditions. Although this might seem like a given, simulating production conditions and/or loads can be very challenging. It is easy to get caught up in configuring clever tests and lose sight of the bigger picture. Don't fall into this trap.

Save and track responses. The requests made are important, but so are the responses. As an API matures and changes over time, so will requests and responses. Requests are easier to track, as they are often embedded in the tests. Responses are not, and they are ephemeral and easy to forget. Save responses with their related tests.

Enforce service-level agreements (SLAs) during testing. If an organization has defined SLAs around API response times, those should be enforced during testing to ensure response times are within acceptable ranges.

Think like a consumer. Don't waste time creating tests that aren't realistic. Try to mimic how user actions will impact the requests made to and usage of the API.

Conclusion

Access to data today is paramount in any system, regardless of size. In a Web GIS, that access happens via APIs. Knowing that APIs are properly deployed, configured, and tuned ensures that users get the data they want, when they want it. Smoke tests verify that an API is returning expected results. Load tests assess performance and scalability. Having a suite of tests available to run on an ad hoc basis—or perhaps on a set schedule—to monitor functionality and performance will keep the APIs that power applications across an organization healthy, performant, and reliable.

For more information, contact Chad Cooper at chad.cooper@jbhunt.com.

About the Author

Chad Cooper has worked in technician, analyst, developer, and engineering roles in the geospatial industry for the last 19 years. For the past 3 years, he has been with J.B. Hunt Transport, Inc., one of the premier transportation and logistics companies in North America. He is the author of *Mastering ArcGIS Enterprise Administration*, available from Packt Publishing. When he is not working, he enjoys spending time with his family, fishing, and reading.

New Certification Validates Developer Expertise

In a world seemingly run by apps, both developer and GIS skills are in high demand. Developers are an important part of the ArcGIS user community because they deliver geospatially enabled apps and solutions that reach people who have no idea what GIS is or that they are using it. A new certification from Esri validates the combination of developer and GIS skills.

The ArcGIS Developer Foundation exam is designed for non-GIS and GIS application developers who have at least two years of experience creating apps that interact with ArcGIS application programming interfaces (APIs) and system components. The exam covers a range of useful topics on development in the ArcGIS environment. The ArcGIS Developer Foundation exam consists of 65 multiple-choice questions that measure the knowledge and skills required to create apps, display 2D and 3D maps, and publish and manage content. The exam also measures understanding of ArcGIS user roles, authentication, and service types.

To help developers considering certification, Esri Academy provides an exam information guide (https://bit.ly/39BRqFh) to assess whether this certification is a good fit for their skills and experience. The guide lists the specific tasks and tools that exam takers should know and (just as important) what they don't need to know to be successful. Candidates for the exam can use the guide to identify knowledge gaps and skills that need refreshing so they can effectively prepare for the exam. The Esri ArcGIS Developer Foundation 2201 learning plan (https://bit.ly/3MKwR7K) contains a mix of self-paced e-Learning resources on topics covered by the exam.

Certification provides a competitive advantage for those seeking professional growth opportunities. Esri technical certification exams are delivered at Pearson VUE test centers worldwide and online using Pearson's OnVUE option. To view full exam details, access the ArcGIS Developer Foundation exam information guide at go.esri.com/eadf-certification.

ArcGIS SDKs Help Realize a Passion Project

By Richard Yumang

Karyn Nolan began working in the geospatial mapping space nearly two decades ago as the owner of Pacific GPS. Her Hawaii-based company focused on creating GPS and GIS solutions for clients that ranged from Trimble to the US Air Force Civil Engineer Center.

After 17 years, Nolan sold Pacific GPS, but she never lost her interest in geospatial mapping. She wanted to create an application that would let winter sport enthusiasts easily find their friends and family on the slopes, so she decided to attend the 2019 Esri User Conference. There, she met Esri developer consultant Josh Peterson. The two discussed the logistics involved in bringing Nolan's idea to life.

She remembers their fateful first meeting. "He outlined the specifics of how to develop the app in a way that felt doable, so it began to be more than just a vision," she said. With the support of Esri Services, Nolan and her team began developing Snow Mappy, the proof-of-concept application for her company Mappy, a startup partner in the Esri Partner Network.

While Nolan always planned for her new app to provide data analytics, the primary goal for Snow Mappy was to create a user-friendly tool that put the power of geospatial mapping in the hands of winter sport enthusiasts. However, implementing ArcGIS Runtime SDKs into an easy-to-use app would be a challenge. Nolan needed developers with experience in a variety of technologies. She again looked to Esri and connected with its Startup program. This gave Nolan access to exclusive support from the Esri team, discount rates on Esri products, and contact with third-party partners experienced in providing custom solutions built with various ArcGIS Runtime SDKs.

Nolan hired FreshWorks Studio to develop the user experience and deploy the app. As the 2020 ski season approached, the Mappy team had an issue that could drastically impede their expected launch: the app crashed when a user switched between 2D and 3D maps or between different resorts. In some instances, the only solution was to reinstall the app entirely.

Peterson and the Esri developer consultant team connected Nolan to a longtime Esri partner, GEO Jobe. "The ski seasons are a fixed point in time each calendar year. So, the release dates are very much dictated by when the skiers are actually going to be on the mountain," explained Eric Goforth, director of professional services at GEO Jobe.

"Part of the reason I was able to make headway was the Runtime team itself," said Goforth. He worked with Nicholas Furness, one of the Runtime SDK product managers, to provide the Runtime engineering team with the information needed to identify the cause of the crashes. The team was able to implement a fix and deliver a preview version of the next ArcGIS Runtime SDK release for Mappy to use. With Esri's cooperation, Mappy was able to test its app with the new version of Runtime, solve the crashing issue, and—most importantly—launch as scheduled.

Nolan continues to work with her partners at GEO Jobe, FreshWorks Studio, and Esri to bring more ArcGIS-based solutions to her users. In early 2021, Snow Mappy launched at resorts in the United States and Canada. The beta app was a success, with nearly 1,500 downloads on iOS alone and 7.5 million real-time data points collected from anonymized users. Nolan and her team have used

this ski season to refine their process for building customized datasets for specific venues, and they hope to apply this approach at hundreds of mountains.

Nolan plans to work with her partners to develop an overlay that will help skiers and snowboarders avoid slopes that are too steep or too flat. Also, Mappy will soon provide indoor mapping as well, using Bluetooth sensors in large buildings. Snow Mappy has proved to be a valuable asset for data analytics, which Nolan has used to form partnerships with ski resorts. But that's only one part of her vision for Mappy. "We work with the venues to work with the consumers," she said.

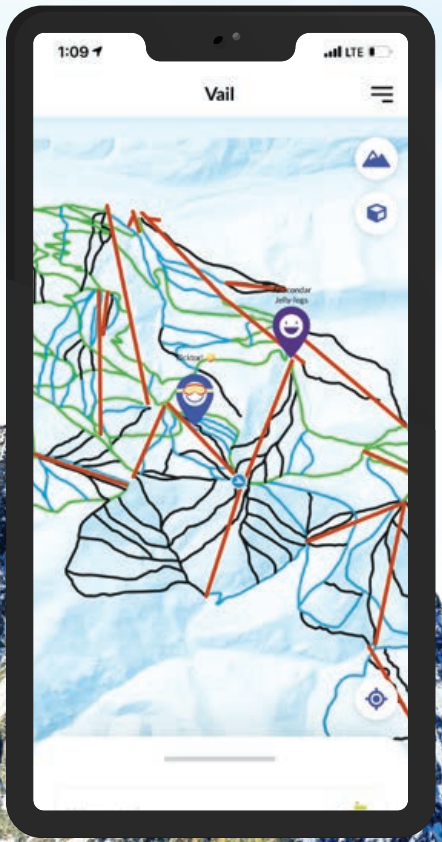
For Nolan, getting geospatial technology into the hands of people who would not be considered GIS experts is very exciting. "I love that guests are getting exposure to these cool 2D and 3D maps and to the Esri world," she said. "I think that *[ArcGIS]* Runtime has really allowed Esri technology to get into the consumer space."

Snow Mappy uses ArcGIS Runtime SDK for iOS and is written in Swift and uses the SwiftUI framework. It provides functionality such as 2D and 3D mapping, geocoding locators, and routing. There are plans for more overlays and web mapping. Snow Mappy makes use of local mobile map packages (MMPKs) and mobile scene packages (MSPKs) but will soon move toward an online system. Nolan has successfully leveraged a wide array of Esri's geospatial tech into what she calls her "passion project," a user-friendly app for "finding my husband on the mountains."

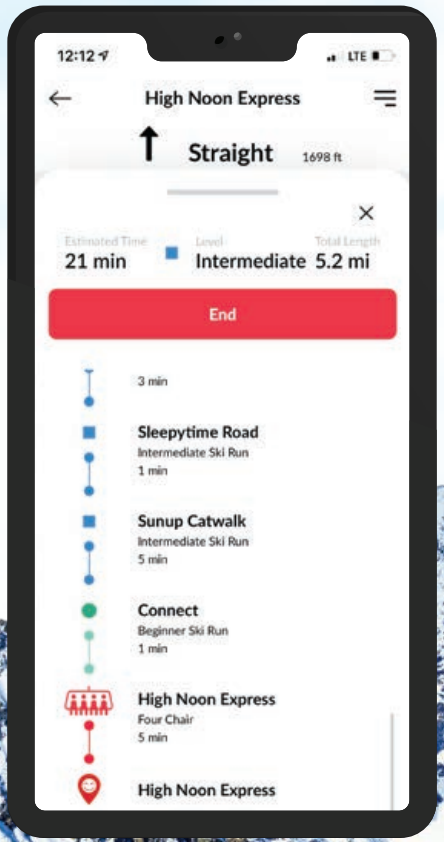
About the Author

Richard Yumang is a senior product marketing manager at Esri and is responsible for marketing ArcGIS developer technology, specifically ArcGIS APIs and ArcGIS Runtime SDKs.

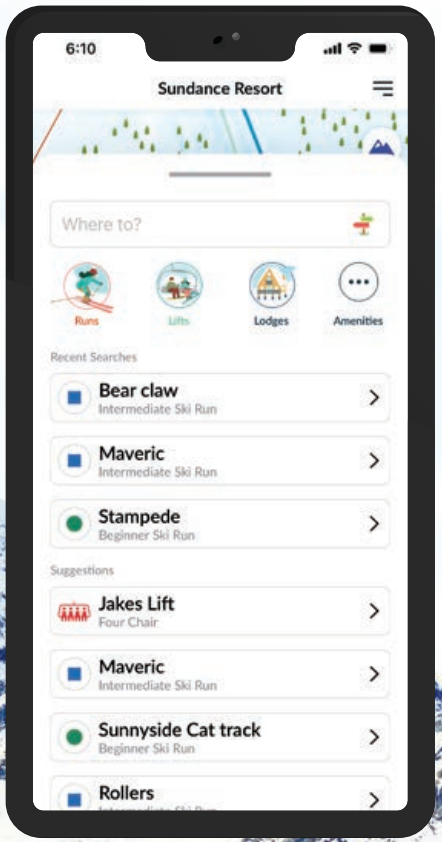
↓ Karyn Nolan wanted to create an application that would let winter sport enthusiasts easily find their friends and family on the slopes using interactive 2D and 3D maps.



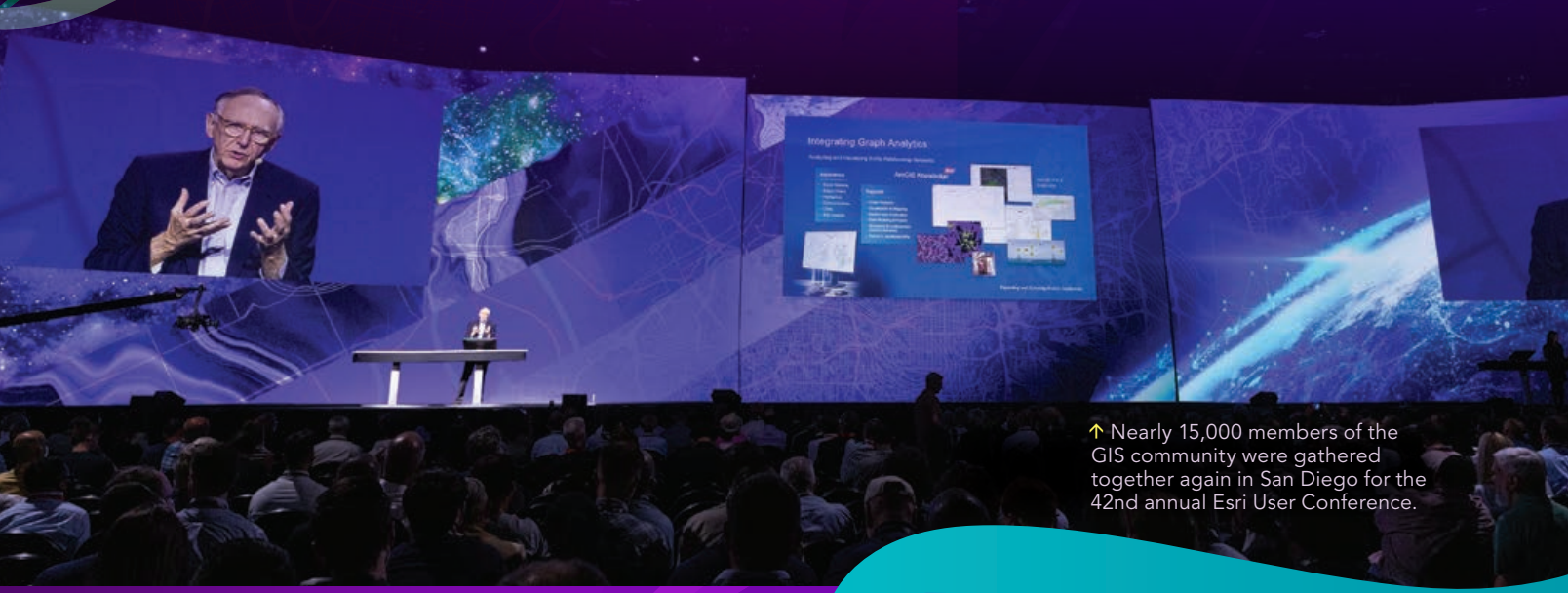
↓ Turn-by-turn navigation in Snow Mappy ensures that skiers and snowboarders stay on routes that match their skill levels.



↓ The user specifies a skill level, and Snow Mappy suggests appropriate runs.



MAPPING THE FUTURE WE WANT



↑ Nearly 15,000 members of the GIS community were gathered together again in San Diego for the 42nd annual Esri User Conference.

After a pandemic-induced virtual hiatus, the Esri User Conference (Esri UC) was back as an in-person event with nearly 15,000 attendees in San Diego, California, as well as approximately 16,600 virtual participants.

Although the size of the conference has grown substantially from the 11 people who attended the first Esri UC 42 years ago, its goal has remained the same: bringing the GIS community together. This year, users from 142 countries were joined by more than 2,100 Esri staff members to reconnect, share work, and celebrate achievements. *(Read more about the awards given for the work of exemplary organizations in "Addressing All Our World's Challenges," another article in this issue.)*

After displaying more than 200 user maps and discussing examples of the outstanding GIS work done by organizations across the world, Esri president Jack Dangermond turned to the theme of the conference, GIS—Mapping Common Ground. He noted that as people attuned to geography, the audience had a special appreciation of the world as "a complex and highly interdependent ecosystem" that is rich in biodiversity but fragile in many aspects and is not well-known and even less understood.

Increasingly dominated by "the human footprint," the Earth is threatened by human-induced climate change, overpopulation, congested cities, and pollution. Dangermond emphasized that our lack of understanding and our failure to collaborate are the biggest obstacles in dealing with these urgent threats to the Earth and our life on it.

However, he sees mapping and the geographic approach as a powerful means for creating understanding, exploring alternatives, finding solutions, and reaching agreement. Mapping common ground is the foundation for positive action. It requires considering all factors. He views mapping as a fundamental language that lets us tell stories about the world as it is today *and* the future we want to see.

By enabling the geographic approach, GIS is a powerful system for creating understanding, exploring alternatives, collaborating to find solutions, and achieving consensus. Dangermond listed just a few of the many areas in which GIS professionals are applying the geographic approach. Their work is needed now more than ever and there is no time to wait.

"You are being called upon, at this most critical point in human

civilization, to provide the language, to provide the solutions, to provide the methods, and to provide the fundamental infrastructure to help civilization find common ground," he said.

Taking on Climate Change

"I've got one wicked problem to talk to you about in the next few minutes and that's climate change. It's real, it's here, and it's scary," said special guest David J. Hayes. The special assistant to the US president for climate policy at the White House, Hayes asserted that, "Geospatial mapping tools may be the most important weapon we have to fight against climate change." Hayes emphasized that we need to know not only the current conditions but anticipate and shape the future. "The stakes here for climate couldn't be higher," he said.

Working with the federal government, Esri is building a prototype online portal that will provide a central hub for climate-related information, including links to funding sources, climate indicators, and policy maps. US President Joe Biden has also signed an executive order that directs the Department of the Interior to take steps to preserve 30 percent of the US landmass and 30 percent of its ocean by 2030 to safeguard biodiversity.

The need to address climate change and preserve biodiversity were also the themes of Wade Crowfoot, secretary of the California Natural Resources Agency, who spoke at the Plenary Session for the second time. "Climate change is on the march," he said, underlining the urgent need to deal with fallout from climate change and the drastic decline in biodiversity.

He sees GIS as a powerful tool for improving conditions. "While this can be very discouraging, solutions abound," said Crowfoot. To describe the solutions that the state is pursuing, he was joined by Nathaniel Roth, chief science and data adviser for the California Department of Conservation. Roth explained the partnership between California and Esri in creating CA Nature (www.californianature.ca.gov). CA Nature is a repository of public data, map applications, and interactive viewers that have been created to support the 30 x 30 California program to preserve 30 percent of the landmass and 30 percent of the coastline by 2030.

See the companion article, "From Challenge Comes Change," in this issue to learn how the Federal Emergency Management Agency (FEMA) is joining with other organizations in using GIS to respond to natural hazards.

Storytelling as a Bridge to Understanding

Jill Tiefenthaler opened the second portion of the Plenary Session by emphasizing that by combining engaging storytelling with the geographic approach,"we can have a profound impact on the world." Tiefenthaler is the chief executive officer at the National Geographic Society, a 134-year-old publication that is famous for storytelling using words, photographs, and maps. The National Geographic Society and Esri have had a long and productive partnership based on their joint recognition of the importance of storytelling in building understanding and promoting needed change.

Tiefenthaler leads the global community of National Geographic Explorers such as Ronan Donovan, a keynote speaker at Esri UC who followed her on the stage. Donovan described the eight years he spent in a remote area of Wyoming studying wolf packs. Using data from the GPS collars worn by the wolves, he mapped their travel and hunting patterns to learn where humans and wolves will likely come into conflict.

His project aims to develop strategies for wolves and people to coexist. After relating stories about the years he has spent in close

← Special guest David J. Hayes, special assistant to the president for climate policy at the White House, addressed the Plenary Session audience on the threat of climate change and the value of GIS in combating it.

→ National Geographic Explorer Ronan Donovan described how he used GIS to map the movements of wolves to better understand how to avoid human-wolf conflict.

contact with wolves, he urged GIS professionals in the audience to collaborate with him to expand the project. Learn more about his work through his ArcGIS StoryMaps story, "Human-Predator Coexistence Project" (https://bit.ly/3bhQgQf).

A Comprehensive Geospatial System

Throughout the Plenary Session, Esri staff introduced new products and demonstrated the additional capabilities of ArcGIS, an integrated technology ecosystem that provides support across many industries and multiple communities including GIS professionals, users of imagery, and developers. ArcGIS is available on premises, in the cloud, and on mobile devices. It supports three fundamental types of systems—a system of record, a system of engagement, and a system of insight—that can be interconnected to form a geospatial infrastructure.

ArcGIS StoryMaps has been an enormously popular method for organizations to communicate information in an engaging way. With the release of StoryMaps, which was announced at Esri UC, individuals now have an easy way to visually tell their personal stories and share them on social media.

Two new products announced at the conference highlight how the analysis capabilities of ArcGIS have been extended to improve understanding and inform decision-making. ArcGIS GeoAnalytics Engine is a standalone product for the spatial analysis of big data in the cloud using the power of distributed processing with Spark.

Another product, ArcGIS Knowledge, blends graph and spatial analysis to solve complex geographic problems using spatial and non-spatial data. This hybrid approach can be applied to understanding complex topics such as criminal activities, consumer spending habits, or the supply chain to drive more informed, data-driven decisions. Both new products demonstrate that more data and more types of data can be included to improve analysis and enhance problem-solving.

In addition to many product demonstrations, representatives from the European Laboratory for Particle Physics (CERN); Egis; the City of Sioux Falls, South Dakota; Energy Queensland; Massachusetts Department of Transportation (MassDOT); and the Jane Goodall Institute gave presentations on their work during the Plenary Session.

The Time Is Now

Dangermond challenged the audience to make a difference at this crucial time, saying, "You *[GIS professionals]*, what you do, and how you do it matters. No one else understands like you do or is equipped to provide the solutions you can. You are privileged and you are being called upon at this most critical point in human civilization to provide the language, methods, and infrastructure for helping the world find common ground. History will judge all of us … based on our success."

Watch videos from the 2022 Esri User Conference from the Plenary Session at https://bit.ly/3JiSdZf.

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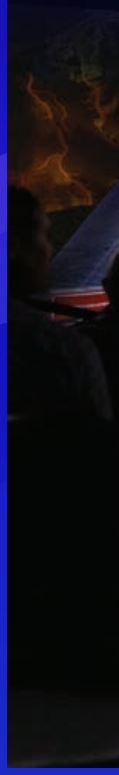
FROM CHALLENGE COMES CHANGE



"The nation needs you. My goal today is to empower all of you ... empower you to see yourself as part of that mission to build a more prepared and resilient nation," said Deanne Criswell, who gave a keynote address at the 2022 Esri User Conference (Esri UC).

Criswell, who became the administrator of the Federal Emergency Management Agency (FEMA) just last year, has been working in emergency management at all levels of government and in the private sector for 27 years. In the United States, FEMA is at the tip of the spear, coordinating the nation's response to the increasingly ferocious impacts of climate change that are evidenced by more frequent and extreme weather events and other natural disasters.

As Criswell noted, the wildfire season on the West Coast has turned into a year-long threat. She recited a roll call of recent fires, floods, hurricanes, tornadoes, and heat domes that have broken records in terms of their severity and destructiveness. She displayed a map showing the frequency of disaster declarations since 2000. It clearly illustrated that while no region has escaped harm, some sections of the country have been repeatedly hammered by disasters. Clearly the risk landscape is all inclusive.

"No one in this room is immune. Every community has been experiencing natural disasters and threats like we have never seen before," Criswell said.

These impacts are borne by communities, but they fall especially heavily on underserved populations. These people can be more vulnerable because of where they live and the limited resources that are available to them. In response, equity is the foundation of FEMA's emergency management approach. The agency is harnessing the diversity of its workforce, removing barriers to programs, and emphasizing people first to create equitable outcomes with the goal of "becoming the FEMA our nation deserves." FEMA programs will lead climate resilience efforts through educating its managers and helping communities become hardened against disasters.

"We have to embrace that our world is changing around us. We have to be better prepared for the threats of the future because our landscape is changing," said Criswell. "Time is our most precious commodity, and the time is now."

FEMA is using GIS now to help plan for that future. The predictive capabilities of GIS have never been more important in helping the agency get ahead of the threats it faces and acquiring the data needed to identify risks and drive its decisions. Criswell displayed the FEMA Risk Index Map, which provides what she characterized as a "30,000-foot view of what is going on." It maps data on the risk level for various natural hazards, anticipated losses, social vulnerability, and community resilience on the county and census tract levels.

It will take more than the dedicated efforts of the agency. "FEMA cannot do this alone," said Criswell. "This is about mapping common ground."

Fortunately, one of the strengths of the emergency management community is its reliance on partnerships to bring experts together to share information and collaborate to solve problems. However, with the scale of current challenges, person-to-person collaboration will not be enough. Digital interactions are required to respond with the speed that is necessary.

> "If there is anybody that can help us solve these types of tough problems, it's everybody here in this room."

↑ Deanne Criswell, administrator of the Federal Emergency Management Agency (FEMA), gave a keynote address that urged conference attendees to "keep innovating and creating" to meet the challenges of climate change.

The FEMA Geospatial Resource Center, a hub site, answers that need. It enables federal agencies and private and nonprofit organizations to contribute their data before, during, and after disasters to help FEMA make decisions that are based on the best data and analysis.

Predictive data and models shared by agencies such as NASA ensure that FEMA is not just solving problems based solely on historical data but is looking at developing trends to strategically invest resources where they will be most effective in mitigating the impact of disasters. "We have to use this information to build a stronger, more resilient nation," said Criswell.

In emergencies, rapidly identifying who has been affected and where they are can save lives and speed the delivery of aid. Assistance teams from FEMA can be deployed accurately to people in need and proactively register them for assistance. Geospatial intelligence helps FEMA deliver its services to the people who need them where they are, instead of making them navigate the federal bureaucracy to obtain aid. Criswell advocates this approach because "in the end, it's all about people."

In concluding her address, Criswell called on the Esri UC audience to contribute their ideas, passion, and creativity to efforts—not only in the United States but around the world—in dealing with the effects of climate change.

"This room is full of the brightest minds. If there is anybody that can help us solve these types of tough problems, it's everybody here in this room," said Criswell. "I ask you this: Keep pushing the boundaries, keep innovating and creating, so we can save the most lives and protect the most property, and we can create sustainable communities for generations to come. Remember, from challenge comes change, so let us begin."

ADDRESSING ALL OUR WORLD'S CHALLENGES

After welcoming the nearly 15,000 attendees to the first in-person postpandemic Esri User Conference (Esri UC), Esri president and founder Jack Dangermond highlighted the work of the user community.

"This group is amazing. You are working on all the great challenges that our world is facing," said Dangermond.

Users and their work are what this event has always been about. Dangermond displayed more than 200 maps from across the user community, chosen from the thousands of maps that had been submitted. They showed how GIS is being used to address the world's most vexing problems across dozens of industries and disciplines.

Highlighting the exceptional work of GIS professionals through presentations and awards is a big part of Esri UC. This year, more than 150 organizations from around the world were honored with Special Achievement in GIS (SAG) Awards. This select group represents just one-twentieth of one percent of the organizations that use Esri technology. Although a separate ceremony was held later in the week to make individual presentations, Dangermond asked members from SAG award winning organizations who were present in the Plenary Session audience—as well as representatives from organizations that were SAG Award winners in 2020 and 2021—to stand and receive the applause of their peers.

In addition to sharing and showing the valuable work of GIS professionals in government, business, research, and educational organizations, Esri UC is an opportunity to present several major awards for outstanding work.

The Making a Difference Award

The first major award presented—the Making a Difference Award—recognizes the use of GIS to contribute to a better world. The Southern California Association of Governments (SCAG) was chosen to receive this award for its pioneering work in government-to-government collaboration, which has brought 192 governments together.

An early adopter of GIS, SCAG has long been recognized as a leader in data-driven planning. SCAG's Regional Data Platform (RDP) truly enables regional planning. RDP improves access to authoritative data, modern GIS tools, and standardized workflows for nearly half of California's population and the largest metropolitan planning organization (MPO) in the United States. SCAG's mission is developing long-range transportation plans and strategies for sustainable communities that support regional growth. RDP represents the implementation of geospatial infrastructure at scale.

"SCAG's mission is to be a catalyst for a bright future, and this paves the way for that," noted Jan Harnik, president of SCAG and the mayor of Palm Desert, who was one of the SCAG representatives accepting the award.

The Enterprise GIS Award

Dangermond described the recipient of the Enterprise GIS Award as "one of the most sophisticated mapping organizations that I have ever encountered. They have a database of a half a billion features that is updated 20,000 times a day." David Henderson, the chief geospatial officer at the Ordnance Survey (OS) in Great Britain, accepted the award on behalf of the more than 1,200 people who make up the team responsible for mapping at OS. "Every day we come to work to try to create great data. Data starts the journey of a great GIS," said Henderson.

This award honors organizations that have increased efficiency, collaboration, transparency, and engagement between internal and external stakeholders. OS, which is Britain's national mapping agency, has revolutionized how it delivers data to support its customers. Its Geospatial Production Platform (GSPP) is key to

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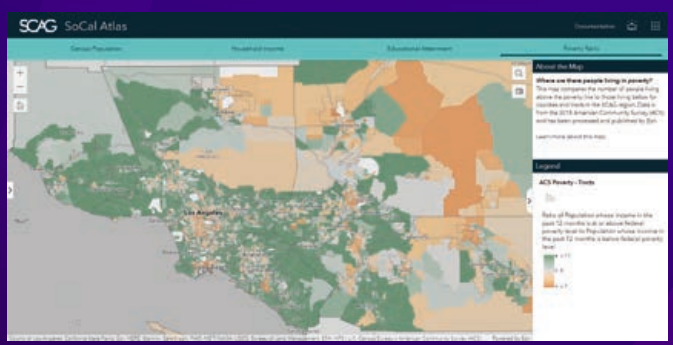
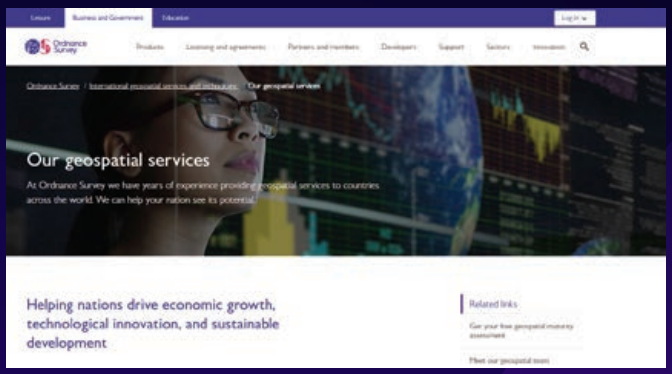




↑ The Ordnance Survey (OS) in Great Britain received the Enterprise GIS Award for its efforts resulting in increased efficiency, greater collaboration, transparency, and engagement from its internal and external stakeholders.

the organization's digital transformation program. This program has reduced the cost of data capture by 67 percent and the time required for updates from 40 days to 2– 5 days. End-to-end supply chain costs have been cut by 40 percent. The GSPP program is a model that other national mapping agencies can emulate in their digital transformation efforts.

The President's Award

The final major award presented during the Plenary Session is one that is personally chosen by Dangermond. It is the highest honor given to any organization that uses data-driven decision-making to impact the world in a positive way. In 2022, the Prague Institute of Planning and Development (IPR Prague) was the award's recipient.

IPR Prague uses GIS in its urban planning efforts to deal with the challenges caused by climate change and the lack of affordable housing. It created a public portal that provides greater visualization and analytics to guide municipal planning through digitally transforming the process to focus on sustainable solutions. Before making any changes, IPR Prague uses GIS and satellite imaging to analyze conditions and determine where actions can make the most positive effect. After implementing mitigating actions, it uses these technologies to measure the effectiveness of its efforts.

"We believe that through our actions we can make Prague a better place to live," said Jiří Čtyroký, the director of the Spatial Information Section, who was one of the representatives from IPR Prague who accepted the award. The other representative was Ondřej Boháč, director of IPR Prague, who noted that Prague is a major tourist destination, visited by eight million people annually. He invited everyone in the audience to visit Prague, "not only because it is one of the most beautiful cities in the world, but the point is that if you all come, we will definitely get more money for GIS."

Dangermond explained that the work of IPR Prague embodies this year's conference theme, GIS—Mapping Common Ground. "But what touches me is that these people—bottom up—did the little things. They planted trees, got the commitment ... they found common ground," said Dangermond.

While each person might interpret the conference theme in various ways, Dangermond emphasized a specific message. "The way I think about it is that mapping is not making maps but mapping as a strategic activity. To create common ground, we have to create an agreed-upon understanding." He believes this agreed-upon understanding is the foundation for positive action.

↑ The Prague Institute of Planning and Development received the President's Award for its use of GIS in its urban planning efforts to deal with the challenges caused by climate change and the lack of affordable housing.

← Ondřej Boháč and Jiří Čtyroký of the Prague Institute of Planning and Development accepted the President's Award.

Balance Privacy with Accuracy with Blur Mapping

By Diana Lavery

You may have heard that data from the 2020 Decennial Census has been protected using differential privacy and have questions about mapping this data.

The US Census Bureau's twin aims of ensuring both privacy and accuracy are inherently in conflict. This is especially true with the increasing availability of advanced computing and data linking. The Census Bureau protected the privacy of the 2020 Census by applying differential privacy through injecting noise into the data and doing additional data processing. In short, the trade-off in the 2020 Decennial data is that census respondents' data will be more private, but individual values at the lower levels of geography will be less accurate.

What Does This Mean for Census Data?

Think of a pointillist painting. At the individual brushstroke level, the painting makes no sense. But when you stand back and can view all the points in the painting, the picture becomes clear.

The Census Bureau "fuzzed" data at very low levels of geography—such as block, block group, and tract—to protect respondents' privacy. Census guidance on working with this data is simple: aggregate up.

What Are Layer Effects?

Layer effects bring Photoshop-like capabilities to the layers in web maps. Some examples of effects are bloom, drop shadow, hue rotate, and sepia. One effect that I find useful is blur. Blur defocuses or softens feature edges. It was originally designed to soften edges of a polygon when mapping data—such as the range of grizzly bears—that lacks a precise boundary or has a shifting boundary.

Blur is the perfect effect for data that has been protected with differential privacy. Blur provides a visual cue to anyone reading your map that things aren't accurate at the individual block, block group, or even tract level. Figure 1 is a map of housing vacancy rates at the block group level in Baltimore, and the blur effect was not applied.

↓ Figure 1: This map of housing vacancy rates in Baltimore, Maryland, at the block group level does not have the blur effect applied.

Figure 2 shows the same map with the blur effect applied. It's harder to tell the vacancy rate for an individual block group because it is difficult to tell the color of individual block groups. Yet, you can still see that there are different areas within Baltimore with various vacancy rates.

In the case of multiscale maps, the blur strength can increase as the geographic resolution increases. The blur strength determines the intensity. The higher the value, the stronger the blur. With census data, apply the strongest blur to blocks, a less strong blur to block groups, and an even less strong blur to tracts. This rewards your map's audience for zooming out with an increasingly clear picture. Your map reader will be visually aggregating up as the Census Bureau recommends, which improves accuracy.

What Blur Does and Doesn't Do

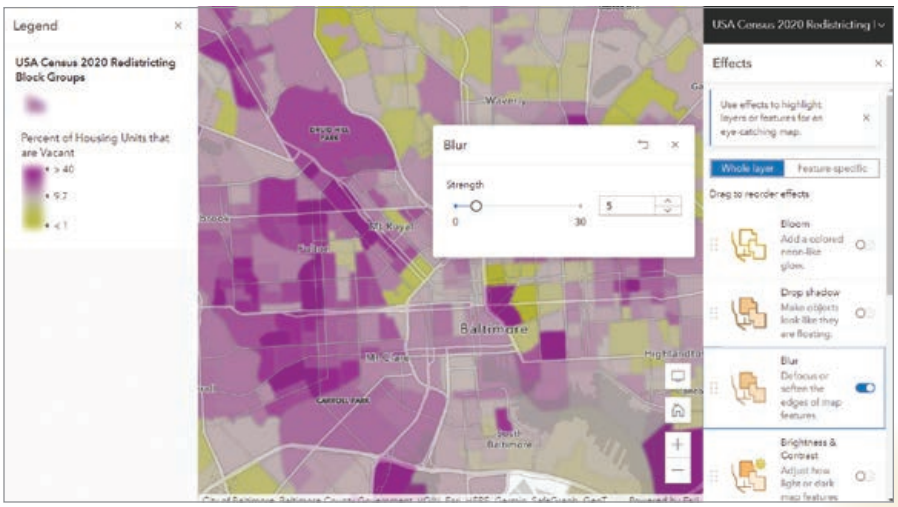
Blur simply creates a fuzzy look in your map, which signals to your map's audience that there is some fuzziness to the data. This can visually communicate that there's some noise in the data. The blurred effect comes through in your map's legend, which is the main way the map's author communicates what the map shows.

Applying a blurred effect does not make the entire map fuzzy. If there are points or lines on top of the blurred polygons, they will be sharp (unless blur has also been applied to them). Basemap labels and details will have their usual high resolution. Figure 3 shows how the blur effect is selectively applied so that the streets and labels from the Human Geography basemap are crisply rendered.

Blur, like all layer effects, does not change the underlying values in the data. Any analysis performed using your map will not be affected.

You can take blur one step further and

→ Figure 2: The same map of housing vacancy rates at the block group level with the blur effect applied.



present an aggregated calculation of some of the attribute fields. The 2020 Census redistricting data and maps available in ArcGIS Living Atlas includes the ArcGIS Arcade expression used by ArcGIS Living Atlas of the World team members to incorporate the values of adjacent features when presenting data in pop-ups.

Will you use blur when mapping census data or other noisy data? Share your experiences on Esri Community (community.esri.com).

Additional Resources

See *What is Differential Privacy? How will it affect our work?,* an ArcGIS StoryMaps story that introduces differential privacy (https://arcg.is/0KuXvj).

Visit Esri's Differential Privacy Resources site, which was specifically designed for GIS analysts (https://bit.ly/3t1u2b1).

Visit the US Census Bureau's comprehensive resource site on this topic (https://bit.ly/3GrTP1y).

Read the ArcGIS Online help documentation (https://bit.ly/3wQAWlM) to learn more about layer effects.

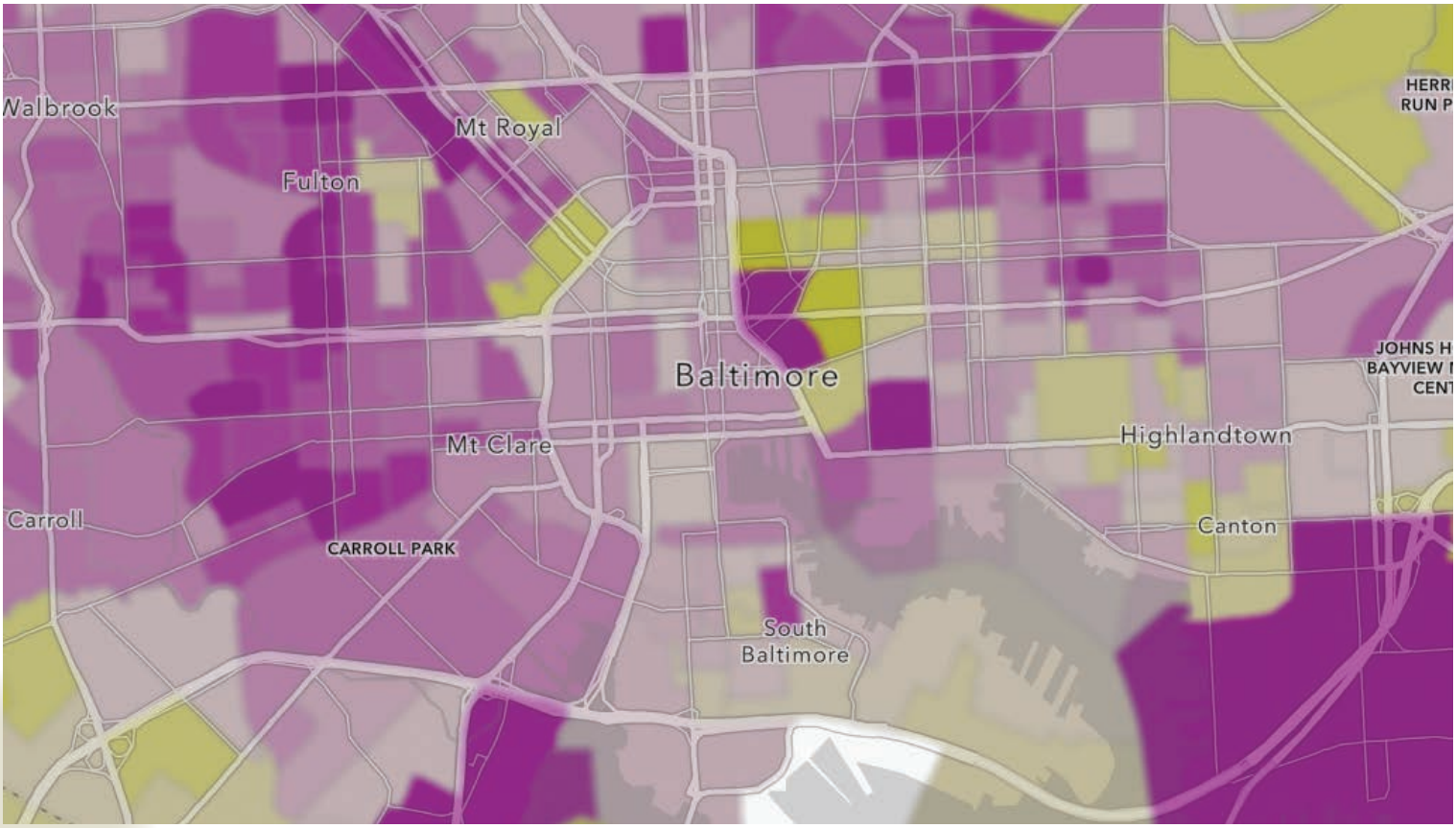
For all the details on the census redistricting data that's available in ArcGIS Living Atlas, see the "Census redistricting data and maps available in ArcGIS Living Atlas" blog post (https://bit.ly/3t3OwzP).

For a list of all the 2020 Census data that is available throughout ArcGIS products, see the "Access 2020 US Census Data with Esri" blog post (https://bit.ly/3MVDkgx).

About the Author

Diana Lavery (she/her/hers) loves working with data. She has more than a decade of experience as a practitioner of demography, sociology, economics, policy analysis, and GIS. Lavery holds a bachelor's degree in quantitative economics and a master's degree in applied demography. She works as a senior product engineer on ArcGIS Living Atlas of the World's policy maps team and enjoys strong coffee and clean datasets, usually simultaneously.

↓ Figure 3: The blur effect does not change the underlying data values and the features and labels of the Human Geography basemap are clearly visible.



Transferring ArcGIS Online Content

By Scott Ball

Have you ever wanted to transfer your ArcGIS Online content to someone else within your organization? You could be switching teams, leaving the company, or simply wanting to hand off ownership of your maps, layers, dashboards, or other items to someone else.

Previously, only an organization administrator could transfer content between organization members. With the March 2022 update of ArcGIS Online, members can directly transfer content to each other.

Transferring content between organization members requires:

- A person who wants to transfer the content to another person in their organization.
- A person in that organization who will receive that content.
- Content—such as maps, layers, and surveys—that will be transferred.

The ability to transfer or receive content is not on by default. Once transfer is initiated, the content just goes. There is no prompt, handshake, or ability by the recipient to reject content that has been transferred. Consequently, the content transfer policy for your organization should be carefully defined.

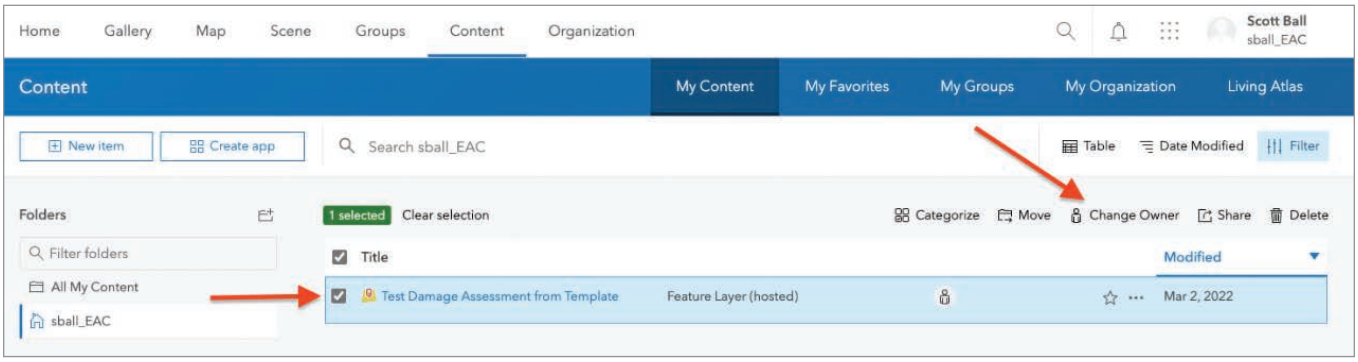
Organization members must have permission to send or receive content that is provided by the administrator. Two new member privileges let an organization administrator enable sending and receiving content between members: Reassign content and Receive content. If you want members with a custom role to be able to send and receive content, turn both privileges on.

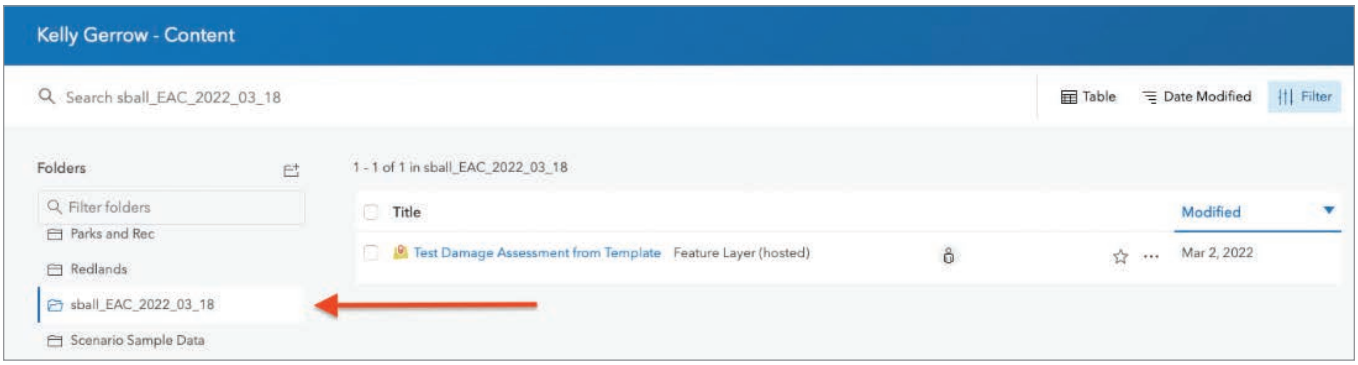
These privileges are set as part of a custom role that can be assigned to organization members. These privileges are not available for use with default member roles—aside from the administrator role, which has always had the ability to transfer content.

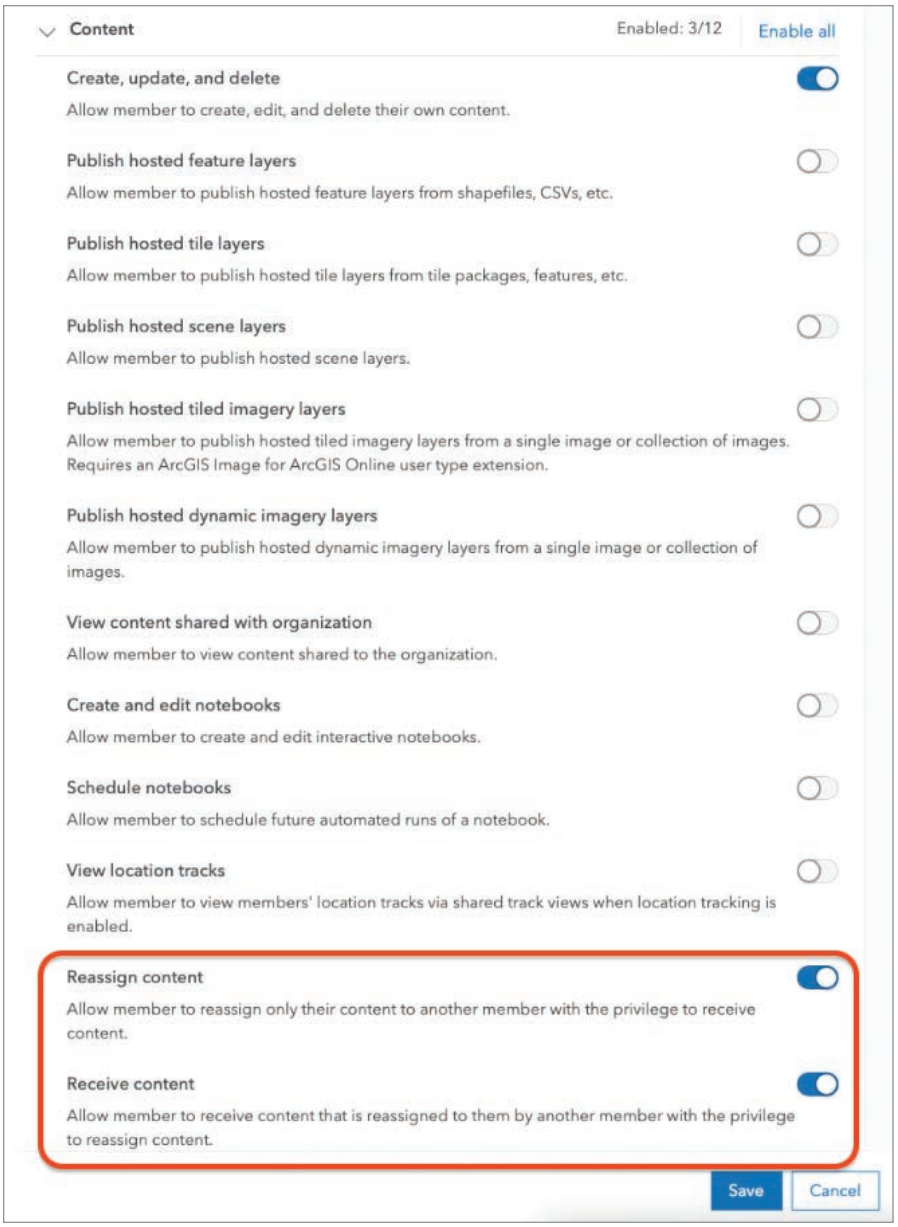
Custom roles can be easily created in the image of a default role during configuration. When editing a custom role, administrators can find the new privileges under General privileges > Content, at the bottom of the section just beneath the View location tracks privilege.

↓ When content is selected, the Change Owner option becomes available.

↓↓ Once a transfer is completed, the content will no longer be visible in the My Content section of the person transferring items. The person receiving the content will have a new folder with the name of the person who transferred items and the transfer date on their My Content page.







← Two new member privileges let an organization administrator enable sending and receiving content between members: Reassign content and Receive content.

Carefully consider who in your organization should have these privileges and when they should have them. Do all users need these privileges all the time? Do they only need these privileges at certain times, such as during project transitions? Do only trusted power users need these privileges? You will want to balance the power of unrestrained content transfer with the administrative overhead of assigning and reassigning roles when content transfers are needed. As an administrator, you know your organization and its personnel best, and you can determine the best strategy for your organization.

Once all persons involved in the transfer have the correct privileges, the process is straightforward. The person transferring the content selects items from their My Content page. With the items selected, that person chooses Change Owner and selects the organization member to whom the content will be transferred. After clicking Save, the content is transferred to the member selected.

The content will no longer be visible in the My Content section of the person transferring items. The person receiving content, who will be the new item owner, will not receive a notification of this new content. Consequently, it is a good idea for persons transferring content to reach out to those receiving content outside the ArcGIS Online system to let them know the process has been completed.

When the transfer is complete, the person receiving the content will have a new folder on their My Content page. The new folder will contain the transferred items, and the folder name will have the name of the person who transferred the content and the date it was transferred. The person receiving the content is the new owner of the items and can freely modify them.

Note: It is also possible to initiate the change owner workflow from the item details page. Keep in mind that if you are not an administrator, you can only transfer items that you own.

About the Author

Scott Ball is a product manager for ArcGIS Online who is working to make the power of geography accessible to everyone. He spends his time listening to user feedback and working to make ArcGIS Online the best software as a service (SaaS).

Captivate Potential Employers with StoryMaps

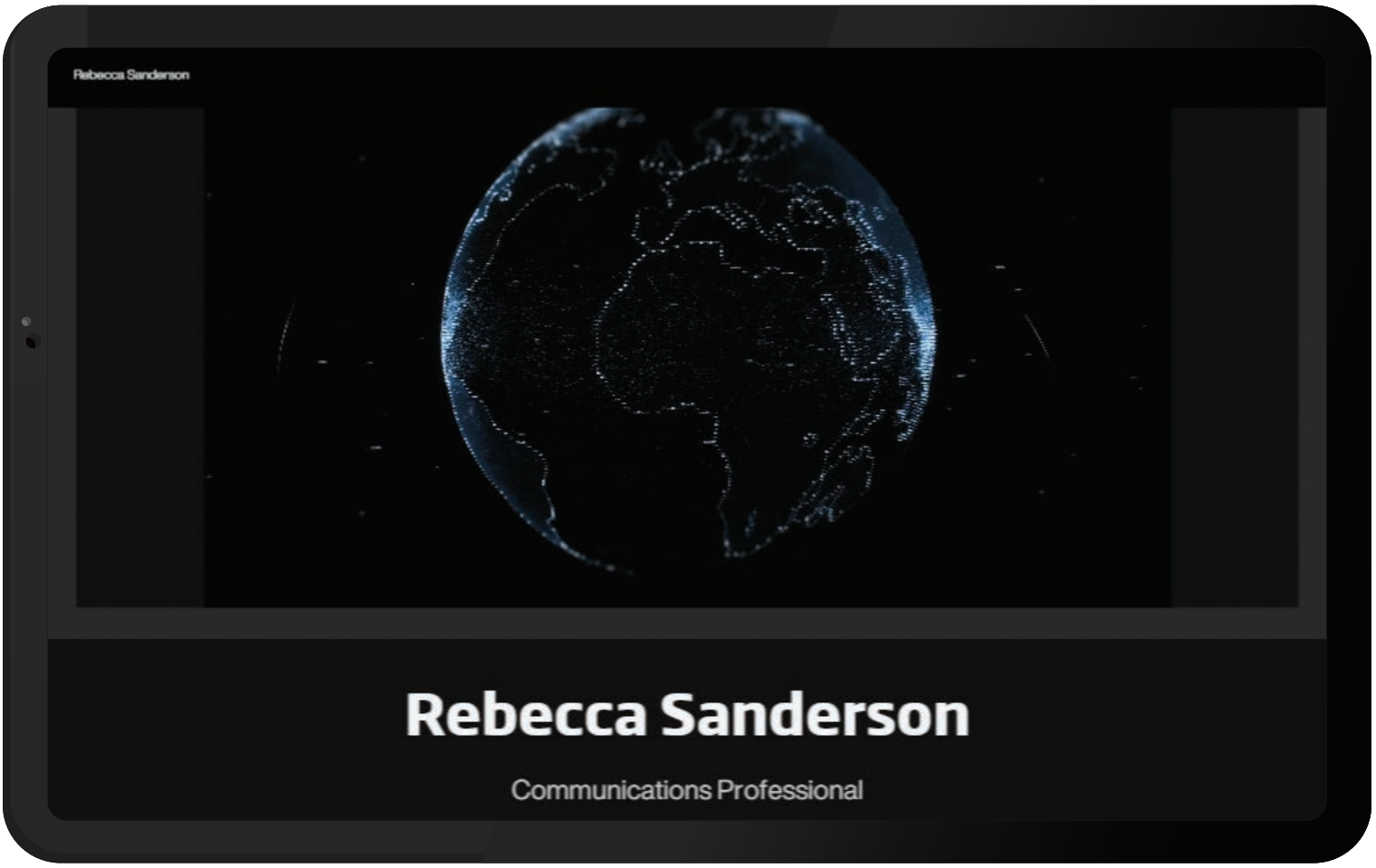
StoryMaps, the new personal storytelling tool for everyone, is a great vehicle for telling potential employers what you can offer them. Its immersive use of media can engage hiring managers and help you stand out from other applicants.

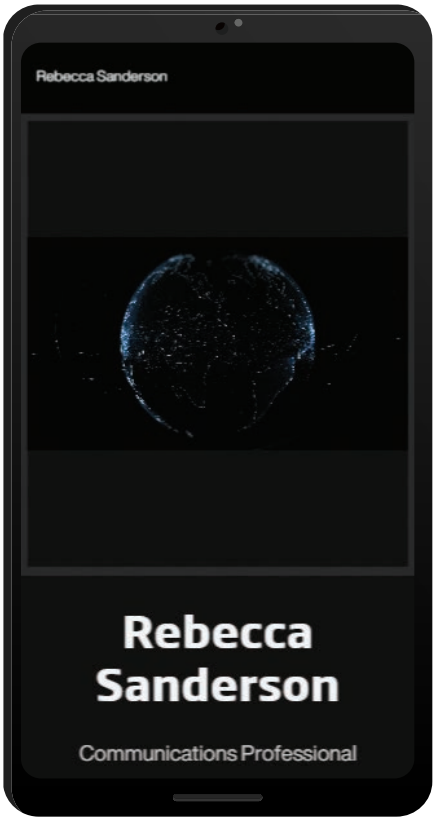
On average, hiring managers spend just seven seconds reviewing a traditional résumé. The compelling interactive content you can include in StoryMaps—images, videos, maps, and audio clips—will encourage the people considering you for a position to spend more time with your application and get to know more about your strengths, experience, and passions.

You can include video greetings, links to your online portfolios, LinkedIn profile, testimonials, and references. You can provide examples of GIS work and map out your employment history. This is especially effective when applying for a GIS position. You can use research you have conducted on a potential employer to communicate that you understand the company culture and share its core values.

Use prebuilt layouts and the tools in StoryMaps to simplify, speed up, and enhance story creation. Simply drag and drop videos, images, and audio clips into your story. Maps can be quickly created using Express Maps, or you can use maps from ArcGIS Living Atlas of the World.

Set the mood with ready-to-use themes or create custom themes by choosing background colors, fonts, and button styles. You can incorporate logos or branding schemes. Use rich text editing capabilities and simple drawing and annotation tools. Once a story is finished, sharing it on social media, embedding it in a website, or providing access to it via a URL is simple and easy because Esri hosts StoryMaps stories.





StoryMaps is designed for individuals, not organizations. It was built separately from the ArcGIS system, so it does not require an ArcGIS Online organizational account.

The StoryMaps mobile apps for iOS and Android let you work on your résumé wherever and whenever you have time. Responsive design ensures that your StoryMaps résumé looks good on any device.

StoryMaps, obtainable only from StoryMaps.com, is available at two levels: a no-cost Basic level and the monthly subscription Premium level with enhanced storytelling capabilities. Try StoryMaps for free with a 30-day trial and get access to Premium plan features.

↑ Use StoryMaps to make a bold statement to potential employers.

← Responsive design ensures that your StoryMaps résumé looks good on any device.

Use Your Voice to Run ArcGIS QuickCapture on an iPhone

By Ismael Chivite

Imagine collecting data with ArcGIS QuickCapture without needing to look at or touch your iPhone? Using Apple's voice control in iOS, you can operate QuickCapture with your voice and use voice commands to launch the app, open a project, and collect data.

Configuring Voice Control in iOS

Voice Control is an operating system feature that became available with the release of iOS 13. It lets you use your voice to tap, swipe, and type on your device. Voice Control is available for US English only.

Before you turn on Voice Control for the first time, connect your iPhone to Wi-Fi then follow these steps to configure Voice Control:

- Go to Settings > Accessibility and tap on Voice Control.
- Before you can use Voice Control, a file must be downloaded. Once the download is complete, you don't need a Wi-Fi connection to use Voice Control.
- Turn on Voice Control.
- Go back to the home screen.

In the status bar at the top-left corner of your phone, you will see a blue microphone icon. This indicates that Voice Control is actively listening for your commands. If the microphone icon is grayed out, say "Wake up" to activate Voice Control.

Using Voice Control with QuickCapture

Say "Open QuickCapture" to launch the QuickCapture app.

To open a QuickCapture project from your My Workspace page, say "Tap" followed by the name of your project.

To collect data, say "Tap" followed by the label of the button you want to tap.

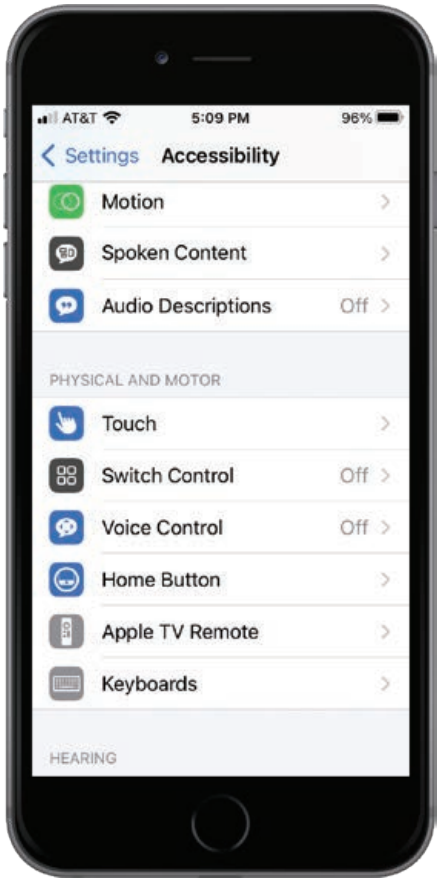
To return to your phone's home screen, say "Go home."

To enter free text in your project, say the button name for the free text field, then say whatever you want to add as free text. To delete text, say "Delete line." When finished adding free text, say "Tap done."

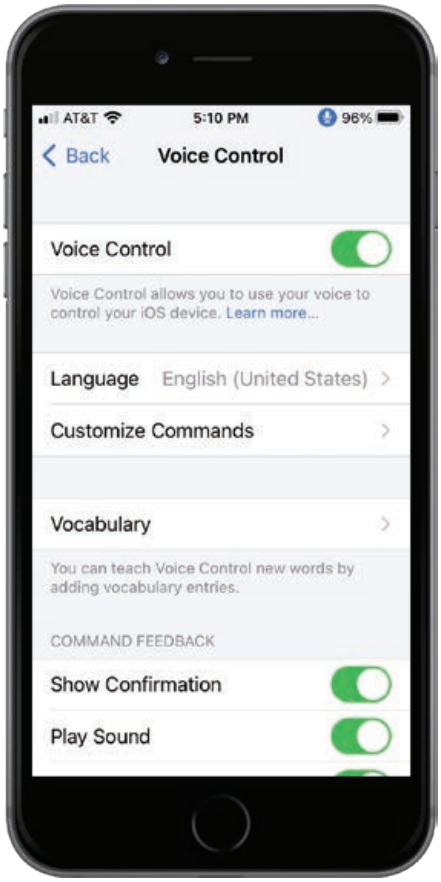
If you change your mind and decide not to enter free text, say "Tap skip."

When finished with all user inputs, say "Tap done."

When data capture is paused or finished, say "Go to sleep" to turn off the



↑ To turn on Voice Control for the first time, connect your iPhone to Wi-Fi and go to Settings, then Accessibility.



↑ After selecting Voice Control, toggle it on. This is also where you can access Customize Commands and enable sounds and show confirmation of actions.

microphone and save the phone battery.

To turn on the microphone and resume data capture, say "Wake up."

To return to the home screen, say "Go home."

To learn more about the options for better controlling the behavior of Voice Control on iOS, read the Apple support topic "Use Voice Control on your iPhone, iPad, or iPod touch" (https://apple.co/3aAZWEV).

Tips on Using Voice Control with QuickCapture

Although it supports the most common actions, QuickCapture is not designed to be fully operated using voice commands. The following actions in ArcGIS QuickCapture are not supported by Voice Control:

- Signing out or in with a new account.
- Accessing the QuickCapture Settings, About, and Feedback dialog boxes.
- Interacting with the camera. You cannot press the shutter button, change the camera, or activate or deactivate the flash using Voice Control.

When interacting with the map view, you cannot open the map dialog box, manually send records, change the navigation mode, or close the map page.

Enable Unsupported Actions

You can create custom voice commands using directions found in "How to customize Voice Control commands on your iPhone, iPad, and iPod touch" (https://apple.co/3xAq9MI). Follow these tips when customizing voice commands for QuickCapture.

Use simple and short labels on all buttons. If a button does not have a label, you cannot invoke it with your voice (unless you use a custom command with a gesture). Remember that Voice Control can drain your battery more quickly.

Go to Accessibility > Voice Control > Customize Commands > Basic Navigation to turn on each item name so that you will no longer need to say "Tap" before specifying which button to push using Voice Control. If you do this, you need to disable Text to Speech in the QuickCapture settings and choose either no sound or a beep. Note: If you don't disable Text to Speech activatation when item name custom commands are turned on, you will end up in an infinite loop.

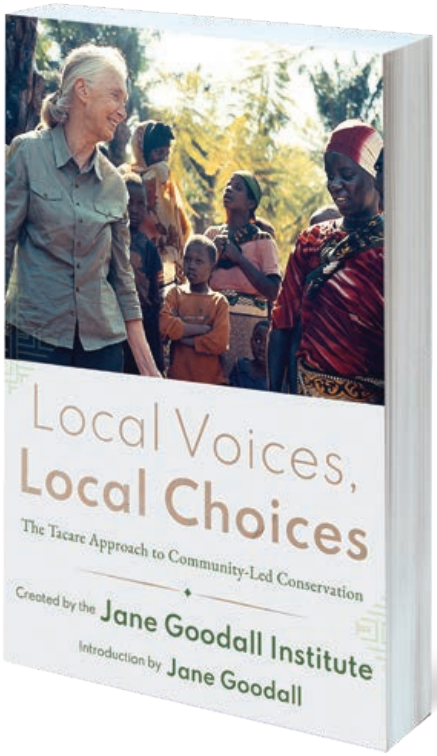
About the Author

Ismael Chivite joined Esri in 2002. A geographer by training, he loves helping people leverage GIS to improve the way they work. As a senior product manager, he is always looking for ideas to create new and improve existing Esri products. Outside working hours, he likes LEGOs, rock climbing, Romanesque architecture, and *Jamón ibérico*.

GIS Bookshelf

Local Voices, Local Choices: The Tacare Approach to Community-Led Conservation

By Jane Goodall Institute



Local Voices, Local Choices: The Tacare Approach to Community-Led Conservation shares the stories behind Jane Goodall's visionary approach to community-led conservation. Goodall is world-renowned for her lifelong work with wild chimpanzees and advocacy for environmental justice.

Her holistic approach to conservation puts the local people in charge of preserving their surrounding ecosystems. This grassroots approach contrasts with top-down efforts led by conservationists who impose their solutions on local communities.

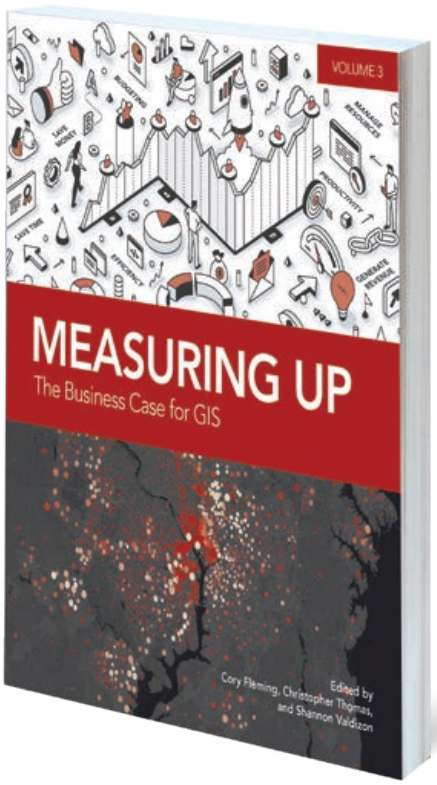
By working with science and technology and the support of conservationists, these communities better understand human impacts on the environment. Through adopting sustainable livelihoods and finding ways to balance their environmental impact with community needs, they are determining a more sustainable future.

The stories in *Local Voices, Local Choices* bring readers the diverse perspectives behind the approach to community-driven conservation of Jane Goodall Institute (JGI) staff and program partners as well as the local people who lead these initiatives. The origins of the Tacare approach, originally designed as a 1994 reforestation project with an abbreviation pronounced *ta-CAR-reh*, is described.

The book's target audience is conservationists, fans of Jane Goodall, and those interested in environmental issues. *Local Voices, Local Choices* vibrantly communicates Jane Goodall's vision and her hope that the Tacare approach will be understood and adopted wherever there is a need for genuine community-driven conservation. Esri Press, 2022, 280 pp., ISBN: 9781589486461, eISBN: 9781589486478.

Measuring Up: The Business Case for GIS, Volume 3

By Cory Fleming, Christopher Thomas, and Shannon Valdizon



A new collection of real-world stories from government agencies, *Measuring Up: The Business Case for GIS,* Volume 3, illustrates how GIS can benefit agencies' bottom lines. Governments often depend on a geographic context when making major decisions, sharing information, and expanding operations. Government organizations dealing with major challenges, such as economic downturns or public health threats, must maintain the quality of day-to-day operations while finding solutions to new and existing problems. Using GIS and location intelligence, they can make more informed, data-driven decisions, which improve outcomes.

This is the third book in the *Measuring Up series*. It demonstrates how government agencies have embraced GIS as a critical infrastructure in their processes. Each chapter covers how GIS helps organizations save time and money, avoid cost, increase accuracy, improve productivity, increase efficiency, automate workflows, manage resources, and aid in budgeting processes. Esri Press, 2022, 200 pp., ISBN: 9781589486249, eISBN: 9781589486256.

Insight from a Pioneer of GIS and Digital Transformation

Smart City 4.0 by Dr. Winnie Tang describes how startups are using GIS for the digital transformation of Hong Kong in the post-COVID-19 era.

Hong Kong, an international financial center and one of the former Four Asian Tigers *[i.e., Hong Kong, Singapore, South Korea, and Taiwan]* is a leading smart city. Tang shares the insight she has gained from building a successful GIS business and as a leader of smart city development in Hong Kong.

The book illustrates—through the use of GIS—how startups have become the driving force of smart city development in the postepidemic era, with applications that predict the risk of virus transmission, improve urban planning, enhance mobility efficiency, and promote communication between the government and citizens.

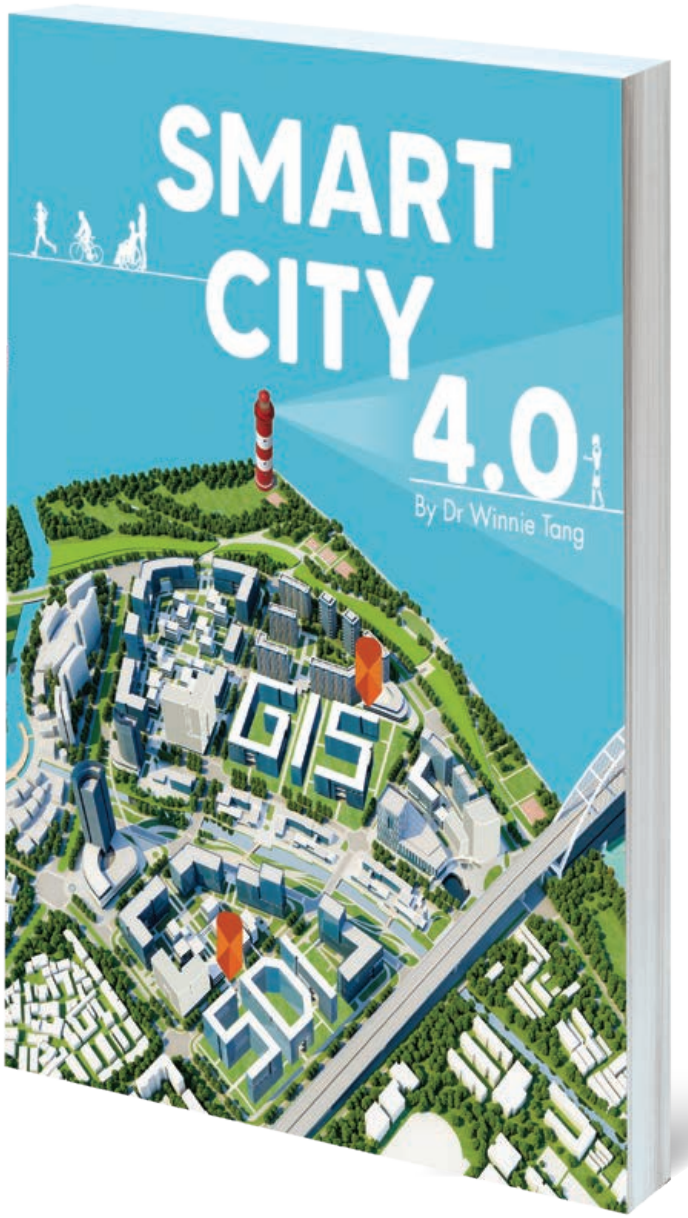
Hong Kong's digital transformation and its smart city applications highlight the huge business opportunities created by smart city development. Applications developed by nine local organizations and government departments in Hong Kong, together with applications from startups outside of Hong Kong, provide examples of best practices. These examples will help readers discern global trends and opportunities in the postepidemic era.

In the book's preface, Esri founder and president Jack Dangermond shares his firsthand knowledge of Hong Kong's turbulent road to digital transformation and how Tang has risen to meet those challenges over the last 25 years.

Tang is a Hong Kong-born IT entrepreneur who founded Esri China (HK) Limited. She specializes in GIS and smart city technologies. She led the world's mapping and data analytics efforts in response to the first severe acute respiratory syndrome (SARS) outbreak, pioneering methods that have become indispensable for timely and effective epidemic monitoring and response.

She is also the founder and honorary president of the Smart City Consortium, a nongovernmental organization (NGO). She serves as an adjunct professor on the faculty of engineering (computer science), the faculty of social sciences (geography), and the faculty of architecture at the University of Hong Kong.

This book was published by Esri China (Hong Kong) Ltd. in March 2022 and is available in both English (ISBN: 978-988-78259-4-4) and Chinese (ISBN: 978-988-78259-1-3) as a free PDF download from https://bit.ly/3susvdg.



CELEBRATING A VOYAGE OF DISCOVERY

By Jack Dangermond

← Victor Vescovo, explorer and founder of the ocean research company Caladan Oceanic, piloted the submersible *Limiting Factor* to the deepest place on Earth with Dawn Wright, Esri chief scientist, serving as mission specialist.

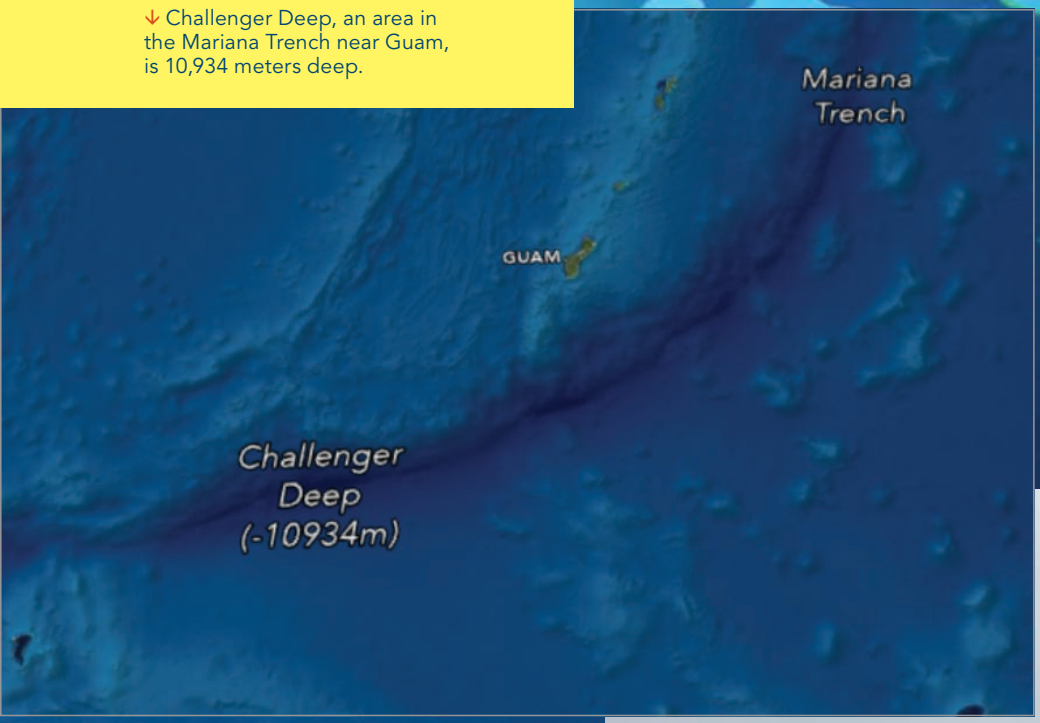
ON JULY 12, 2022, Dr. Dawn Wright, an esteemed oceanographer and Esri's chief scientist, made a historic voyage to the deepest known point in the Earth's ocean. Victor Vescovo, undersea explorer and founder of the ocean research company Caladan Oceanic, piloted the submersible *Limiting Factor*, and Dawn served as the mission specialist. They descended nearly 11 kilometers (6.83 miles) to Challenger Deep, an area in the Mariana Trench near Guam.

There is much to celebrate about this historic journey. Only 22 people have visited Challenger Deep, a number that only recently exceeded the number of people who have walked on the moon. Dawn was the first person of African descent (of any gender) and the fourth woman to dive to the world's deepest point. This mission was also the first successful side-scan sonar mapping operation at full ocean depth.

This trip provides a magnification of her life's work. All of us at Esri could not be prouder of our Deep Sea Dawn and all she has accomplished during her career.

GIS TECHNOLOGY FOR THE OCEAN

Much of Dawn's work has involved first-hand observation and analysis of undersea realms and phenomena whose power and beauty are almost indescribable. More than three decades ago, she was part of a contingent of scientists who descended to the East Pacific Rise, an underwater ridge where two tectonic plates are separating from each other. At that time, they came the closest to witnessing an historic volcanic eruption. Building on that experience,



↓ Challenger Deep, an area in the Mariana Trench near Guam, is 10,934 meters deep.

THE NEED FOR OCEAN MAPPING

A decade after she joined Esri, the work that she and her ocean science colleagues are accomplishing around the world could not be more vital. Since the ocean covers nearly three-quarters of our planet, mapping the ocean has always been important. Precise ocean mapping is crucial for generating realistic maps of our world.

↓ Dawn, standing next to the submersible *Limiting Factor*, which carried her and Victor to a depth previously attained by only 22 people.

Dawn became a leading authority on marine geomorphology, the field that studies the geology of the ocean floor.

Early in her career, she realized the importance of mapping as a tool for both analysis and communication and became an early developer of GIS technology for the ocean. She cofounded the Ocean, Weather, and Climate Special Interest Group, which meets yearly at the Esri User Conference, and wrote two books for Esri Press.

It was her drive to improve GIS for use by scientists that led her to join Esri in 2011. She saw a gap between how GIS was developing and how it could be used to better accomplish scientific endeavors. Working with Esri developers, Dawn has helped the company improve its software to support the needs of all scientists, including oceanographers.

In particular, she was instrumental in helping to develop 3D capabilities and complex fluid systems modeling. Aided by her deep understanding of the crucial differences between ocean and terrestrial mapping, she worked to develop a method for depicting changes to these systems over time. As a company, Esri has always been committed to listening to its users, and Dawn has served as a conduit to address user needs in the scientific community.

Today, however, ocean mapping has achieved a new level of urgency. Climate change, overfishing, and acidification jeopardize the health of entire marine ecosystems. Biodiversity loss and the destruction of coral reefs threaten the ability of the ocean to provide food for millions of people and the smooth functioning of the blue economy, which the World Bank defines as the sustainable use of marine resources for economic growth, improved livelihoods, and jobs while preserving the health of ecosystems.

Understanding the ocean's dire predicament requires the kind of clarity only a rigorous, data-driven approach can provide. For a system as complex as the ocean, that means using the most advanced mapping techniques. Dawn's championing of GIS—so important 30 years ago—is now nothing less than essential.

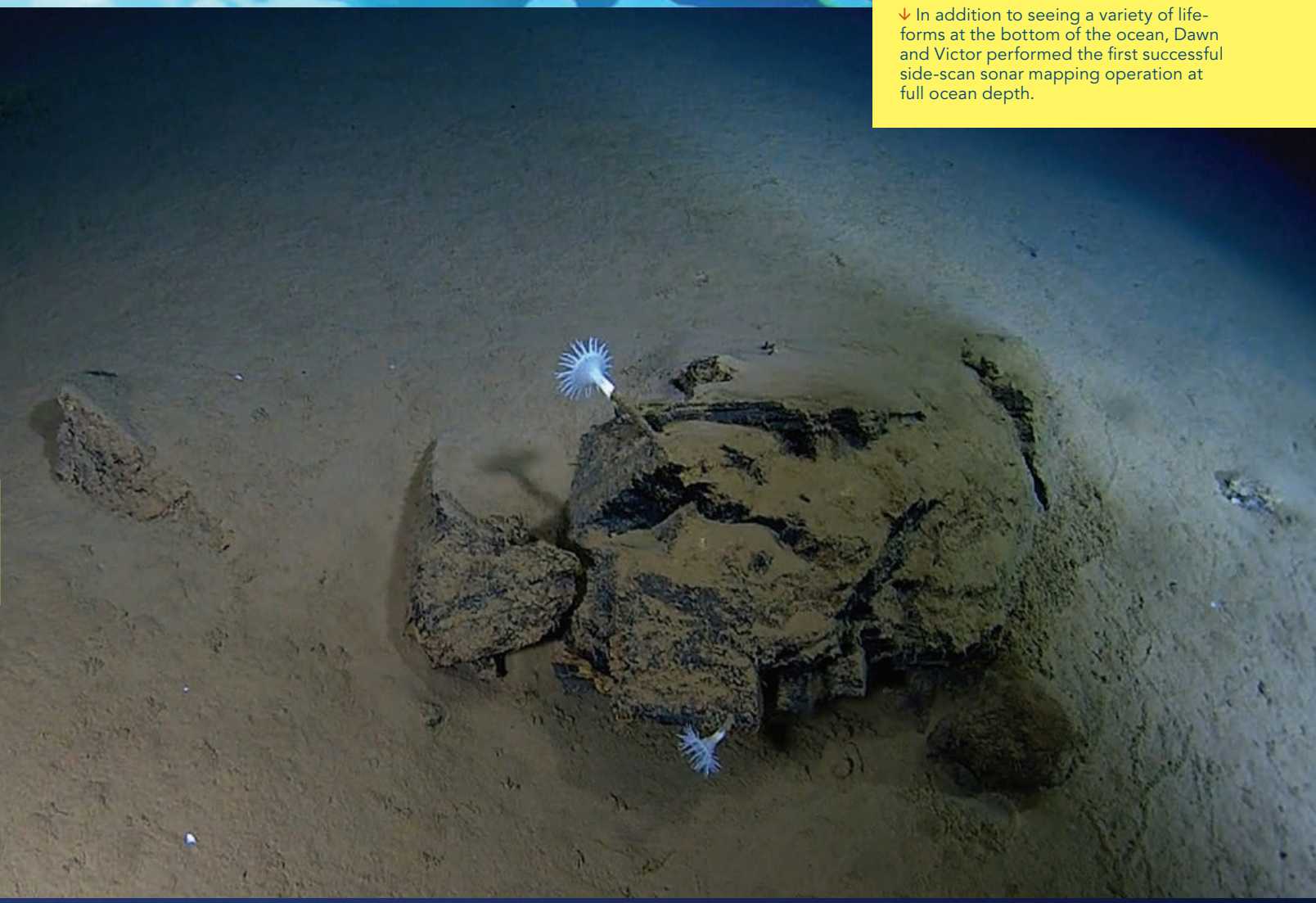
This has required a great deal of catching up. It is no exaggeration to say that we have maps of Mars and our moon that are more complete and detailed than our ocean maps. To date, only 23.4 percent of the ocean floor is mapped to modern standards. The Nippon Foundation-GEBCO Seabed 2030 Project aims to fill in the map with high-resolution data by the end of the decade.

A complementary effort to develop a 3D map of our ocean's ecosystems has been created through the efforts of Roger Sayre of US Geological Survey, Dawn, and her Esri colleagues. Through the partnership of Esri and the US Geological Survey and in collaboration with many other research and government organizations, the result was the ecological marine units (EMUs) and new methods of 3D marine mapping, which provided a baseline method for understanding the ocean's ecosystems and established a framework for detecting change.

EMUs quantify ecological values of the ocean with statistical clustering of distinct ocean properties that most likely drive ecosystem responses such as salinity, dissolved oxygen, and temperature. With EMUs, conservation-minded organizations, academic institutions, or citizen scientists can gauge positive or negative trends and use data to make informed decisions that preserve marine environments.

Together, these efforts lay the groundwork for understanding, which in turn can drive policy. As we continue to map the ocean, we do not know exactly what we will find, which underlines the need to pursue the task wherever it might lead.

↓ Her trip on the *Limiting Factor* is a highlight in her decades-long career exploring and mapping the Earth's oceans.



↓ In addition to seeing a variety of life-forms at the bottom of the ocean, Dawn and Victor performed the first successful side-scan sonar mapping operation at full ocean depth.

TOOLS THAT WILL AID DISCOVERIES

Dawn's trip to Challenger Deep was a particularly stark example of the ocean's mysteries, but it is also a powerful symbol that we have the tools to map those mysteries to the benefit of humanity. Dawn and Victor brought with them a type of advanced side-scan sonar that had never been tried at such great depths. Hopefully—once the data is processed in the coming weeks—it will yield more detailed maps of this final frontier.

No matter what this data reveals, we will have Dawn's powerful first-person account of the voyage. And I'm sure it will further reinforce her sense of wonder, which she will share to motivate all ocean mappers. A fascination for the unknown will serve us well in the challenging years ahead.

Saving the ocean will require global cooperation. Maps that drive that effort must develop in an open way that fosters collaboration. Although there was only room for two in the submersible that transported Dawn and Victor, the world traveled with them.

ADDITIONAL RESOURCES TO EXPLORE

- Get a behind-the-scenes look at the expedition of Challenger Deep. https://bit.ly/3o1X2fU
- Enjoy the stories about Caladan Oceanic's 2021 expeditions with this ArcGIS StoryMaps collection. https://bit.ly/3c9UPfH
- Read about all the ways GIS is used in marine science. https://bit.ly/3z6qBTK

ABOUT THE AUTHOR

Jack Dangermond is the founder and president of Esri. With a background in landscape architecture and urban design, he and his wife, Laura, founded Esri in 1969 on the idea that computer-based mapping and analysis could make significant contributions to geographic planning and environmental science. Since then, Esri has become the global market leader in GIS and location intelligence, with 49 offices worldwide, 11 dedicated research centers, and a strong user base of about 350,000 organizations around the world. Dangermond has received many acknowledgments and awards for his contributions to the fields of geography, environmental science, planning, and GIS, including 13 honorary degrees.

Finding the Most Suitable Sites for US Embassies

By Uli Ingram and Grace Shirley

In the fall semester of 2021 at Kennesaw State University, five undergraduate students—in conjunction with the US State Department's DipLab Demo Day—embarked on a unique research opportunity. The student team, with faculty lead professor Uli Ingram, accepted a challenging assignment: to find ideal locations for new United States embassies in cities all over the world.

Geospatial sciences students Andrew Bailey, Alaina Ellis, Cheyenne Feltman, and Grace Shirley and architecture student MaKenna Chambers made up the team that participated in the US Department of State program. It is a public-private partnership that taps into the efforts and expertise of students and faculty at colleges and universities across the United States in research related to foreign policy challenges.

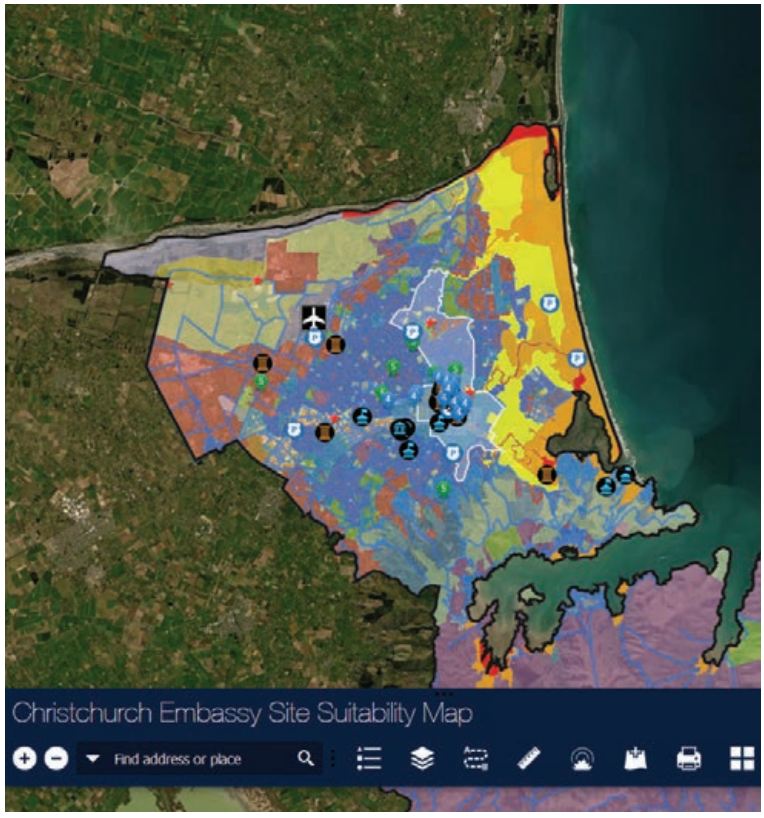
The students were provided with a list of parameters for ideal embassy sites. They were to consider proximity to favorable locations, such as host government offices, other foreign embassies, businesses and cultural centers, and public transportation. They also had to consider maintaining distance from unfavorable features such as potential security threats, natural hazard zones, and areas with high crime rates. The goal was to deliver strengths, weaknesses, opportunities, and threats (SWOT) analyses for each assigned city by the end of the semester.

Team members found the data searching phase, often hampered by language barriers and countries with limited publicly available spatial data, to be the most arduous. Once the required data was collected, they utilized ModelBuilder and the ArcGIS Spatial Analyst extension of ArcGIS Pro to produce weighted suitability overlays that considered both the inputs and the relative importance of each. The resultant focus areas considerably narrowed the scope for site searches, even identifying promising individual parcels in some of the more data-rich cities.

Prior to this project, site acquisition staff in the State Department's Bureau of Overseas Building Operations (OBO) relied primarily on local brokers, real estate agents, and other qualitative measures, rather than geospatial analysis and GIS software, to find future embassy locations. This project provided a proof of concept for the implementation of a more quantitative approach to site acquisitions with geospatial analysis and Esri tools to supplement the OBO's current system.

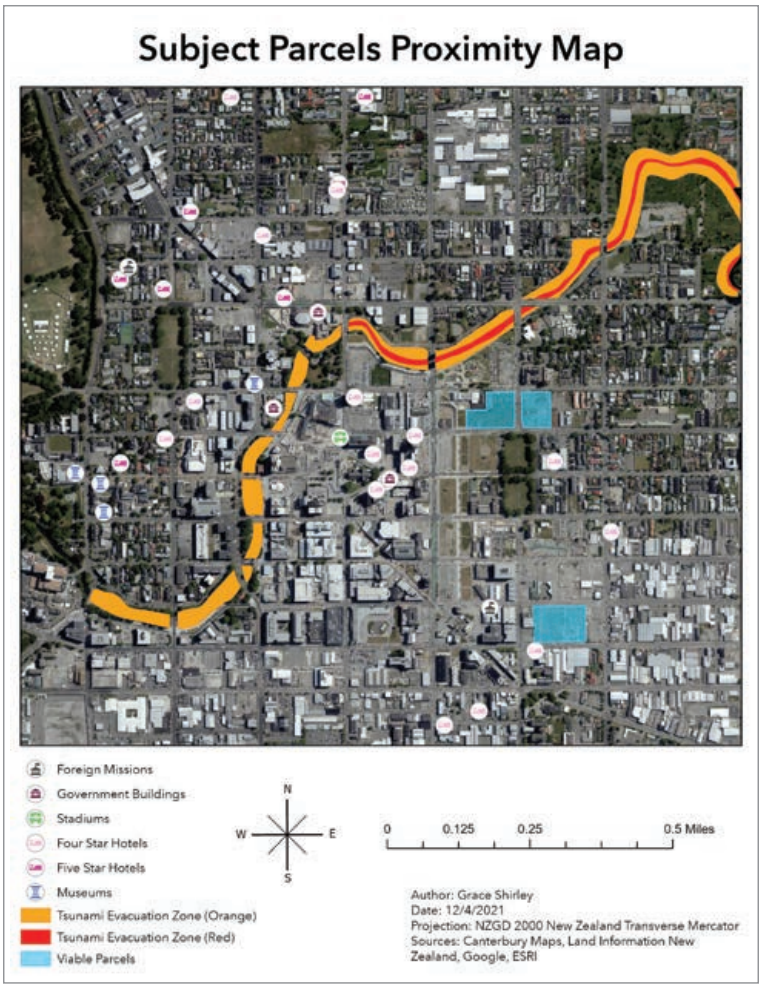
After a full semester of data collection and analysis, weekly meetings with Ingram, and biweekly progress meetings with OBO representatives Sunny Peterson and Calvin Clessas, the students presented their final reports and findings to the OBO in December 2021. Ultimately, the results were delivered in the form of ArcGIS Pro project files and geodatabases, stand-alone maps, and interactive web applications tailored to each city.

In February 2022, the team reunited to present its research once



↑ The overlay area and an image of the overlay area within the city boundary demonstrate how far the scope of the site search was narrowed.

→ The results of analysis were also provided as apps.



← The students at Kennesaw State University who were tasked with determining ideal embassy sites considered proximity to favorable locations, such as host government offices, other foreign embassies, and businesses, in their analysis.

more at the Diplomacy Lab Demo Day, representing one of only three teams in the nation chosen to present to State Department representatives and project partners. While Diplomacy Lab projects have historically focused on more traditional subjects in foreign policy, the inclusion and support of GIS research demonstrated the vast spectrum of opportunities in the fields of both foreign policy and geospatial science.

"You are literally the future of foreign policy; you are the future of the Department of State," said Thomas Debass, managing director for the Office of Global Partnerships, while addressing the presenting student research teams, "American leadership can only be maintained if students like you continue to engage with us, and hopefully you can join our ranks."

After the success of the first round of the project, Ingram and Kennesaw State University have ramped up their involvement in the Diplomacy Lab program. The project is continuing during the spring 2022 semester, this time with two additional Directed Applied Research students and 20 Advanced GIS students analyzing a new list of cities around the world.

For more information, please contact Uli Ingram at uingram@kennesaw.edu.

About the Authors

Uli Ingram is a senior lecturer of geographic information systems at Kennesaw State University, with a bachelor's degree in international affairs from Kennesaw State University and a master's degree in geography from Georgia State University.

Grace Shirley, an undergraduate student at Kennesaw State University, is due to graduate in December 2022 with a bachelor's degree in geospatial science, with a concentration in land surveying.

New MOOC Explores the Intersection of GIS, CAD, and BIM

Esri has developed a new massive open online course (MOOC) called Transform AEC Projects with GIS and BIM. The first offering will run from September 14 through October 12, 2022. The course will give participants firsthand experience integrating CAD, BIM, and GIS data to help reduce costs, streamline workflows, and increase sustainability throughout a project's life-span.

GIS data has been used for a long time in the planning and operation of buildings, bridges, airports, and other infrastructure projects. CAD and BIM data are also key for the design and construction of these structures. Bringing GIS, CAD, and BIM data together offers many benefits.

This course is for GIS and architecture, engineering, and construction (AEC) professionals and anyone else who wants to improve project decision-making, gain critical insights, and deliver more sustainable infrastructure, more efficiently. GIS visualization and spatial analysis capabilities enhance each phase of the project life cycle—from planning and design to construction and ongoing operations.

During this course, participants will create highly realistic project visualizations using a building information model, 3D mesh, and scene layer and see how the design of these projects is informed and optimized by analyzing place-based factors. Learn how to monitor job progress using drone-captured imagery and dashboards and collaborate through sharing project data and visualizations using the cloud. Familiarity with GIS concepts and ArcGIS Pro is helpful but not required.

To view complete course details and register, visit go.esri.com/aec-mooc.

Supporting Midwives Worldwide

By Monica Pratt

Three GISCorps volunteers helped Direct Relief and the International Confederation of Midwives (ICM) launch a hub site using ArcGIS Hub to provide data, information, and resources to the worldwide community of midwives.

According to the United Nations Children's Fund (UNICEF), more than 800 women die each day from complications that occur during their pregnancies or in childbirth. For each of these women, another 20 women suffer serious injuries, infections, or disabilities related to childbirth.

Properly trained and equipped midwives can provide up to 90 percent of the essential health interventions for pregnant people and their newborns. The profession of midwifery predates modern obstetrics, tracing back to ancient times, and has been practiced by indigenous cultures all over the world. More recently, midwives were nurses who undertook additional study. Currently midwives become qualified by obtaining a dedicated university degree. They can work in many settings, such as maternity wards in hospitals, birth centers, and obstetricians' offices.

ICM, an accredited nongovernmental organization (NGO), supports professional associations of midwives throughout the world. Its member associations represent 117 countries in six regions. Furthermore, ICM collaborates with the World Health Organization (WHO), the United Nations Population Fund (UNFPA), other UN agencies, and an international roster of professional health-care associations and other NGOs.

A nongovernmental, nonsectarian, and not-for-profit humanitarian aid organization that is active throughout the United States and in more than 80 other countries, Direct Relief (https://www.directrelief.org/) has "a mission to improve the lives of people who are endangered by poverty or emergencies—without regard to their politics, religion, or ability to pay." This includes supporting midwife-led continuity of care (MLCC), which is an evidence-based approach to improving health outcomes for women and babies during vulnerable periods of pregnancy and childbirth.

Making Important Data Accessible

Direct Relief and ICM collaborated on the Global Midwives' Hub, a project to support midwives by amassing a substantial repository of midwifery-focused data from reputable sources and making it available.

Jessica White, the GIS project specialist at Direct Relief, was extensively involved in the development of the hub site. According to White, "Midwives are experts in their field, providing crucial health services to their communities and advocating for improvements within their profession. Midwives can often find the concept of working with data to be overwhelming, as it is out of the scope of their usual work. We want to recognize the important role that midwives play, to remind them they are continuously creating data with every patient they see and delivery they support and increase their capacity to understand and make use of data."

The goal of the Global Midwives' Hub is to make midwifery-focused data easily accessible by midwives anywhere in the world, improve geographic data literacy, and strengthen the ties between midwives' associations to ultimately enhance maternal and newborn health worldwide.

Direct Relief contacted GISCorps for assistance in creating the site. URISA's GISCorps has been providing GIS services on a volunteer basis since 2003. GISCorps has supported hundreds of missions that range from humanitarian relief to conservation. A team of three GISCorps volunteers from dymaptic—Mara Stoica, Jessica Lott, and Heidi Moring—were selected for the project.

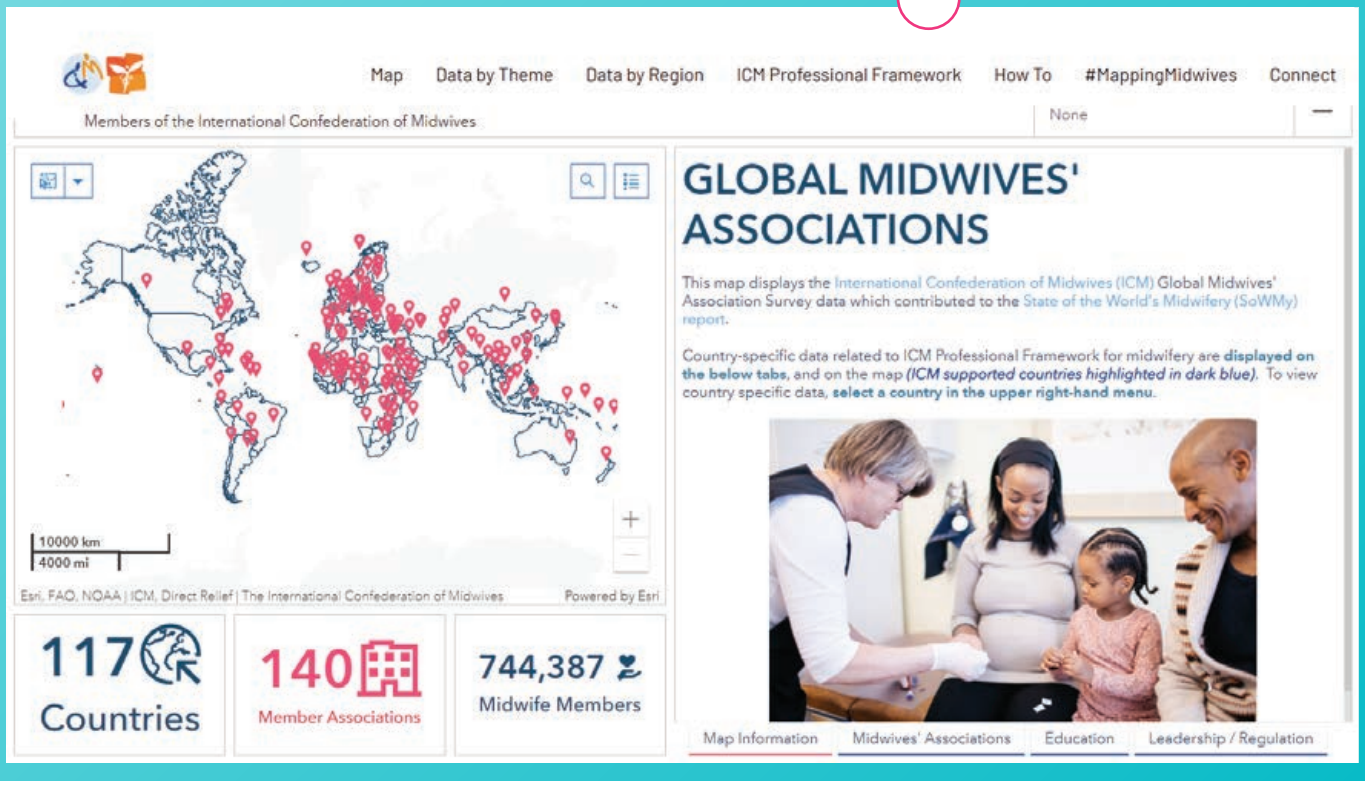
A GIS-focused software development company, Esri partner dymaptic uses its deep experience with the Esri system to create solutions for its clients' real-world needs that range from configurations to custom applications built from scratch. Its customers include Fortune 500 companies, nonprofits, and large municipal governments.

The company encourages its staff members to volunteer for GISCorps projects. According to Stoica, who is the CEO of dymaptic, this work boosts morale. "It's an enriching experience both for our volunteering staff and for the company. Allowing and encouraging our people to do good in the world makes both them and us feel good, and it's a strong contributor to a positive environment and company culture."

"Helping others has always been a passion of mine, so when I was told that I could use my tech skills to assist others, I was thrilled," said Lott, a GIS developer at dymaptic.

The datasets, with a list of attributes, were provided by Direct Relief. The GISCorps volunteers worked on the project for more than a year, completing it in May 2022. Providing a solution that met the needs of ICM was one of the most challenging aspects of the project according to Lott. "My knowledge of how midwives use GIS data was basically nonexistent. A lot of the time spent on the project was learning how this data was consumed by their users so that we could help build a solution that was useful and intuitive."

↓ The Global Midwives' Hub provides critical information in an accessible format, putting tools for effective advocacy into the hands of midwives around the world.



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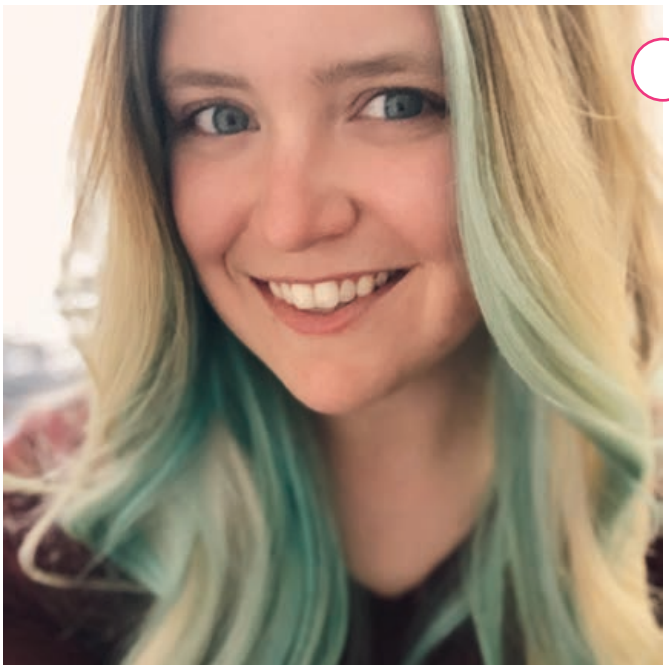


C

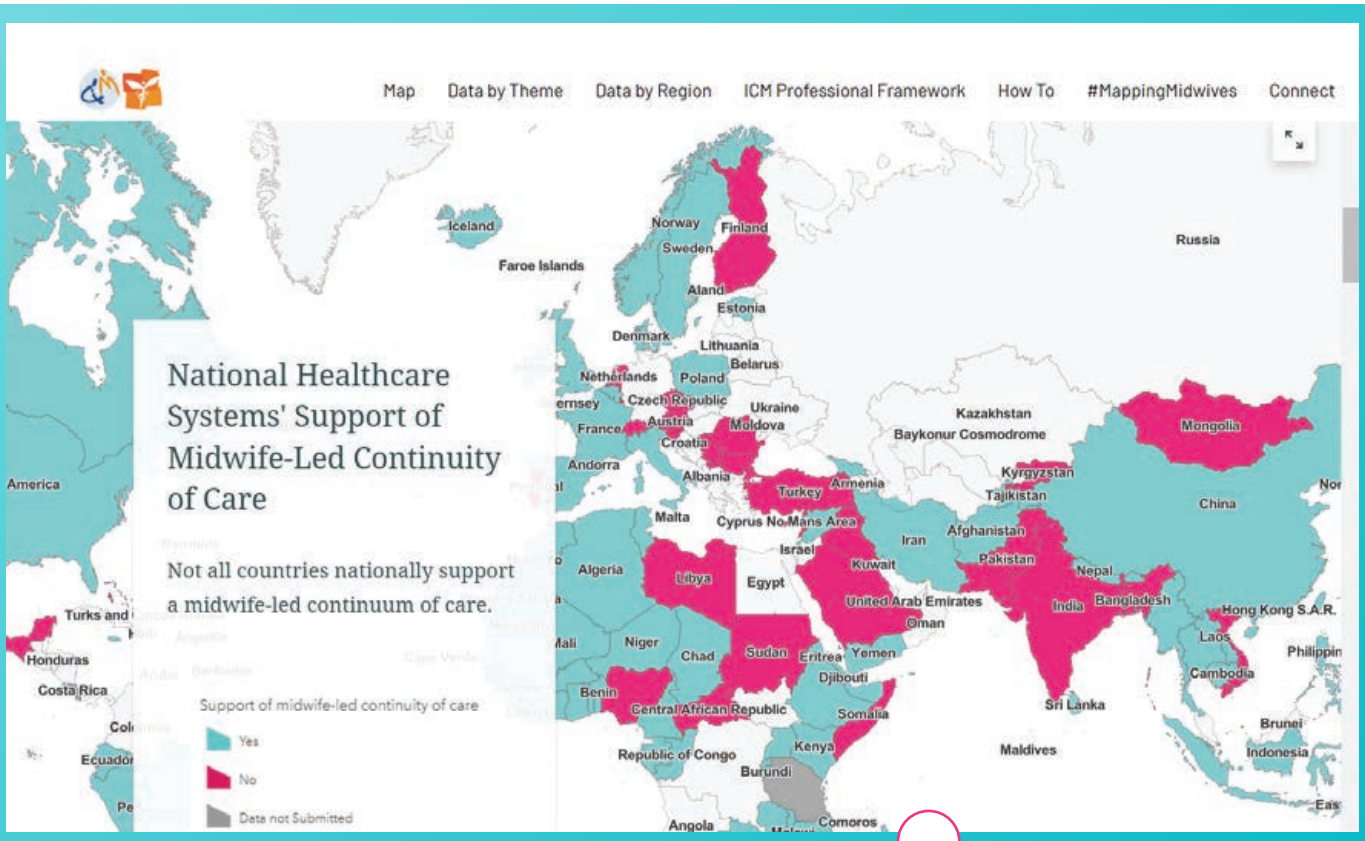
A Mara Stoica, CEO of dymaptic, was one of the GISCorps volunteers who worked on the Global Midwives' Hub.

B Jessica Lott, a GIS developer at dymaptic, was a volunteer on this and another GISCorps project.

C Direct Relief GIS project specialist Jessica White was extensively involved in the development of the hub site.

"The sense of accomplishment from being able to use your GIS skills to help those in need is hard to beat. GISCorps made it possible to connect with those who could use assistance."

Jessica Lott
GIS Developer
dymaptic



↑ Direct Relief and ICM collaborated on the Global Midwives' Hub, a project to support midwives by amassing a substantial repository of midwifery-focused data from reputable sources and making it available through a hub site.

The actual accumulated time on the project was about three weeks, with most of that time spent creating Python scripts to automate data loading of feature layers. Moring, who is also a GIS developer (and is no longer with dymaptic), wrote the Python script that automated loading data from spreadsheets into ArcGIS Online. At the end of the project, Lott spent time assisting Direct Relief in configuring the hub site and reviewing the hub community users so that users could designate some content as favorite content, access content anytime, and create data visualizations to share with others.

Tools for Advocacy

The Global Midwives' Hub (https://www.globalmidwiveshub.org/) features data from *The 2021 State of the World's Midwifery Report* (*SoWMy*), *2021* report, a publication of UNFPA, ICM, and WHO. *SoWMy* datasets can be explored, searched, and visualized along with related data provided by WHO and UNFPA as well as national and subnational statistics.

The combination of open data, mapping tools, and named users available on the Global Midwives' Hub provides critical information in an accessible format, putting tools for effective advocacy into the hands of midwives around the world. These resources support ICM's more than 140 midwives' associations, which serve more than 744,000 midwife members worldwide. Through the site, data on demographics, health coverage, morbidity and mortality, midwifery workforce, national health policies, and population is available as downloadable datasets and in Esri StoryMaps apps about each region. The pop-ups in the map of the midwives' associations with ICM membership give information about midwives in each country.

The site makes specific information on the following available: educational opportunities; professional requirements for midwife certification; leadership, regulation, and the nature and extent of each national organization's participation in ICM. Training modules to teach users how to use the Global Midwives' Hub, how to use the data it provides, how to visualize data, and how to share their work are currently under development.

Helping Safeguard Lives

Midwives fill a vital role by making effective care accessible and promoting the well-being of women, adolescents, and newborns. As the findings in *SoWMy* demonstrate, midwives are core members of the sexual, reproductive, maternal, newborn, and adolescent health (SRMNAH) workforce needed to safeguard the lives of millions of mothers and children. Midwives are instrumental in making progress toward the targets of the 2030 Agenda for Sustainable Development.

According to *SoWMy*, there is currently a global shortfall of 900,000 midwives. This shortage is most severe in Africa. The Global Midwives' Hub, built through the collaboration of Direct Relief and ICM and with the help of GISCorps, is making this important data accessible so that it can be used to promote advocacy for regulations that support midwives and promote better health outcomes for mothers and children.

The data made available through the hub site is being used by midwives' associations around the world as they advocate for their profession and improved health outcomes within their ministries of health. Several midwives' associations have taken their understanding of data a step further by collaborating with Direct Relief on mapping projects within their countries, looking to geographic data to answer questions important to their work. Those midwives are referred to as #MappingMidwives, with several collaborations of midwives ongoing in Argentina, Malawi, Namibia, and Switzerland.

Connecting with Those Who Need Help

The Global Midwives' Hub was the second GISCorps project for Lott. In 2021, she was one of several hundred GISCorps volunteers who helped create a nationwide COVID-19 testing and vaccination layer for the United States. The midwives project required a much larger commitment on her part, but she strongly encourages GIS professionals who think they do not have enough time to volunteer for GISCorps.

"Sometimes just helping an organization plot a few points can have a large impact on their endeavors. The sense of accomplishment from being able to use your GIS skills to help those in need is hard to beat. GISCorps made it possible to connect with those who could use assistance," said Lott.

Stoica echoed the value of volunteering her GIS expertise "for an organization that has such a profound impact across the globe. It feels amazing to know that I have contributed toward making life better for mothers and babies from every corner of the earth *[and]* to learn about the struggles and challenges these women battle every day, the perseverance and love that drives them, and how the support of a worldwide network contributes to that fight. I'm so happy that they now have another tool at their disposal," said Stoica.

For her part, White could not be more pleased with the collaboration with dymaptic and the GISCorps. "It was an incredibly rewarding experience partnering with such talented, driven, and supportive individuals. As the Global Midwives' Hub continues to evolve, we look forward to supporting midwives as they use geospatial data for data-driven advocacy, decision-making, and for improving the health outcomes of the communities they serve."

About the Author

Monica Pratt is the founding and current editor of *ArcUser* magazine, the executive editor of *ArcNews* magazine, the editor of *Esri Globe*, and the head of the publications team at Esri. She has been writing on technology topics, specializing in GIS, for more than 30 years. Before joining Esri in 1997, she worked for newspapers and in the financial industry.

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