Summer 2014

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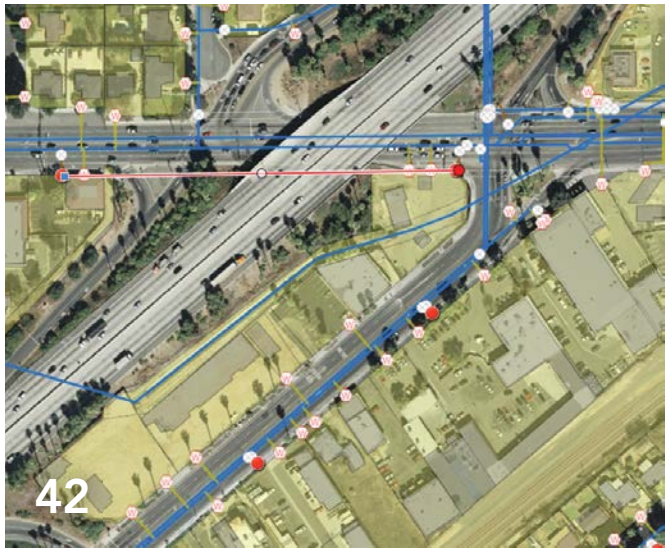

Special Section

Deciding a Better Future

As users of Esri technology, you are well aware that GIS enables better decision making. It helps you—whether you work in a government office or a business—make decisions that are fact based, considered, and contextual. From managing school district buildings to inventorying real property to optimally locating clinics, this issue contains many examples that demonstrate the value of applying a geographic perspective.

This issue also contains an article on the keynote address given at the Esri International Developer Summit by GitHub cofounder Chris Wanstrath. In that speech, he noted that, "Software development isn't really about software, it's about people." He explained that the success of the largest social coding site is based not on its bells and whistles but on its ability to let people work together with as little friction as possible, so they can build great things.

Similarly, the value of GIS isn't that it is a great technology but that it is a great technology for helping us collaborate to solve really big problems. Dealing with effects of climate change is arguably the biggest problem we are collectively facing.

Esri recognizes this need to address the impacts of climate change. It is sponsoring the Climate Resilience App Challenge, which will tap into the resourcefulness of its developer community by using data from US government agencies with Esri apps, maps, services, and APIs. Esri is encouraging developers to create apps that will help people do a better job making the countless small decisions that, cumulatively, have a big impact on our future and that of the planet. Winners will be recognized at the Esri User Conference in July 2014.

Another similar contest on a much larger scale will be announced at the User Conference. Esri has partnered with the United Nations International Strategy for Disaster Relief (UNISDR) to build a global community of resilient cities with the aid of GIS technology. As a first step in those efforts, Esri will launch an app challenge centered on UNISDR's 10 Essentials for Making Cities Resilient.

The User Conference—with its theme "GIS—Creating Our Future"—is an especially appropriate setting for these announcements. If we do little or nothing or work at cross purposes, our future looks grim. On the other hand, if we use the collaborative and analysis tools in GIS to work together, we can create a more promising future.

Monica Pratt
ArcUser Editor

editor's page

ArcUser

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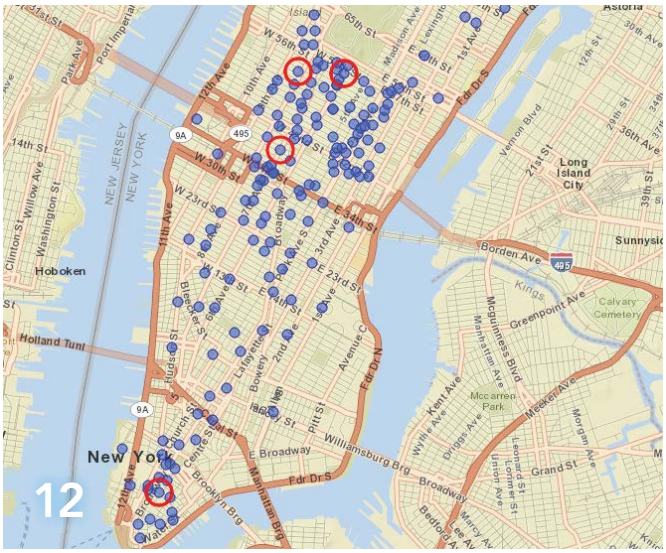
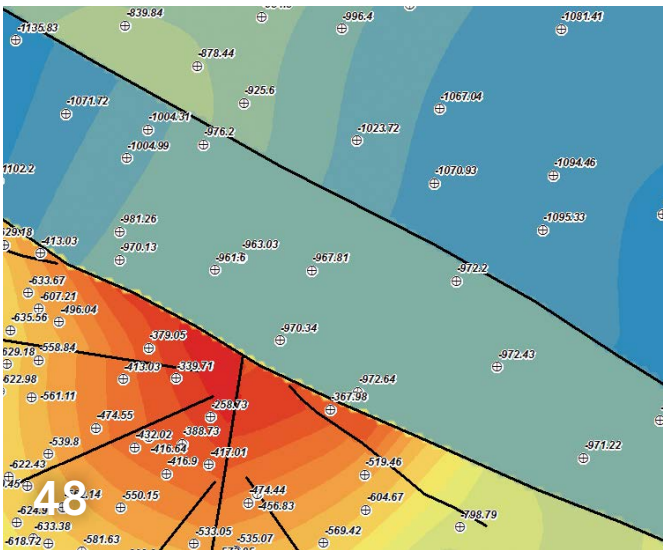
Departments





Software and Data

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Data—The Secret Sauce for Economic Development

By Keith Mann, Product Marketing Manager for Esri Location Analytics, and Brent Roderick, Product Specialist

Shocked patrons read the "We Are Closed for Business" sign on the locked door of a darkened restaurant. This scenario is a common one in many communities. More serious than the closing of a favorite gathering place was the impact on the city's local business environment. More than 100 people were suddenly unemployed, business and tax revenues were lost, and a large building stood empty. Empty buildings that once housed businesses drag down the prosperity of the community.

Local economic development agencies need to attract new businesses to empty sites as soon as possible, but where to start? How to transform the site of a failed business into an enticing location with tons of potential?

The answer: Show them the data. But what kind of data?

Data about the types of people who live, work, and shop near a site is gold to potential business operators. To better assess the viability of business, they need data that answers basic questions about the demographics, lifestyles, and spending habits of the population in an area.

Who Are They? (Demographics)

Esri's updated demographic data provides the characteristics of a population by giving a breakdown of variables such as age, gender, income, housing, family type, education, and employment. This kind of information can characterize populations and answer questions like:

- Are they retirees or young families?
- Are the majority single or married?
- Do they have children?
- Do they have significant disposable income or are they struggling to get by?
- Are they new arrivals or have they lived in the area for a long time?

This type of information enables a city's economic development staff to better promote a site by showing prospects a real and quantified description of the types of customers that are nearby. Analysts can provide maps based on the demographics of age, income, and household type that show who lives where.

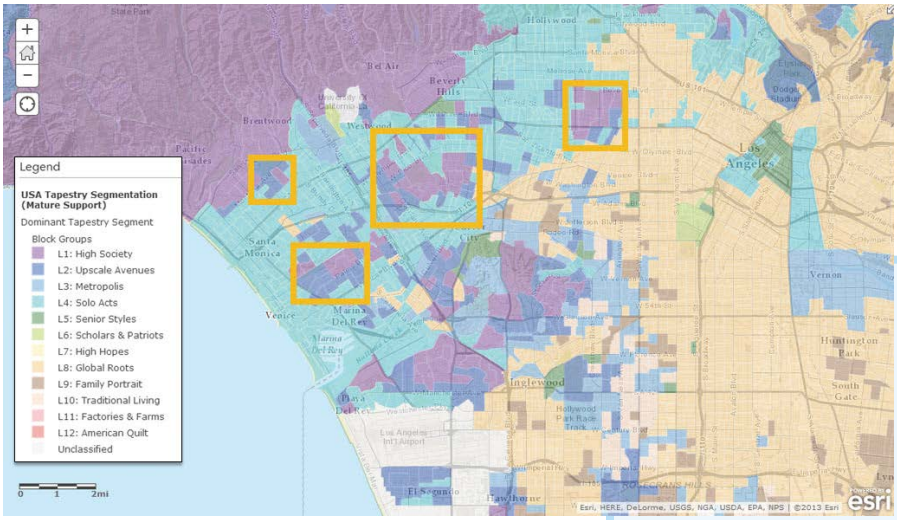
When evaluating the potential of an area, this type of demographic data lets analysts consider groups, like seniors or daytime populations that work in the area, separately as additional revenue sources. With this information, economic development staff can see the types of restaurants that do well. Conversely, restaurant development companies can locate areas that contain populations within targeted income or age ranges.

What Do They Do? (Lifestyles)

While household income visualized on a map is a good start, for more detailed information

↓ This map of Los Angeles County illustrates the ranges of Median Household Income. Rectangles represent areas matching the demographic criteria for a new restaurant.

↓↓ Four suitable areas are identified on this map based on LifeMode summary groups in the Esri Tapestry Segmentation system.



about the preferences and habits of a population, lifestyle data (also called segmentation data) can be added to demographics.

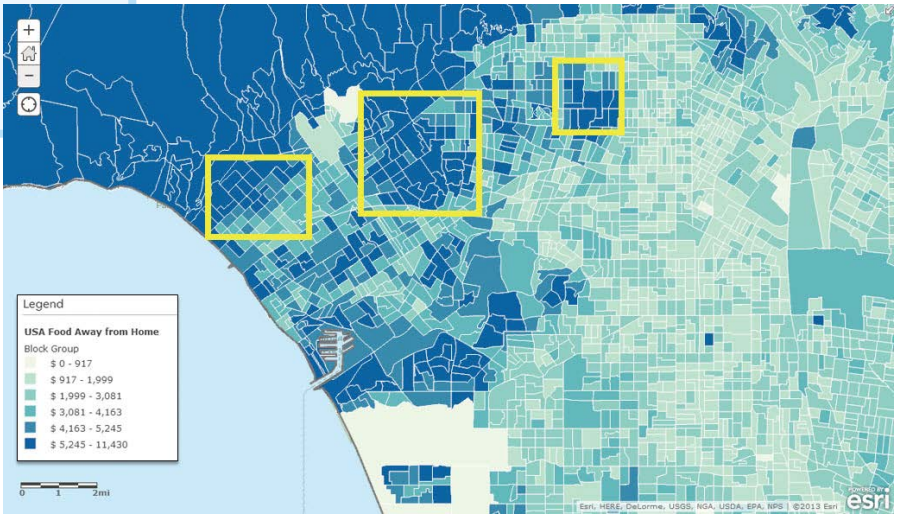
Lifestyle data adds a new perspective to demographics. It is based on the principle that people with similar tastes and lifestyles are likely to seek others like themselves and cluster together in a community. People typically move through various life stages: they marry, have children, become empty-nesters, and retire. They tend to relocate in neighborhoods where others who are at a similar stage live. Even though individual residents may come and go, a neighborhood's character, once established, tends to remain stable over time.

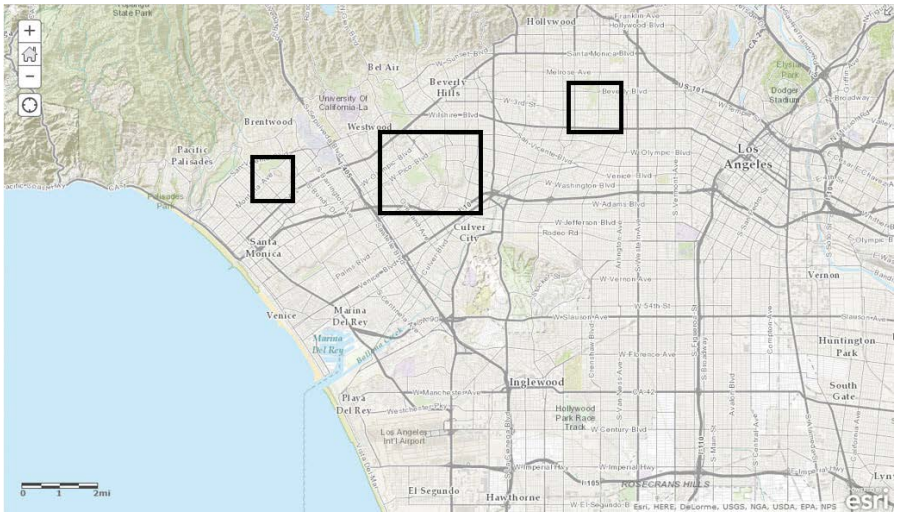
After using Esri's Tapestry Segmentation data to identify the types of neighborhoods in the area, the city staff in this example might learn that the typical resident near the closed restaurant likes sports; watches movies at home; eats out fairly often at family-type restaurants; drives a moderately priced vehicle; and goes online for information, banking, and shopping.

Adding this information to the mapping analysis could narrow the types of prospective restaurants and allow the city to pitch the site to businesses likely to find the site appealing. Armed with lifestyle information, the staff could show restaurant chains not only the demographics of the targeted areas but also their lifestyle and media preferences. This information provides valuable insights into the likelihood that residents in an area will eat out and the best ways to communicate with them.

↓ Esri Consumer Spending data for Food Away from Home in Los Angeles County was used to identify three target areas.

↓↓ This map shows the three coincident areas identified by the demographics, lifestyles, and spending data that contain potential customers for a new restaurant.





How Do They Spend Their Money? (Spending data)

Spending data provides detailed information on how the local population uses its income. Esri's Consumer Spending data compares spending by households in an area for a variety of categories to the national averages for those same categories. Market Potential data measures area demand to national averages. Studying the indexes for each database can help determine actual spending by adult or household, and the potential demand for different types of restaurants.

Site Selection Analysis

Location is a critical element for any site selection or trade area analysis. Studying the competitive landscape is necessary to ensure that a new restaurant wouldn't cannibalize current ones. When the staff members in this scenario ran Esri's Business Locations data for restaurants in the area, they found everything from fast-food to fancy sit-down places and determined a new restaurant in the empty location could be viable and would not damage the business of existing restaurants.

Drive time—how far people would drive—was also considered. Most of the targeted population live within 20 minutes of the site. Proximity to an interstate and a rather upscale shopping area were added assets.

Putting It All Together

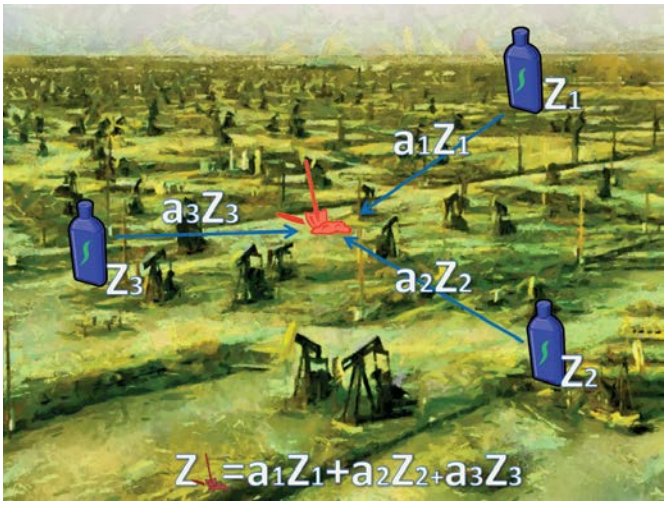
Incorporating demographic, lifestyle, spending maps, and the other information in the analysis enabled the staff to quickly see the types of restaurant companies they should focus on in promoting the empty building. A family-style restaurant with a varied menu and a bar where patrons could visit and watch sports would be a good candidate for the site in this scenario. Staff members compiled a list of restaurants that met the criteria and created presentations illustrated with charts and maps.

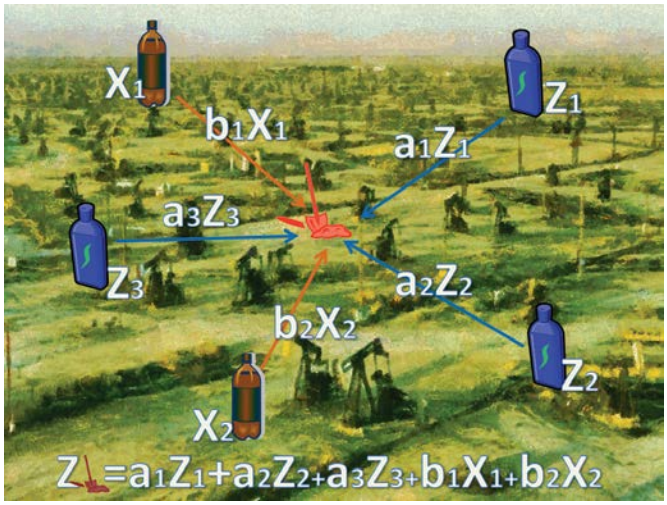
Demographics, lifestyle, and spending data can provide answers to the *who, what, where,* and *how* questions that businesses can use to evaluate potential sites efficiently and avoid a scattershot approach. This information can also help cities market commercial sites by identifying and pitching to businesses that would be a good fit for an area. In either case, data, spatial analysis, and maps provide actionable answers to business questions.

Using Multivariate Interpolation for Estimating Well Performance

By Konstantin Krivoruchko, Esri, and Nathan Wood, Chesapeake Energy Corporation

This article discusses multivariate interpolation using cokriging methods and how the cross-covariance graphs produced using the ArcGIS Geostatistical Analyst extension can model variables' spatial dependence. It also describes how data from a petroleum study was analyzed using multivariate interpolation with cokriging methods to select optimal additional well locations for the study area.





↑ Figures 1a and 1b: Both kriging and cokriging predictions are weighted sums of all the available measurements.

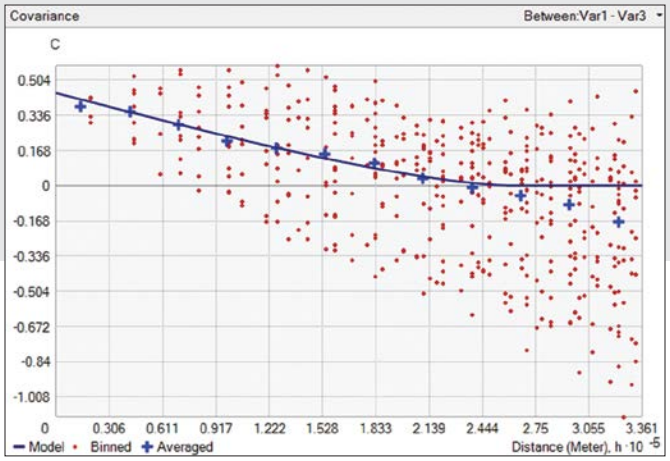
In many applications, including environmental monitoring, atmospheric modeling, real estate markets, and forestry, several spatially dependent variables are recorded across the region. The multivariate spatial interpolation model (called cokriging) requires specification of valid and optimal correlation and cross-correlation functions. Using these functions, cokriging combines spatial data on several variables to make a single map of one of the variables using information about the spatial correlation of the variable of interest and cross correlations between it and other variables.

This article discusses cokriging methodology and illustrates its usage with real oil and gas data collected in several hundred wells. A series of probability maps were created showing well performance index using kriging models and also using cokriging with permeability of the rock, depth to top of shale (which would affect the pressure at which the gas is produced), and total clean volume pumped (i.e., the amount of liquid pushed into the well) as secondary variables. The proper use of these additional variables significantly improves spatial predictions that are used for future gas and oil production planning.

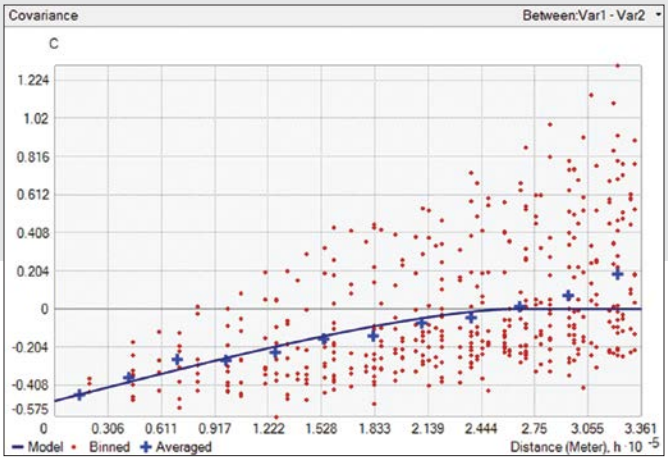
Understanding Multivariate Interpolation

The prediction of multivariate spatial processes is an important problem in many research areas in geology, environmental monitoring, meteorology, real estate markets, and agriculture. Because they are expensive to collect, in many cases only a limited number of data points are available.

Consequently, it is desirable that all available observations be taken into account. Their contributions should be weighted by the strength of their correlation with prediction locations. A typical example is mapping air pollution. Predictions can be improved by using distance from roads and measurements of other pollutants. Multivariate interpolation modeling, today known as cokriging, was first used to improve prediction of the earth's gravitational field using data from wind measurements made by Lev Gandin in 1963.



↑ Figure 2a: Cross-covariance with positive correlation between two variables



↑ Figure 2b: Cross-covariance with negative correlation between two variables

Cokriging models are efficient, but they require certain restricting assumptions, in particular, assumptions about data normality and stationarity. These assumptions are often unrealistic, but they serve as building blocks for more sophisticated models.

In the ArcGIS Geostatistical Analyst extension, one, two, or three variables can be used as secondary variables for making more accurate predictions of the primary variable at the unsampled location. The prediction is a weighted sum of the observations in the searching neighborhood.

Applying Cokriging

For the examples shown in this article, a dataset containing production data from 381 wells collected between the beginning of 2009 and the end of 2010 was used. This data is owned by Chesapeake Energy Corporation and was used with permission on the condition that no locational information be disclosed.

In Figure 1a, the prediction at the shovel location is a weighted sum of three measurements of the variable Z. Coefficients a1, a2, and a3 are functions of the covariance model, which describes the spatial correlation of Z. In Figure 1b, the prediction at the shovel location is a weighted sum of three measurements of the variable Z and two measurements of the variable X. Coefficients b1 and b2 are functions of the cross-covariance model, which describes spatial correlation between Z and X. Therefore, the secondary variable X is used as an additional set of the measurements.

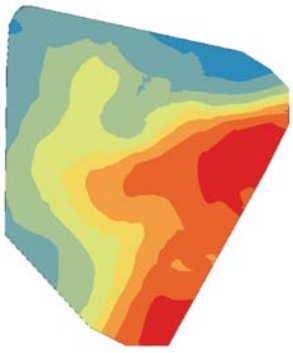
Figures 2a and 2b show cross-covariance models (blue lines) with positive (Figure 2a) and negative correlation (Figure 2b) between two variables. Crosses and red points show cross-covariance values averaged at particular intervals of distances between pairs of points and angles.

If variables are spatially independent, cross-covariance is equal to zero. The weights of the secondary variables are also zero. The predictions using kriging and cokriging are identical, as the secondary variables are ignored.

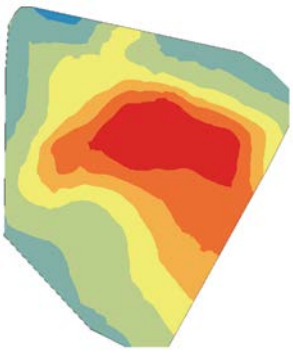
If cross-correlation exists and is estimated correctly, cokriging outperforms kriging simply because it is based on a larger amount of information. However, the prediction quality may decrease if cokriging model parameters are estimated incorrectly.

To summarize, all that is required for optimal multivariate prediction is an accurate estimation of several correlation functions. This can be done interactively using the

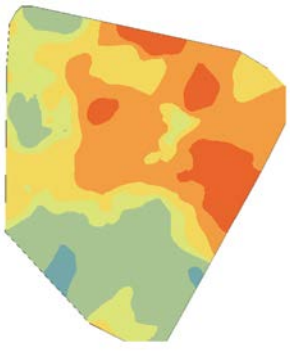
↓ Figure 3a: Interpolated map of the depth to the top of the shale formation

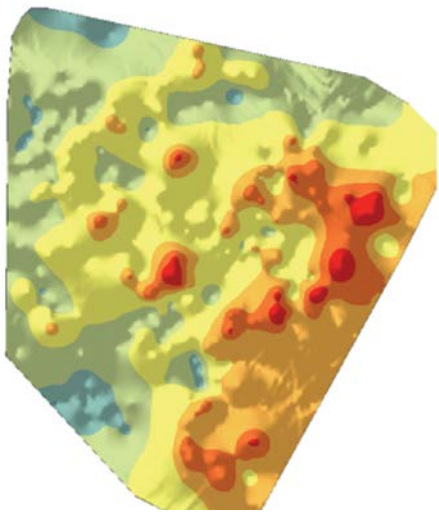


↓ Figure 3b: Interpolated map of the permeability of the shale rock

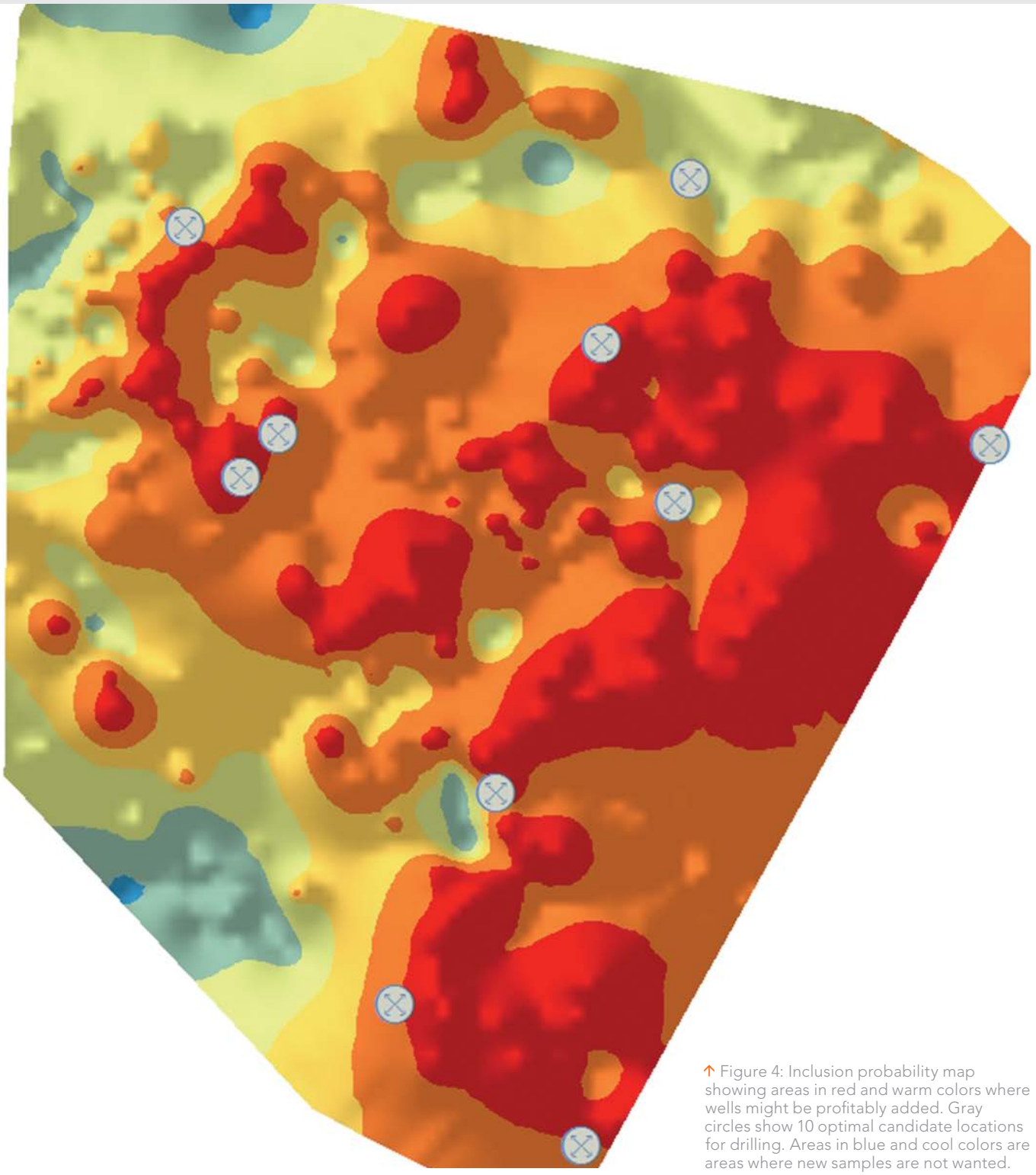


↓ Figure 3c: Interpolated map of the total clean volume pumped





→ Figure 3d: Cokriging the well performance, index prediction which extracts information from both primary and secondary variables through their correlation functions



↑ Figure 4: Inclusion probability map showing areas in red and warm colors where wells might be profitably added. Gray circles show 10 optimal candidate locations for drilling. Areas in blue and cool colors are areas where new samples are not wanted.

Geostatistical Wizard in the Geostatistical Analyst extension.

Evaluating Oil and Gas Data

Several factors go into deciding whether to drill a well. A primary factor is how much petroleum a well can be expected to produce. A sound economic decision will be based on the expected return on investment. With the data examined in this example, the goal is to find areas that will produce the most petroleum. Once those areas are determined, a separate economic analysis would be required to determine how much profit could be generated from each well. In evaluating the profitability of the wells in this example, $3.73 per barrel for oil and $97.98 per Mcf. *[1,000 cubic feet]* for gas were used.

A well performance index (WPI) was used to estimate how productive a well would be. WPI is the daily rate at which petroleum is produced multiplied by the daily pressure, summed over the first 90 days of production. This was the main variable that was

interpolated to help decide where to drill for the most productive wells. WPI values range from 45,000 to 750,000, so a quick economic analysis determined that the minimum WPI at which a well would become profitable was 250,000. Although a well could exceed this WPI and be unprofitable, areas below this performance threshold would not be of interest.

For every oil and gas well drilled, several geophysical and operational parameters are measured during the drilling process. Over time, this information paints a picture of the spatially dynamic characteristics of the petroleum reservoir under extraction. After reviewing these parameters, the list of parameters was limited to the ones that were expected to have the biggest impact.

The secondary variables expected to influence the WPI are permeability of the shale rock, the depth to the top of the shale formation, and the total clean volume pumped into the well during the fracking process.

Permeability measures how easily oil and gas can flow through rock. The higher the permeability, the easier it is for petroleum to leave the rock through fractures (both natural and man-made) and enter the wellbore. Therefore, the general assumption is that higher permeability will correlate with a higher WPI.

The depth to shale rock is dynamic and can change several hundred feet across a reservoir and dramatically at fault lines. One of the impacts this measurement has on oil and gas production is as an indicator of the amount of pressure the rock is under. The deeper the rock occurs, the higher the pressure, and vice versa. Therefore, the assumption is that a higher pressure well will produce more oil and gas more quickly than a lower pressure well.

The final variable, total clean volume pumped, is an operations-side consideration. It is a measurement of the amount of liquid pumped into the wellbore to create man-made fractures in the shale rock. Once again, the assumption is that bigger is better. The higher the volume pumped, the larger and more numerous the fractures created, allowing more oil and gas to flow into the wellbore and positively impact WPI.

The Effect of Incorporating Secondary Variables

The cokriging output surface, especially when the secondary variables are sampled more densely than the primary variable, produces a more realistic depiction of the data by extracting additional information from the secondary variables. Figures 3a, 3b, and 3c are interpolated maps of the three secondary variables (the depth of the top of the shale formation, permeability of the shale rock, and the total clean volume pumped). Figure 3d shows the cokriging WPI prediction, which extracts information from both primary and secondary variables through their correlation functions.

New well sample locations for drilling can be selected using a spatially balanced design algorithm that was discussed in "Unequal Probability-Based Spatial Sampling," an article by Konstantin Krivoruchko and Kevin Butler that appeared in the Spring 2013 issue of *ArcUser*. This design algorithm uses the inclusion probability raster, which defines an *a priori* sample intensity. The inclusion probabilities can reflect both statistical data features, such as kriging predictions and prediction standard errors, and all relevant geologic information and the reservoir engineers' expert knowledge. Each raster cell with nonzero inclusion probability has a chance of being selected. Figure 4 is an inclusion probability map showing areas in red and warm colors where wells might be profitably added. Gray circles show 10 optimal candidate locations for drilling.

Further Reading

Krivoruchko, Konstantin. *Spatial Statistical Data Analysis for GIS Users*. Esri Press, 2011, 928 pp.

Krivoruchko, Konstantin, and Kevin Butler. "Unequal Probability-Based Spatial Sampling," *ArcUser* Spring 2013, pp. 10–17.

ArcGIS Online Updates

Features in this update make it easier to manage your subscription, add analysis capabilities, improve ready-to-use apps, include more configurable templates, and enhance content.

Managing Users

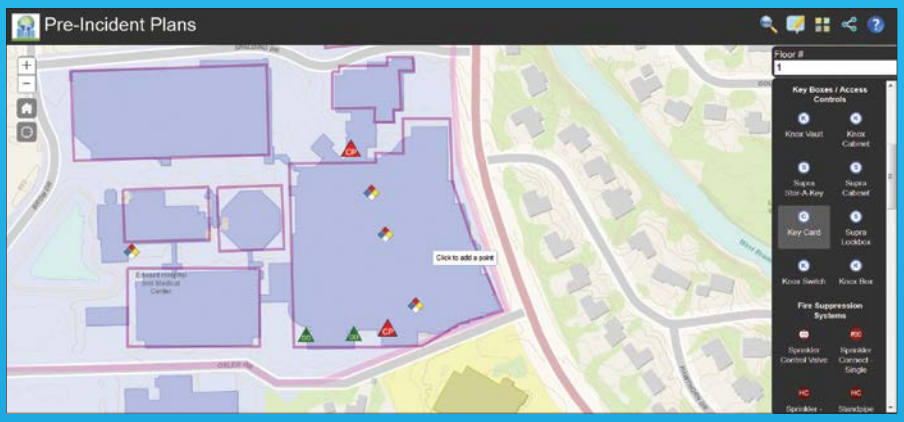
Custom roles make it easier to manage the interaction of the people in your organization with ArcGIS Online. In addition to the roles previously available, new custom roles let you define the privileges assigned to people in your organization with greater specificity. In response to your requests, you can now give your users access to templates that can be used as starting points for making maps.

Better Analysis

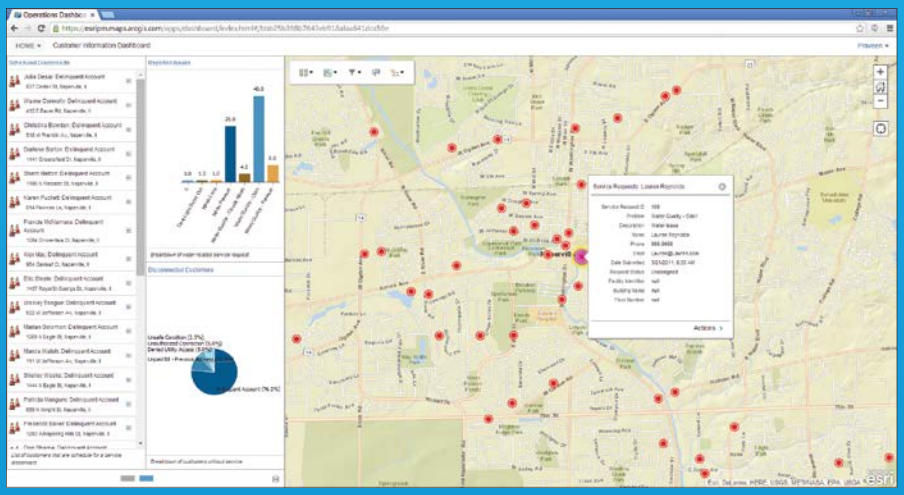
New analysis tools added with this update include Derive New Locations and Find Similar Location tools. The Derive New Locations tool creates new features based on a query. The Find Similar Locations tool accesses the similarity of locations in a candidate search layer to one or more reference locations. Existing analysis tools can now use KML files as input. The Map Viewer now supports interactive geocode rematching so you can work with unmatched records and adjust matched records. It's also easier to add multiple stops to routes.

Improved Ready-to-Use Apps

Significant changes were made to the ready-to-use apps that come with your ArcGIS Online subscription. One of the most requested for the Operations Dashboard for ArcGIS app was browser support that includes iOS and Android tablets so the app can run across platforms. You can use layers from dynamic map services as a data source and search for features by coordinates and placenames. New capabilities are provided for creating and managing selections and adjusting matched records. With the Collector for ArcGIS app, you can now download maps to a device and view, collect, and edit data offline as well as manage map content on the device and synchronize changes when connected.



↑ The Operations Dashboard for ArcGIS app now has browser support for iOS and Android tablets so the app can run across platforms.



↑ The newest version of the Collector for ArcGIS app lets you download maps to a device and view, collect, and edit data offline.

WebApp Templates

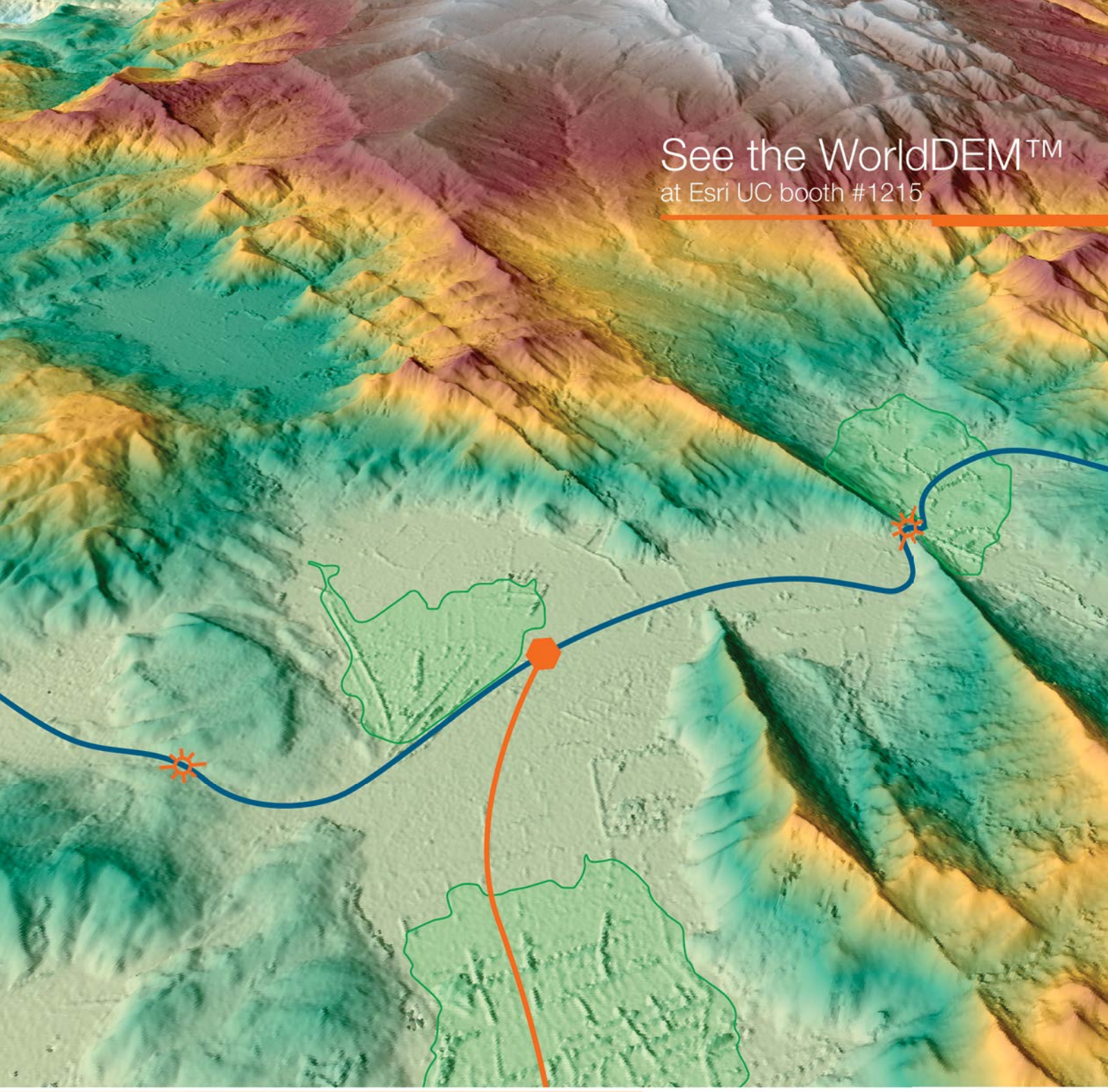
One new template helps you tag, edit, and view geographic content. It automatically sets attribute values and filters content in a web map when it is viewed. The other new template can summarize the numeric attributes of features visible in a map extent for a specified operational layer.

Expanded Content

New Moderate-Resolution Imaging Spectroradiometer (MODIS) image services access the National Aeronautics and Space Administration (NASA) Global Imagery Browse Services and deliver global, full-resolution satellite imagery. The World Imagery map service was updated with DigitalGlobe imagery for select areas. Demographic and lifestyle maps now include new data for Germany, France, India, Japan, and Korea. Landscape analysis layers include 16 new global layers. A new basemap, Dark Gray Canvas, is in beta.

New Help Website

ArcGIS Online Help has been redesigned for usability and appeal. The new site is currently available only in English, but other languages will be added soon. Access it at doc.arcgis.com/en/arcgis-online/.



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Planning Planting

Realistic 3D vegetation library for urban design

Use your 2D data to create attractive 3D visualizations in Esri 3D products like Esri CityEngine and ArcGIS for Desktop with this free library.

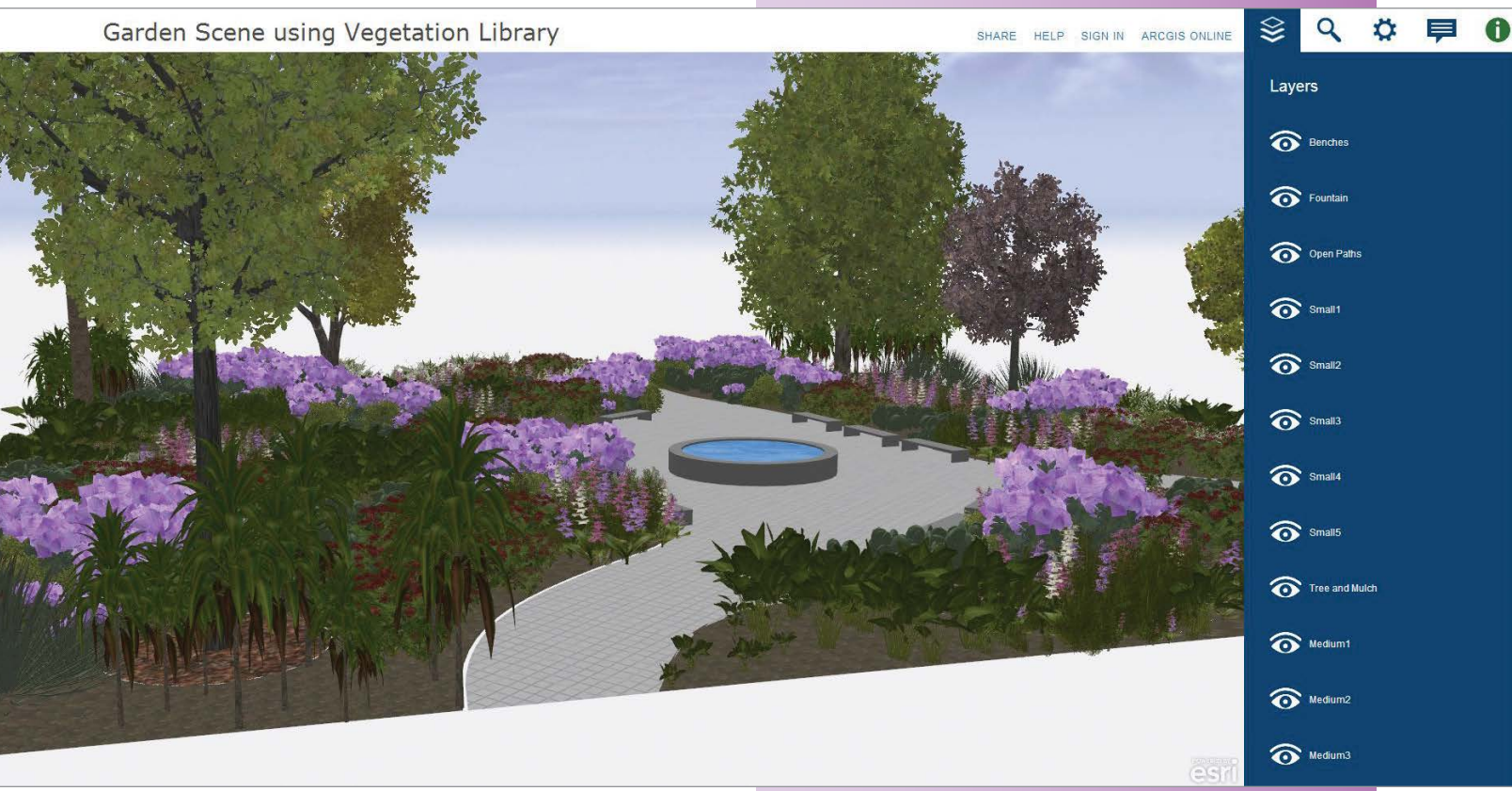
The Esri 3D Vegetation Library is an out-of-the-box toolset you can use to generate high-performance, realistic plant models for design projects ranging from small gardens to forests. The library contains 3D plant models from e-on software that are compatible with e-on's LumenRT Immersive Visualization solution. Esri CityEngine scenes and plants can be imported directly into LumenRT.

The Esri 3D Vegetation Library contains 80 realistic 3D models of flowers, shrubs, and trees. Each plant also comes with a solid representation for creating analytical or thematic 3D maps.

Procedural rules for creating lifelike 3D vegetation populations are included so not only can single plants be placed onto points, but thousands of plants can be arranged on a landscape with a custom mix of species. Models can be generated based on genus, species, common name, height, or crown diameter.

Download the library, explore interactive WebGL scenes, or watch the LumenRT videos at the 3D Vegetation with LumenRT Models details page in ArcGIS Online.

↓ The free Esri 3D Vegetation Library contains 80 realistic 3D models of flowers, shrubs, and trees.



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It Can't Wait

Making communities more resilient to climate change now

In a White House speech in March 2014 announcing Esri's support of president Barack Obama's Climate Data Initiative, Esri president Jack Dangermond noted that local governments are already using GIS to "bring climate change data to life."

He showed how GIS is being used to transform the way the United States and other nations are addressing climate change. Created to better understand and safeguard the earth, GIS is *the* framework for devising strategies for dealing with a world roiled by the effects of climate change.

The *National Climate Assessment for 2012* notes that extreme weather events, such as droughts, high-intensity hurricanes, and severe flooding, have increased and are likely to continue increasing as the world's climate warms. These events seriously impact the world's population and its economic well-being as well as the environment.

According to the *Stern Review on the Economics of Climate Change,* if measures are not taken to deal with increasingly common extreme weather events, the cost of climate change could increase to "around 20 percent of global GDP by the end of this century."

Although climate change is typically discussed at the global or national level, communities are on the front line of climate change, dealing with wildfires, floods, and droughts. Mitigation, response, and recovery efforts originate at the community level.

As environmental conditions shift, familiar policies and standards become obsolete. Communities need to better understand these conditions and adopt policies and procedures that reflect this "new normal." They need new ways to keep citizens safe and businesses operating. Only through understanding the risks communities face can proactive policies be developed and implemented that will increase their long-term resilience to the effects of climate change.

Why GIS?

Because climate change encompasses the interdependent relationships between land, ocean, atmosphere, and the effects of human activity, it requires the powerful multidimensional framework of geography.

GIS is the technology that harnesses this framework so data can be explored in context, patterns discovered, information generated, and scenarios tested. It has evolved from applications that merely collect and display data to systems that can perform complex simulation and modeling.

The utility of GIS in addressing climate change extends from its tools for integrating big data from sensors and other unstructured

↑ Typhoon Haiyan, which devastated portions of southeast Asia in November 2013, is the deadliest typhoon to hit the Philippines. *Photo courtesy of the European Union Humanitarian Aid and Civil Protection department.*

↑ Esri president Jack Dangermond speaking in support of the Climate Data Initiative during a White House press conference in March 2014

data sources with managed and location data to the design models for evaluating strategies to planning the implementation of the best of those strategies.

The development of the ArcGIS platform, and especially ArcGIS Online with its maps, apps, and services, has opened the power of this framework beyond specialists and scientists to policy makers, knowledge workers, and citizens. It lets anyone ask questions of the data without ignoring its complexity.

In dealing with the earth's altered circumstances, the ArcGIS platform enables multidisciplinary collaboration in a way that promotes the dialog that is so vital in creating the societal will—often so difficult to obtain—that is necessary for success.

Enabling Meaningful Comparison

The Urban Observatory, introduced at the Esri User Conference last year, uses the ArcGIS platform to help better understand cities. The world is an increasingly urban place with estimates that the majority of the world's people will live in cities by 2050. Many of those cities, located in coastal areas, are among the most vulnerable to the effects of climate change. Much can be learned from studying cities but, until recently, the data on those cities was collected at different scales and in different ways, making comparison problematic.

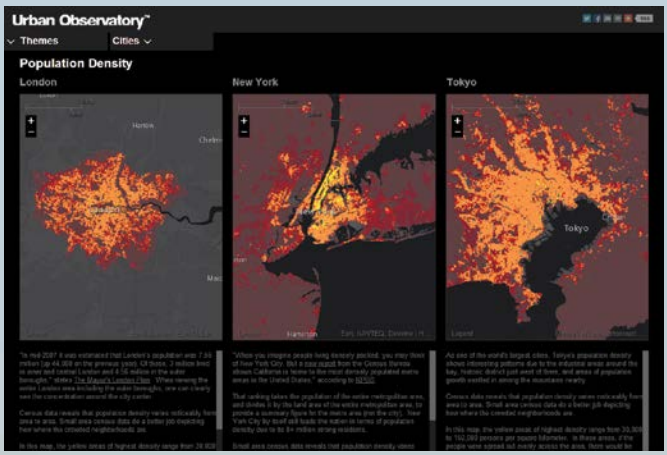
The Urban Observatory, through its use of ArcGIS, integrates information by mapping this data, standardizing its scale, and allowing for visualization and more detailed comparison of cities. Richard Saul Wurman, Radical Media, and Esri created this tool for understanding cities. Learning about which strategies work and which don't can save lives and potentially trillions of dollars.

Urban Observatory (www.urbanobservatory.org) continues to grow with the addition of 105 new maps in May 2014. It returns to Esri User Conference this year, with an interactive showcase that leverages touch screens, multimedia content, and advanced, cutting-edge display technology.

Opening Up GIS

ArcGIS Online, a vital component of the ArcGIS platform, lets individuals and organizations capitalize on the abundance of resources it makes available by using Esri Story Map apps. These apps simplify the map creation process so people who are not

↑ GIS tools can integrate big data from sensors and other unstructured data sources with managed and location data, providing a comprehensive perspective.



↑ The Urban Observatory, through its use of ArcGIS, allows an "apples-to-apples" comparison of cities.

GIS experts can combine and explore resources and integrate related data and observations. This can let them better understand and communicate the effects of climate change so more effective adaptive measures can be adopted.

Resilience Resources

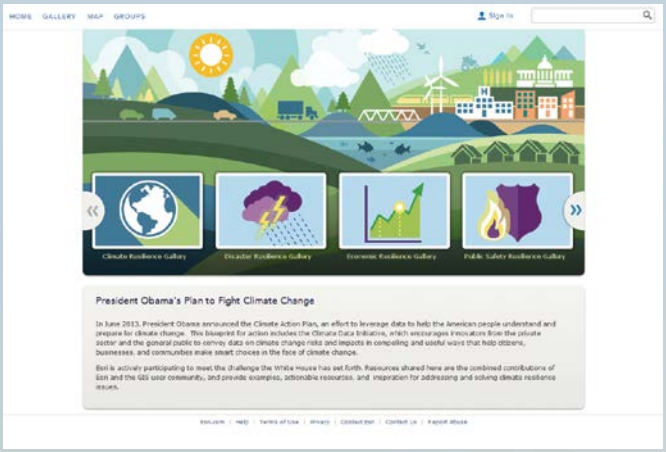
Esri is hosting a new geocollaboration portal (resilience.maps.arcgis.com/home/) on ArcGIS Online as part of its support of the White House Climate Data Initiative. The initiative, part of the larger Climate Action Plan, encourages tech innovators to develop apps that use the government's climate data in a way that helps citizens, businesses, and communities make decisions that will mitigate the impact of climate change. The geocollaboration portal is a mechanism for sharing knowledge and resources. People use it to discover, contribute, and share resources critical to confronting the impacts of climate change.

"We felt it was important to establish this collaborative network of individuals and organizations that use GIS to come together to combat the impacts of climate change," said Dangermond. The Esri portal contains maps and other resources organized into various categories of resilience: climate, disaster, economic, public safety, and transportation and infrastructure, as well as the UNISDR Making Cities Resilient gallery. UNISDR, or United Nations International Strategy for Disaster Relief, launched the Making Cities Resilient campaign in 2010 to address the issues of local governance and risk in urban areas.

Save the World—Make an App for That

In addition, Esri is sponsoring the Climate Resilience App Challenge. "We need to address the impacts of climate change immediately," said Chris Thomas, Esri's director of government markets. "Esri is calling on developers to create applications that help collect and exchange data, analyze and plan for a wide variety of weather-related impacts, educate the public, and encourage citizens to take personal responsibility."

Open to anyone in the world, the contest will award prizes to the developers of the top three applications that focus on solutions to climate-related issues. With these apps, regional government agencies, businesses, and others would have the tools to make the data already regularly collected by agencies such as



↑ The geocollaboration portal (resilience.maps.arcgis.com/home/) is a mechanism for sharing knowledge and resources.

National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA) useful. For example, apps could improve preparation for and reaction to severe weather events. Apps will be judged on the creative use of data, Esri apps, maps, services, and APIs. Winners will be recognized at the Esri User Conference in July 2014.

Resilience Worldwide

In addition to its support of the White House Climate Data Initiative, Esri has partnered with the UNISDR to build a global community of resilient cities with the aid of GIS technology. This agreement builds on an existing UNISDR campaign, Making Cities Resilient. Esri is committed to providing expertise, support, and capabilities on a global scale for the Making Cities Resilient effort.

Margareta Wahlström, the head of UNISDR, said, "This partnership with Esri can help bridge the gap between aspiration and implementation by putting the latest science and technology at the disposal of those who have joined the Making Cities Resilient campaign."

At the 2014 Esri User Conference, Esri will launch an app challenge centered on UNISDR's 10 Essentials for Making Cities Resilient to be followed by a competitive grant program that awards ArcGIS Online for Organizations accounts to selected cities and nonprofits.

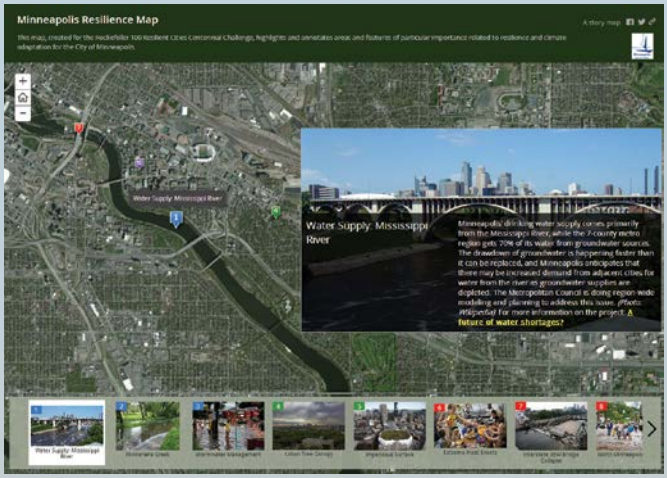
More Than Just Data

Successfully applying GIS requires the right data—the data needed to address a specific issue—in a format accessible to tools that can produce meaningful information.

Making that data accessible requires support for open standards and interoperability, something that Esri has long supported through its active participation in the development of various standards such as those supported by the Open Geospatial Consortium (OGC).

In May 2014, Esri announced its support for a new OGC specification, the GeoPackage Encoding Standard. "Esri continues to add support for many open and interoperable data sources," said Keith Ryden, the Esri software development team member who led Esri's work on GeoPackage. Adding GeoPackage support was a natural progression to Esri's previous support of the OGC's various other standards.

↑ Data and other resources gathered by government agencies and others are made readily available through the geocollaboration portal.



↑ This map, created for the Rockefeller 100 Cities Centennial Challenge, highlights areas and infrastructure related to resilience to the effects of climate change.

Reexamining Assumptions

The increasingly devastating effects of flood, wildfire, drought, and other calamities that have been accentuated by climate change make it apparent that the status quo is no longer sufficient.

The regulations, policies, and procedures that were once effective in protecting lives, property, and prosperity are no longer viable in this rapidly evolving world. GIS is uniquely suited to address this complex process of assessing risks and developing strategies for minimizing those risks.

Esri was founded on the belief that geography is at the heart of a more resilient future. It is actively engaged in the quest to better understand and tackle the problems associated with climate change. The ArcGIS Platform supports an ecosystem of maps, apps, and services that fosters the creation, integration, and sharing of information about the state of the planet. Esri supports standards that make this possible and the tools that enable developers and users in the private and public sectors to formulate innovative approaches for dealing with the pressing problems associated with climate change.

Working Together

Esri has partnered with other organizations working on complex climate challenges. These partners include the International City/County Management Association (ICMA), National Association of Counties (NACO), National League of Cities (NLC), Tumml, American Public Works Association (APWA), American Planning Association (APA), Association of State Floodplain Managers (ASFPM), American Water Resources Association (AWRA), International Association of Fire Chiefs (IAFC), Local Government Commission (LGC), National Association of Development Organizations (NADO), National Alliance for Public Safety GIS Foundation (NAPSG Foundation), National Information Sharing Consortium (NISC), National Oceanic and Atmospheric Administration (NOAA), National Association of County and City Health Officials (NACCHO), Trust for Public Land (TPL), and Public Technology Institute (PTI).

Esri is committed to providing the platform and tools that will help communities throughout the world access content, do analyses, share results, and together meet the challenges of climate change.

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Audit Ready

USCG validates real property assets

By Matthew DeMeritt, Esri Writer

In 2012, the United States Coast Guard (USCG) had to complete an enterprise-wide shore infrastructure real property audit within a year to comply with a new federal act. The agency completed the audit within the required time frame using a validation process that incorporated ArcGIS and GPS.

Changing Audit Requirements

The Chief Financial Officers (CFO) Act of 1990 established chief financial officers in major federal agencies and enhanced federal financial management activities to include annual audits of financial statements.

Building on the CFO Act, president George W. Bush issued Executive Order 13327 in 2004, which focused on federal real property asset management and stated, "The policy of the United States is to promote efficient and economical use of America's real property assets and to assure management accountability for implementing federal real property management reforms."

This order created the Federal Real Property Council (FRPC) to establish and enforce more stringent annual real property reporting requirements. The council outlined no less than 26 data elements that must be captured for uniform reporting of federal real property assets.

"The provisions of those directives required that federal agencies document the existence and completeness of all real property inventories," said Peter Spinella, real property specialist at USCG. "This means the Coast Guard must thoroughly demonstrate knowledge of its real property holdings and have recent photographic evidence of each asset."

Previous shortcomings in accounting for real property contributed to failed attempts by the USCG to pass CFO Act audits. The USCG made a commitment to the Department of Homeland Security (DHS) to pass the 2012–2013 audit. This required validation of the USCG's real property inventory of more than 50,000 individual assets at locations from Maine to Guam before June 2013.

Forming a Plan

The USCG developed a real property Asset Enrollment Template (AET) for capturing the information necessary to meet CFO Act/FRPC documentation standards. Each real property asset in the portfolio has an associated AET on file.

Each AET contains data about an asset that includes its real property unique identifier (RPUID); age; historic cost; unit of measure; and size along with a current photograph containing an embedded date stamp, RPUID, and the asset's geographic coordinates. These are just a few of the 26 data elements that the FRPC requires for uniform reporting. The status of each file, from creation to final approval, is tracked in Microsoft SharePoint.

Initially, the methodology for gathering and processing the data required to generate an AET was unnecessarily arduous. It used professional surveyor-grade GPS receivers and Microsoft Office software—two products not designed to interoperate—to crudely layer GPS information onto digital photos.

To increase work efficiency, the USCG Civil Engineering unit in Providence, Rhode Island, researched and prototyped the use of a GPS-enabled camera and its accompanying software application. The GPS-enabled cameras easily and quickly acquired geotagged photos, and their use was adopted throughout the USCG as the most efficient method for acquiring AET photo documentation.

Capturing Big Footprints

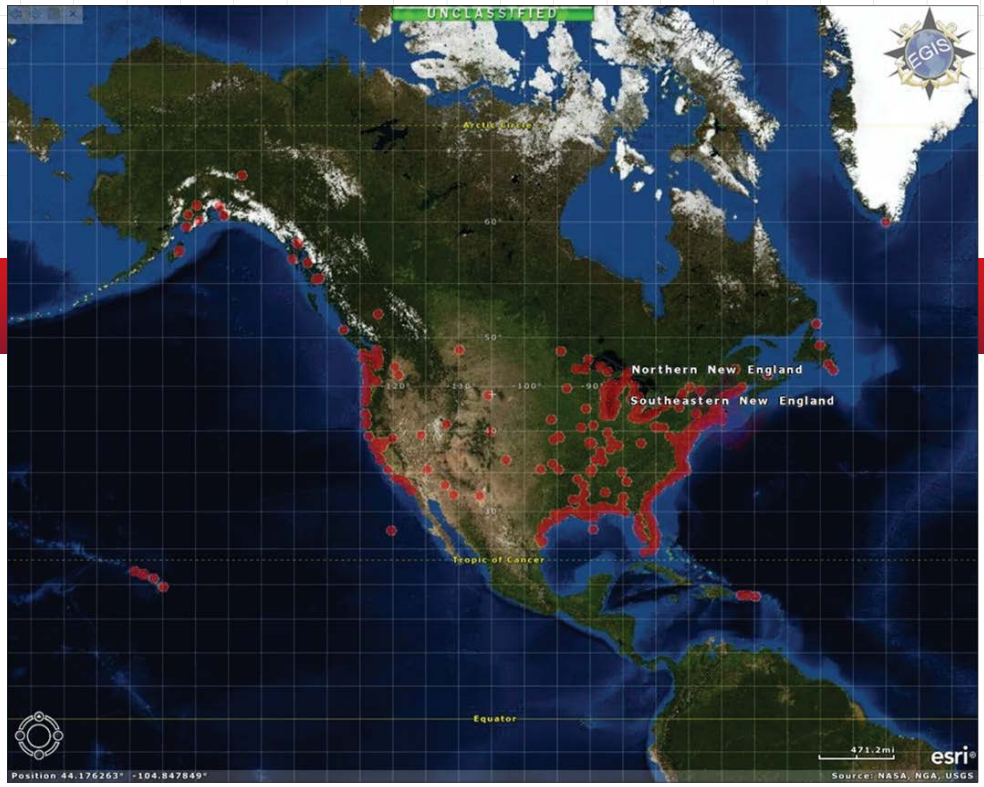
In addition to photo-processing challenges, Spinella and his team also discovered that measuring larger assets using traditional methods, such as measuring wheels and tapes, significantly limited efficiency. With so many large assets to validate, this threatened to delay completion of the DHS audit.

The USCG had to develop a new method to gauge the area of its large-footprint real property holdings. They started by building a geodatabase for the site using the correct state plane and projections and creating polygons and features.

"This gave us a table so that, if we were measuring the gross square area of a roadway system, each polygon showed up in the table for that feature class," said Spinella. "That returned not only the individual sizes but also the total square area of the roadway system."

↗ Mapped GPS points obtained from asset photos show the location of USCG real property.

↘ GPS-enabled cameras documented the location, condition, and inspection date of real property assets.



By demonstrating the accuracy of building and structure measurements using ArcGIS software and current aerial imagery, Spinella and his team were able to convince stakeholders that ArcGIS could determine the size of infrastructure, such as airfields and property lines, to within 5 percent accuracy, eliminating the need to physically measure large structures.

"Incorporating these two technologies into our AET production/property validation process saved thousands of man-hours and millions of dollars in travel costs," said Spinella.

Keeping Up-to-Date

Moving forward, the USCG is currently working to establish a process to keep the property inventory data current, as normal operations and maintenance will inevitably require updates to the metadata of individual assets. Spinella and the team are currently developing the capability to give operational commanders asset visibility using ArcGIS. With the mountain of data gathered during the initial inventory validation establishing the USCG shore infrastructure real property baseline, creation of near real-time links to project and work-order databases, and new configuration control processes that hold officials accountable for unauthorized changes, the Coast Guard will be able to sustain its real property inventory in audit-ready condition.

For more information, contact Peter C. Spinella at Peter.C.Spinella@uscg.mil.

Saving Space and Time with Mosaic Datasets

By Peter Simmons, The Regional Municipality of York, and Chris North, 43 North GIS Consulting Inc.

The GIS team for the Regional Municipality of York (York Region) implemented new image mosaic capabilities using ArcGIS 10 to create mosaics more efficiently while improving the accessibility of information for organizations across the region.

Located just north of Toronto, Ontario, Canada, the Regional Municipality of York is a diverse area of 1,756 square kilometers (678 square miles). The region's Geographic Information Services Branch (GIS Branch) works with nine local municipalities, two conservation authorities, and two school boards and their respective GIS staff, to provide services to their organizations. The management and delivery of imagery/raster datasets for the region are the most demanding services the GIS Branch provides. This imagery is used for location visualization, work planning, and emergency management and dispatch support, among other business processes.

The GIS Branch serves a variety of spatial data and services to more than 330 desktop GIS users and thousands of visitors to the region's internal and external website. For raster data, the GIS Branch manages:

- Three catalogs
- 16 regional coverage datasets
- 13 orthophotography datasets
- Multiple years of imagery collections from 1995–2012

Orthophotography is also widely used. Each year, the GIS Branch collects 275 MB to 416 GB in orthophotography (depending on the resolution and number of images) and manages two terabytes of orthophotography data, ranging in date from 1995 to 2012 with resolutions of 3 cm to 50 cm. The use and transfer of massive files associated with spatial raster data, such as orthophotography, can grind the region's network and all the workstations on it to a halt.

Raster Mosaics Had Shortcomings

To help address this issue, the GIS Branch implemented the use of tiling and image mosaics. While some improvements to network and workstation performance were realized, the introduction of tiling and image mosaics introduced a new set of challenges.

Duplication became an issue. The individual tile TIFF images were stored on the file server, while the raster mosaic was stored on a separate ArcSDE instance in Oracle. This doubled the disk space required to 4 terabytes and necessitated a separate instance of Oracle.

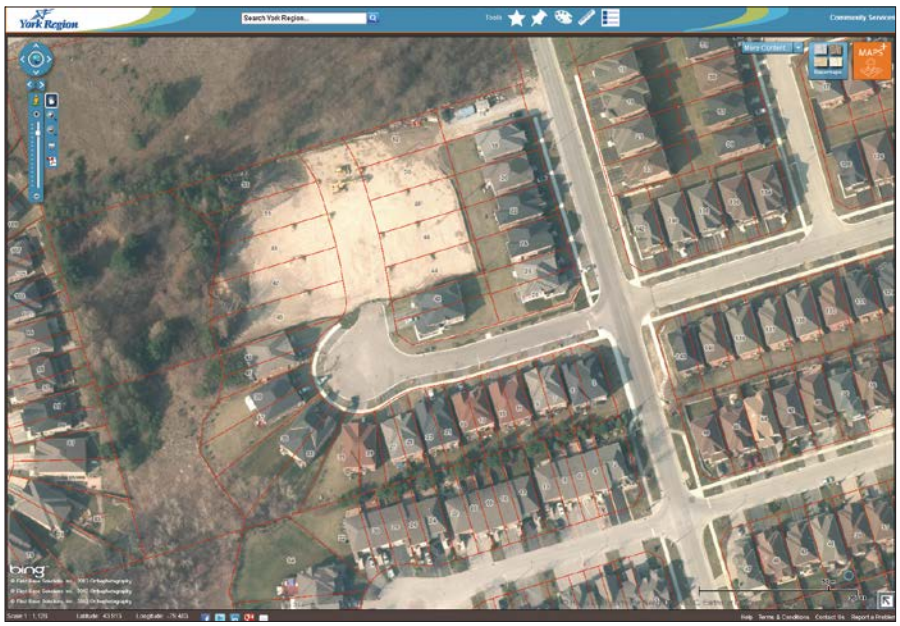
Image file size became another issue. The oldest imagery was not available to ArcGIS desktop users because its inconsistent image file sizes (length and width) would not mosaic into ArcSDE. The time required to create a raster mosaic of the region was at least 24 hours, and another 24 hours was needed to run pyramids and statistics on the mosaic. Prior to running the process, a GIS technologist would spend about 7 hours writing and testing the scripts and then several more hours monitoring the process and testing the result.

A New Approach to Mosaic Datasets

Given these challenges, the GIS Branch identified the need for a new approach to creating mosaic datasets. The branch believed that the mosaic dataset available at ArcGIS 10 could help solve the storage space and time problems. To quickly familiarize staff with the new

Method	Number of Hours		
	Staff Time	Processing Time	Total Time
ArcSDE Mosaic	14.5	54	68.5
10.x Mosaic Dataset	4	23	27
Time Savings	10.5	31	41.5

↑ Figure 1: Comparison of both staff and processing time required to create a mosaic dataset between the York Region's old method using an ArcSDE instance in Oracle, and its new method, creating a mosaic dataset using ArcGIS 10.



↑ The Regional Municipality of York has grown rapidly from a population of 166,000 in 1971 to more than 1.1 million today. Historical raster data helps illustrate this growth.

technology and ensure proper implementation, the GIS Branch sought assistance from external resources. The deliverables defined included an environmental scan of the current raster data management technologies and emerging trends, implementation of a best practices solution, and technology transfer to regional staff. Over a period of two months, 43 North GIS Consulting Inc. worked with staff to reach these goals.

The new mosaic datasets method is easy. It is completed by one person with the process running in the background during a workday on an average high-speed computer and without special software. Having one person create the mosaic dataset without the assistance of the database administrator reduced staff time. There are no scripts to write or Oracle work required.

Creating the mosaic dataset takes seconds, while adding the raster files only takes a few minutes. The bulk of the process (about 2.5 hours) involves building overviews for the 1,100 images that cover the region. Compared to the previous process, which took two days to mosaic the images, build pyramids, and run statistics on the mosaic, the new mosaic dataset delivers substantial gains to the GIS Branch and, in turn, the region.

Images are available in an enterprise geodatabase less than two days after they are received rather than taking more than a week. The new mosaic dataset also eliminates approximately 2 terabytes of storage from data duplication, as well as the need for an additional Oracle instance.

In the proof of concept, one orthoimagery collection was processed using both the old and new methods and the times logged in the table shown in Figure 1.

Access to Data That Was Previously Unavailable

The mosaic dataset in ArcGIS 10 allowed the region to publish MrSID images from 1995 into the enterprise GIS database environment. These images were not previously available as a mosaic due to different sizes of the image. MrSID images had been stored offline and were not accessible to GIS users throughout the region. This historical data is valuable and frequently requested by departments in the region.

Imagery in multiple resolutions can now be used in one mosaic dataset. While the region generally only has one resolution per year, some years have strips of higher resolution imagery. These are now part of a mosaic dataset along with the lower-resolution data. Users see either the low- or high-resolution imagery, depending on the zoom level.

Another advantage is the mosaic dataset footprints can be manipulated by removing unwanted pixels (commonly the black pixels found at the edge of images that have been clipped). This is done by re-creating the overviews with just those images with black areas selected in ArcMap. This lets the user only see what they need and eliminates areas with no value.

Highlights of the Mosaic Datasets Method

The new process was tested in January 2013 and implemented in March 2013. The new method to create a mosaic dataset was then transferred throughout the region. The new solution enables the creation of a high-performance regional mosaic 40 hours sooner than the previous method. This new method:

- Provides access to new types of imagery files and historical information.
- Needs half the storage space.
- Streamlines processing and eliminates the need for multiple technicians to manage the mosaic.

While the region's new mosaic datasets method clearly delivers time and storage space savings to GIS staff across the region, its true value is the increased access to data that it delivers. Decisions affecting development, utilities, water and wastewater, education, transportation, and others, benefit from access to current and historical imagery. By providing access to mosaic datasets, GIS staff can now help to support these critical decisions and the timely delivery of services across the region.

To see the region's orthophotography, visit www.YorkMaps.ca.

About the Authors

Peter Simmons is a GIS technologist with the Geographic Information Services Branch, The Regional Municipality of York, in Ontario, Canada.

Chris North, MSc, is the principal at 43 North GIS Consulting Inc., located in Toronto, Ontario, Canada.

We're All Storytellers Now

By Allen Carroll, Program Manager, ArcGIS Online Content

Awareness of GIS outside the geospatial community has grown—slowly, perhaps, but steadily. Access to spatial information has vastly increased because millions of us walk around with powerful computers—mobile phones in our pockets or laptops in our backpacks. Many of us have broadband Internet connectivity in our homes and offices.

We know that communicating the results of our work—simply and compellingly—has become a key part of our work. If we fail to communicate our results, to tell our stories, we fail as professionals. Our managers and stakeholders are continually trying to navigate a blizzard of information. Spreadsheets no longer convince. Plots of complex, multilayered GIS data are not effective for non-GIS audiences. Communication has become as essential to GIS work as more traditional activities such as data management and spatial analysis. We're all now storytellers, whether we want to be or not.

As these changes have expanded our roles, additional capabilities in GIS have been developed that help tell our stories. This began when ArcGIS started incorporating enhanced cartographic tools that help GIS users produce maps that are more attractive and effective as information products. This trend has continued as web services enable GIS users—and, increasingly, everyone else—to create mashups from multiple sources and enliven maps with pop-ups and interactive functionality.

Most recently, web and native apps let people incorporate spatial data into a variety of user experiences. People can follow audio tours on their cell phones; they can ask their devices to inform them when they're close to points or areas of interest; they follow spatial narratives; they can vote and Tweet on maps; and they can compare changes to an area by swiping between two maps.

Meanwhile, the proliferation of connected devices has (belatedly) helped spur the mass emancipation of data. For many years, spatial data largely resided inside the organizations that created it. In its slave state, the data served those host organizations reasonably well. By emancipating this data, it can serve vastly broader audiences and diverse purposes. Data can be manipulated by many more users and combined and integrated with other data to serve new, and sometimes unanticipated, uses.

But the key and sometimes unrecognized aspect of making specialized geospatial data accessible to new audiences is that it must be presented and interpreted in new ways. Cartography needs to be simplified. Technical terms need to be eliminated from legends. Text summaries need to be written in accessible language. User experiences need to be developed to facilitate easy navigation and use of the data.

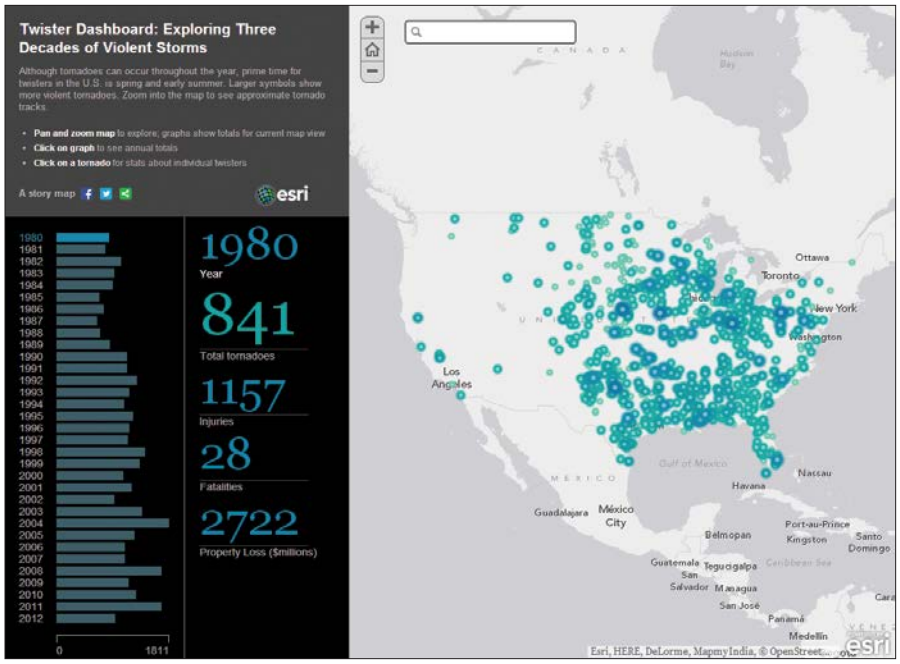
Esri Story Map apps and a variety of other apps by Esri and its partners have been developed for just this purpose. By stripping away unnecessary technical detail and presenting data in accessible, intuitive user experiences, these apps help GIS professionals present data to managers and colleagues within their organizations. These same apps can help organizations tell their stories to customers and constituents. These maps can describe an organization's work, increase public understanding of trends and phenomena, and recruit audiences to help enrich data with their observations.

It's tempting to think of storytelling platforms—web and mobile apps—as novelties or extras that don't really do the core business of GIS. This is *not* the case. GIS cannot be fully effective if it doesn't communicate, convince, educate, and inform.

As GIS professionals, we want to help make our companies more profitable or our agencies more effective. We want to make human society more healthy, affluent, and sustainable. We will not achieve these goals if we don't communicate our insights. Storytelling is key to our success.

About the Author

Allen Carroll leads an Esri team that works on the development of the Story Map app. He came to Esri after 27 years at the National Geographic Society. As chief cartographer, he was deeply involved in the creation of the society's renowned reference and wall maps, globes, and atlases. He spearheaded the creation of websites and publication of maps that ranged from wall maps and supplement maps to special projects featuring biodiversity and indigenous cultures.



Whetting an Appetite for Geospatial Apps at the

2014 Esri International Developer Summit

By Carla Wheeler, Esri Writer

Esri DevSummit by the Numbers

Nearly 1,800 attendees
Almost one-third of them newcomers
300 Esri staff members in attendance

Development Work

33 percent using .NET ArcObjects
30 percent using JavaScript
25 percent using Python

They came hungry.

They had an appetite for ArcGIS API for JavaScript, ArcGIS Runtime SDKs, Python, Ruby on Rails, Web AppBuilder for ArcGIS, ArcGIS Pro .NET SDK, Esri Geotrigger Service, and anything else available to build and power their geospatial apps.

When they left the Esri International Developer Summit (DevSummit), held March 10–13, 2014, in Palm Springs, California, the 1,800 developers and GIS professionals were well fed, stuffed with knowledge from more than 200 technical sessions hosted by Esri.

Boris Lutskovsky of Portland, Oregon, uses ArcGIS API for JavaScript and ArcGIS for Desktop in his work at EarthSoft, which makes environmental data management software. But he branched out at the DevSummit, getting a taste of Python and Node.js. He raved about a technical session called Accessing and Visualizing Esri Geoservices with ArcGIS API for JavaScript, D3, and Node.js, which focused on how to make compelling maps and visualizations from a multitude of services.

"It perfectly matches an issue I'm working on right now," said Lutskovsky, who likes the DevSummit's educational aspects. "It was really good to get one-on-one time with Esri developers and learn some new skills with new technology."

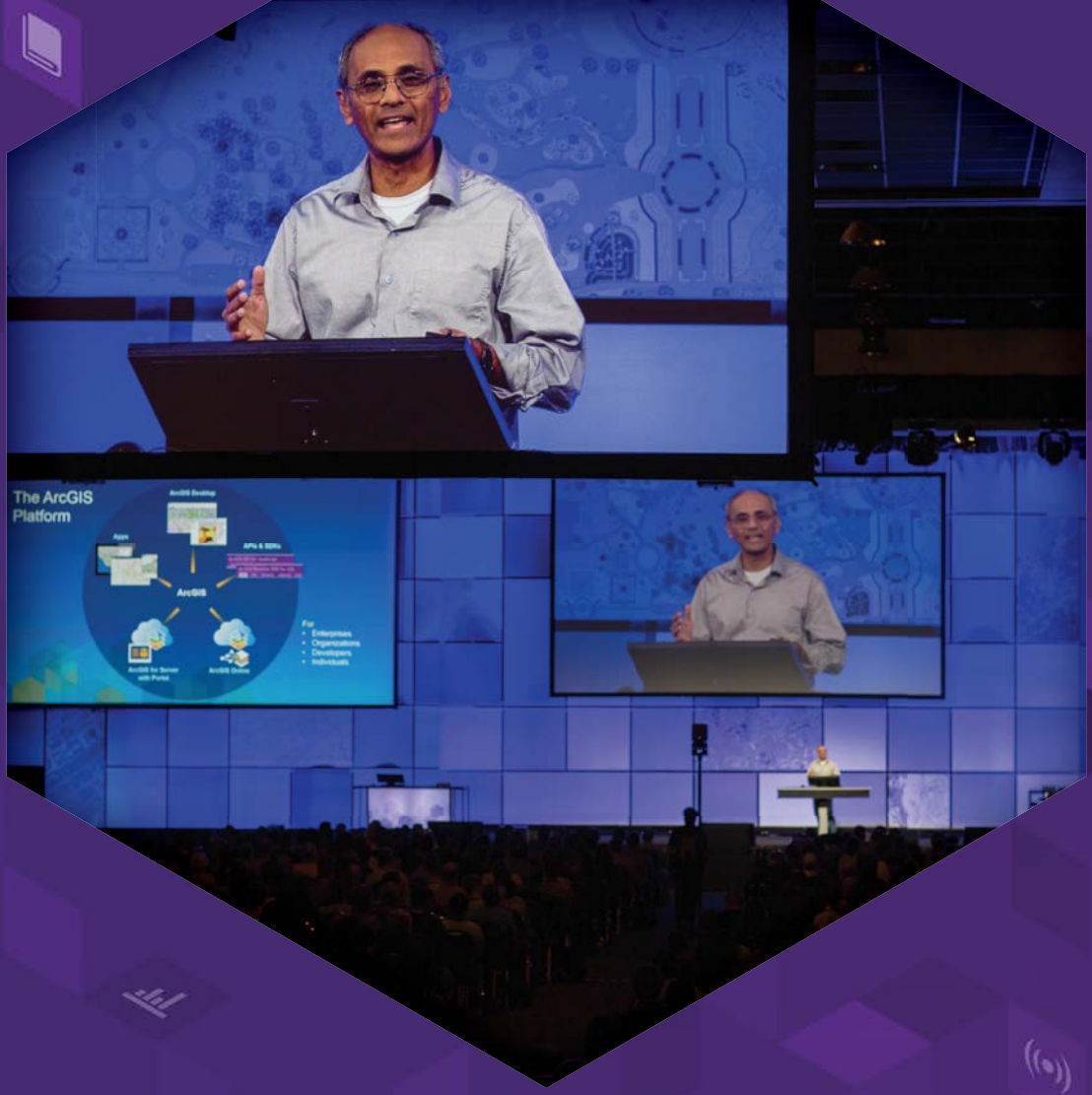
Esri hosts the DevSummit annually to familiarize developers with the ArcGIS platform and offer training and technical workshops that will help them build apps with geospatial functionality. In welcoming attendees, Esri president Jack Dangermond told them that the company is upping its commitment to supporting developers.

"We've been lifting up the hood of the platform and making it a strong platform for developers," Dangermond said. "This has meant opening up a lot of things—opening up some of our software to open source with GitHub, opening up our data models with open data programs and applications, and also opening it up for easy configuration and development with lots and lots of resources for developers."

Esri director of software development Sud Menon spoke about what the ArcGIS platform does for developers, including creating maps and authoring apps to share with users.

That's what Jessica Altamira plans to do with ArcGIS. She attended DevSummit to get training and tips on how to develop a web app for a resort owner on Long Caye in Belize. Altamira is a student in the master of science GIS program at the University of Redlands in California. For a school project, she will develop an online app that will help the resort publicize the island's ecologically valuable areas to potential visitors.

The features she will map include mangroves, coral reefs, and lagoons. "I would like users to be able to zoom in to their area of interest and view the vegetation layers with pop-up windows



containing pictures of the area," Altamira said.

To learn about creating apps for the web, Altamira attended the session Introduction to the Web AppBuilder for ArcGIS: JavaScript Apps Made Easy. (In the summit agenda, the new Web AppBuilder for ArcGIS is described as a pure HTML5/JavaScript-based application that lets developers create intuitive, fast, and beautiful web apps without writing a single line of code.)

"A basic knowledge of widgets and web design is a must for my project," Altamira said.

She also attended Publishing and Using Map Services with ArcGIS for Server and Introduction to ArcGIS API for JavaScript sessions, where she said she got some "good tips and tricks."

Altamira said she also may use ArcGIS Online to create Story Map apps for Long Caye, which is near the famous diving site the Great Blue Hole. "User-friendly maps are always a good promotion technique for vacationers seeking a tropical island getaway," Altamira said.

Nicolas Roldos, another student in the master of GIS program at the University of Redlands, went to the DevSummit to learn about the new Esri Geotrigger Service. The Geotrigger Service gives developers the technology and tools to configure apps for Android and iOS devices that send users location-based alerts while keeping battery drain to a minimum.

Roldos is using the Geotrigger SDK to develop a location-based service to advertise concerts and sales at record stores in and around Los Angeles, California. "I have set up a framework for an iPhone application targeting small record stores and live music venues in the LA basin," Roldos said.

> "I was ecstatic to be surrounded by GIS nerds."
>
> Jessica Altamira

Here's his idea: With the app on their smartphones, users would receive an alert that notified them about a concert at a music venue or a sale at a record store when they entered a specified geographic area or "trigger zone" near the venue or store. "For example, a record store in Long Beach may have a 40 percent markdown on vinyl records on [a certain] day," Roldos said. "A trigger can be set up around the store and its vicinity to alert passersby of this sale without using flashy signage, e-mail blasts, paper flyers, or other forms of marketing."

Roldos thinks the Geotrigger Service embodies the power of *where*.

"With my app, the concertgoer or record buyer is empowered by his or her location and proximity to participating stores and rewarded with a coupon or markdown on ticket price," he said. "The power of *where* supersedes the power of, say, a large customer e-mail database or flashy signage. With so many people using smartphones to make decisions on entertainment and shopping, an application using the Geotrigger SDK hits the nail on its head in terms of providing a customer or concertgoer with an experience that is relevant and redeeming."

Roldos said he left Palm Springs armed with the information he needed to build the location service. "DevSummit was a lifesaver in terms of getting me where I need to be in my understanding of *[the Geotrigger Service]* to integrate the SDK into my app," Roldos said. "The summit overall was very helpful for my project, my knowledge of what Esri makes available, and the amazing growth Esri is having in its developer platforms. It was clear that Esri is taking the lead in developing GIS for the next generation."

Web app developer Alex Bostic from URS Corporation, an engineering, design, and construction firm, was at his fifth DevSummit. Bostic lives in West Virginia but develops web apps for the Tampa Bay Partnership, an organization that promotes economic development in the Tampa Bay area of Florida.

Bostic plans to use Esri Business Analyst Online and Story Maps apps, along with ArcGIS Online, to give businesses interested in relocating to the Tampa Bay region the means to analyze educational information about the potential work force in the area.

He said the businesses, often high-end medical device and financial services companies, want to see where universities are located on a map and find out information about the graduates.

For him, the DevSummit is a must-attend event. "Being able to make connections with Esri developers and others creates a support network that would not be established otherwise," said Bostic. "The keynote *[speaker]* Chris *[Wanstrath of GitHub]*, was a huge part of my liking the experience this year. His presentation style and talking points appealed to me. Also, the Innovation Lab is a good experience because you get to see cutting-edge stuff that makes light bulbs go off."

(Read about the DevSummit keynote by GitHub cofounder and CEO Chris Wanstrath in "It's All about Collaboration: Open source and the future of software" also in this issue. View the DevSummit Plenary Session videos at video.esri.com.)

For developers interested in geospatial technology, Altamira said DevSummit is like no other conference.

"I was ecstatic to be surrounded by GIS nerds," she said. "No sarcasm there. I'm glad this field is really moving forward. Networking was quite easy and enjoyable. Although I'm only 22, I realize gaining this type of exposure at a young age is great!"

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Fun and Games at DevSummit

Duck and Throw

It wouldn't be the Esri International Developer Summit (DevSummit) without the DevSummit Dodge Ball Tournament. This year, 31 teams squared off on Wednesday night to compete for the top prize: free passes to the 2015 DevSummit. Bracket winners also received special T-shirts. The winning team, the Dirk Diggler All-Stars, was composed of Bradley Harried, Polar Geospatial Center; Greg Schulz, Target Corporation; Jeremy Moore, Minnesota Department of Natural Resources; Matt McLees, Scott County, Minnesota; Patrick Thorsell, Scott County, Minnesota; and Joshua Pust, Target Corporation. Julie Powell, Esri; Eric Ito, Esri; Russ Roberts, Esri; Mike Shaw, SpatialMax; Dave Wright, i-cubed; and Nathan Noble, Vestra Resources, filled out the roster for the second-place team, the Sitting Ducks.

Less Is More

The ArcGIS JavaScript Code Challenge (aka 100-lines-or-less-js Esri mapping app code challenge) demonstrated how real-world problems can be solved with just a little code using ArcGIS API for JavaScript. To enter, contestants visited the 100-lines-or-less-js project on GitHub, forked the repository, and made pull requests to submit code. The contest, which ran from March 8–27, drew 18 entries.

GeoHappenings, an app that provides real-time social mapping for events (like DevSummit), topped the field. For the win, its creators, Jeremy Folds and Nick Volpe of DTSAgile in Fort Collins, Colorado, received a DevSummit 2014 pass and an ArcGIS Online subscription. Volpe accepted in person, while Folds accepted on his phone via Facetime from his office in Colorado.

This was the first coding challenge the two had entered. "All in all, it was a fun app challenge, and we enjoyed competing in it," said Folds. "Watching all of the messages roll in on GeoHappenings from different parts of the globe was really awesome, and there are still a few trickling in here and there."

Second place went to Billy Ashmall for the ISERV Viewer, which makes images of earth captured by the ISS SERVIR Environmental Research and Visualization System (ISERV) available to everyone. Ashmall received a DevSummit 2014 pass. Third place and a $100 Esri Press gift certificate went to Vinícius Machuca for PocketDirections, a simple ArcGIS routing app that runs on various devices.

← The Dirk Diggler All-Stars were the eventual victors in the DevSummit Dodge Ball Tournament.

The Sitting Ducks, shown in action, were second. →

← There was a lot of time for unstructured fun at DevSummit, like this pickup frisbee game.

← Nick Volpe (on right) and Jeremy Folds (on phone) accept the first-place award for their entry in the 100-lines-or-less-js code challenge.

↓ GeoHappenings recording DevSummit social interaction

Endurance Coding

The Esri DevSummit Hackathon contestants gathered in the Renaissance Palm Springs had just one day to create community-oriented apps that integrated Esri's location-based technologies with the APIs of event partners Twilio, SendGrid, Geofeedia, and Microsoft. The County of Riverside, California, supplied its open data.

Entries were judged on innovative and creative use of technology, user experience/user interface, potential for real-world application, and completeness. The first-place team could choose Esri International DevSummit passes for 2014 or 2015 for each of its members and had three minutes to present its entry to the audience assembled for the summit keynote address. Second-place winners received AR Drones 2.0 Quadricopters, while third-place winners got radio controlled copters.

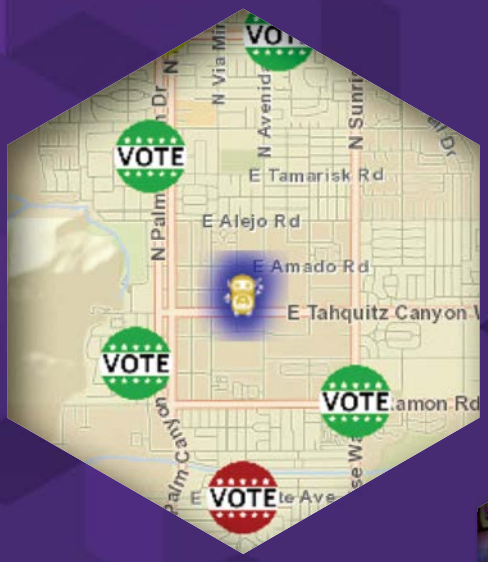
For the second year in a row, the team of Jamie Tran, Mara Stoica, Christopher Moravec, Ryan Colburn, and Agnes Stelmach triumphed. Their polling place app, SAMVotes, was designed to help Riverside County improve voter turnout. The app integrated the .NET SDKs, Windows Store App, and ArcGIS API for JavaScript. SAMVotes won four Xbox Ones provided by Microsoft and Dr Dre Beats Studio Headphones award by Geofeedia.

Jon Nordling and Michael Humber won second place with Riverside County Community Events, an app that connects Riverside County citizens with the county's public services. The app integrated Microsoft Enterprise SQL Server, PHP, CURL, and jQuery Mobile technologies with Riverside County data on the ArcGIS platform. In addition to Esri APIs, it used the Twilio and SendGrid APIs. The app also won Raspberry Pis provided by SendGrid.

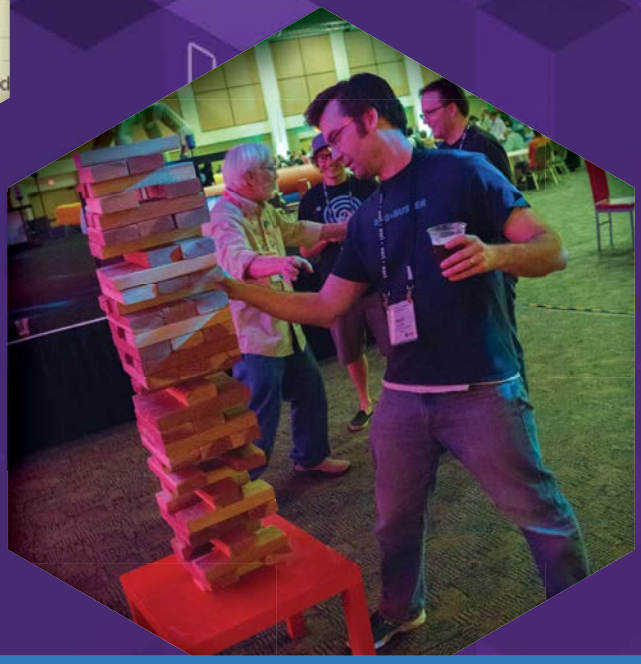
Third-place prizewinner Citizen Reporter, created by Diego Pajarito Grajales, Joshua Tanner, and Shaunak Vairagare, makes reporting incidents easy and encourages efficient decision making. It uses crowdsourcing to prioritize events. The greater the number of reports of an incident, the higher it ranks.

High-Speed Tech Transfer

The world's fastest tech sessions, SpeedGeeking, covered 10 hot topics that focused on mobile but also provided quick insights into the latest in ArcGIS technology for server, big data, security, and visualization.



← SAMVotes app won the Esri DevSummit Hackathon.



← The party on the last day featured a variety of games and refreshments.

It's All about Collaboration

Open source and the future of software

By Monica Pratt, *ArcUser* Editor

"Software development isn't really about software; it's about people," said Chris Wanstrath, cofounder and CEO of GitHub, in his Keynote Address to the attendees of the 2014 Esri International Developer Summit (DevSummit), held March 10–13 in Palm Springs, California.

During the hour-long address, Wanstrath described his journey over the last nine years from Cincinnati to San Francisco and from a disenchanted English major to cofounder of the largest social coding site. During the course of this journey, he changed from a fervent believer in open source who secretly—and with some pangs of guilt—dreamed of running his own business to the pragmatic head of a hugely successful corporation who sees open- and closed-source software development as complementary and, ideally, intertwined.

A (Very) Brief History of Wanstrath

As he energetically roamed the stage, Wanstrath seemed to be having an animated conversation with friends rather than giving a speech to a hall packed with nearly 1,500 developers.

He described himself as a builder who "always liked to draw; liked to write; liked to make music; liked to build castles of mud, sand, stone…any raw materials I could get my hands on." When he was about 12 years old, he was messing around with an ancient computer in his grandparents' basement when he stumbled on a copy of QBasic. He discovered that building software was "really magical," and he was hooked.

His focus moved from writing QBasic programs to video game programming to programming for the web and trying to understand more about human-computer interaction. Although he programmed a lot in high school, he decided not to go the computer science route in college. Instead, he majored in English.

He also became active in the open-source community. "I really latched onto the philosophy of open source: that information wants to be free (except for my bank account PIN) and that sharing code is the moral way to do it. Proprietary code is evil—all that sort of crazy stuff you get into when you are very young." At the same time, he longed to start his own business because he believed strongly in "doing things right and really being proud of what you are doing."

In 2005, he realized he was spending all his time and money programming, so he dropped out of college, moved to San Francisco, and got a job as a programmer at the video game site Gamespot. While he liked the user community, his job largely involved pleasing advertisers. He quit Gamespot in 2007 and spent the summer consulting.

During this time, he became aware of Git, an open-source version control system that had been invented in 2005 by Linus Torvalds. Famous as the creator of the Linux operating system, Torvalds had created Git as the way to manage work on the Linux kernel. It was Git that sparked the invention of GitHub.

About the same time he started working with Tom Preston-Werner on what would become GitHub, he was also working on a project called FamSpam, an app designed to solve problems with intrafamily communications. It turned out to be an idea that everyone liked but a product that no one wanted. In retrospect, Wanstrath realized that he had spent too much time on the idea and never had the right problem. "Technology should make your life easier, not harder." Instead of inventing FamSpam, he "could have just picked up the phone and talked to my mom, but that just wasn't happening at the time."

Both projects were released to beta at about the same time, but Wanstrath quickly found himself spending all his time with GitHub.

Why and How GitHub Works

The vision for GitHub was initially very limited: code sharing without aggravation. Preston-Werner and Wanstrath reasoned that the worst thing that could come out of the project would be an awesome tool that no one else would use. So what? They would still have an awesome tool and have a great time using it.

Wanstrath believes a large part of GitHub's success is due to its flexible model that does not require permission for collaboration. Any project can be forked (copied down), changes made to the copy, and—optionally—a pull request can be made to the owner of the original repository who can decide to merge the changes (or not).

Originally, forking involved taking a philosophical stance against someone's code, but GitHub has made forking a loving term. "The real meaning of fork you: Let's build something together and build something great," said Wanstrath. GitHub continually refines the product by finding ways to make collaboration and communication easier by eliminating friction from the process.

The company's philosphy is that the product *is* the marketing, and the way to accelerate growth is to make the product "super good." The response to GitHub has been overwhelmingly positive. In just five years, it has become the largest code hosting site in the world with more than 5 million members sharing more than 10 million repositories. GitHub's home page says "Build software better together," and for Wanstrath, that is what it is all about—not git, not code, but projects and people working together.

People can use GitHub to work open-source code publicly via the web or work privately on closed-source code in a private repository on private servers using GitHub Enterprise, as Esri and other large software shops do.

Not One or the Other

GitHub is a closed-source application built both on and with open-source software. "Our business would not exist if not for open source and closed source. It's the combination that makes GitHub successful. GitHub chooses to use open source because we think it makes sense," said Wanstrath. "We don't have a huge philosophy around it other than we like things that work well and we like things that are high quality. Our experience so far has been that open source is all those things."

Open source is "a really cool way to build software." GitHub uses GitHub to develop GitHub. Some software companies call using their own tools *dogfooding*, a term that he finds objectionable. He prefers the phrase "drinking our own champagne" because GitHub is a really cool tool that they would have used anyway.

Why do people do open source? There are many answers to that question. In some ways, open source just makes sense. It is less work to modify code and share it. And surprisingly, "when you share code with the world, the world will often give back." By sharing things that aren't core to its business, a company can get enhancements that benefit it and the larger community.

Why contribute back work? It can actually be more work not to contribute code back once patches, bug fixes, and other changes have been made because maintaining that code separately will be a lot more work.

However, some aspects of open source don't seem to make sense, at least on the surface. "People are just submitting a bug because it's simple. There's not something master planned behind it." That can be baffling for people who are looking for an angle, for the "what's in it for me" aspect of open source. They often overlook the simple fact that programming (like guitar playing and other activities) can be both a profession and a hobby.

"For a lot of people, this open-source thing is not a big mystery. They are just doing it for fun. There are people who work on the Linux kernel who are not professional programmers at all," said Wanstrath. "They're like a neurobiologist or something and they program on the Linux kernel for fun. That is what they do in their spare time. The world is a very strange place."

The impact of open source on business will only increase. Wanstrath believes the value of open source is not about the actual software but "the things you do with it and the way you think about building software. People who think open source is not right for them are as shortsighted as people who think everything should be closed source. The future is going to be this gray mix of both, and we are already there—it's just not evenly distributed."

Harmonious Relationship

Wanstrath views the relationship between open source and closed source as a symbiotic, rather than adversarial, relationship. "There is not this big divide. It's not open source versus business. When I was young, that was what I thought. I thought business was evil for some reason because the code was kept secret and the code wanted to be free. That's not true at all. If anything, they complement each other."

Facebook, Esri, and many other companies build software both on open source and closed source and, in the process, release their own open source. The Esri site on GitHub is an example of the way things are going: a closed platform with open source on top of it. Currently Esri has hundreds of open-source projects on GitHub, including the projects posted as part of the JavaScript coding contest, 100-lines-or-less-js, held during the DevSummit.

The pattern of using both open and closed source is both popular and successful because it lets companies learn about the people using their software. Working directly with people who are building on a company's software—directly in the code—is a great way to do that.

Open source is all about community. Wanstrath maintains the lone coder is a myth. Software development is now a group activity. "Great coders relentlessly iterate. And I think the best coders relentlessy iterate with other people. They build things together. The future of this stuff is about the way people work together." Ultimately, successful software development is about getting stuff done and shipping software.

Open Source for More than Software

A lot of times, open source is not about having a great idea up front but about releasing an idea and seeing how things develop. This approach has proved fruitful for more than just software—lots of activities can benefit from community and better communication. GitHub's own lawyers use GitHub to draft documents. The City of San Francisco posts laws on GitHub. The Smithsonian has posted the sunflower genome. People have written books using GitHub.

Wanstrath sees his potential customers as "anyone who builds stuff, anyone who wants to build stuff." GitHub is just a tool. Its power resides outside the tool in a workflow that everyone can participate in and understand.

"If I had to think about what's the future of programming (because I'm up here and it's like a keynote), it's not about fancier features, not about fancier testing, not about fancier code coverage—it's about fancier communication." Success will continue to come not from adding features but from removing them to create a workflow that makes it really easy to work with people. "With GitHub, you can work with anyone on anything in the world. It's all available to you," he said.

ArcGIS Pro Helps You Get Work Done Faster

ArcGIS Pro, a new application that will come with and work with ArcGIS for Desktop, makes the GIS functionality you most often use easy to access so you can get your work done faster without a learning curve. It is the essential application for creating and working with spatial data on your desktop that provides tools to visualize, analyze, compile, and share data. ArcGIS Pro joins the existing ArcGIS for Desktop applications: ArcMap, ArcCatalog, ArcScene, and ArcGlobe. ArcGIS Pro can run side by side with any version of ArcGIS for Desktop. You can use it with existing map documents.

Build GIS Projects

Your work in ArcGIS Pro is organized into projects, which contain all the resources for you to do your work in one place. A project contains maps, layouts, layers, tables, tasks, tools, and connections to servers, databases, folders, and styles. It can also incorporate content from your organization's portal or ArcGIS Online. The next time you want to work on this project file in ArcGIS Pro, all the components you need are available for you to use.

To get started with a project, you can gather relevant content and build your own project from scratch or start by opening a prebuilt project. Esri and others in the community have designed solutions—projects for a particular purpose or application—that contain maps and apps that can be more quickly deployed by your organization.

You can find and add content to your project by browsing or searching by keywords. Create, document, discover, and share geographic information with others in ArcGIS Pro by using the basic item description or standards-based metadata for project items to find and share information more easily.

Visualize Data

Maps are the canvases on which you display your spatial data in a project. You can store as many maps as you need in the same project, and you can open multiple maps or scenes at once and view them side by side. This means you can look at the same data in 2D and 3D simultaneously. ArcGIS Pro employs industry-standard navigation functions and keyboard and mouse shortcuts that allow you to explore maps.

To author a map in a project, you add layers of content to it. You can add a layer to multiple maps; for example, you might use the same imagery basemap as the underlying backdrop for many maps. Layers have properties that allow you to set how their content is displayed, including the symbols used to draw the data. While layers have spatial data, you can also add nonspatial tables. Tables are presented in a tabular view so rows and columns can be viewed, selected, edited, and queried. To display your data on a page, you can create layouts in your project.

Perform Analysis and Geoprocessing

Geoprocessing provides a rich suite of tools for performing spatial analysis and managing GIS data in an automated way. A typical geoprocessing tool performs an operation on a dataset and creates a resultant output dataset. When you find the right geoprocessing tool, you specify input and output dataset locations, adjust additional parameters that affect the process, and run the tool. In addition to the suite of tools provided with the application, geoprocessing also has a framework that allows you to build custom tools.

ModelBuilder is a visual language that allows you to create a diagram or model of your spatial analysis or data management process. This model is composed of graphic elements representing geoprocessing tools, data layers, and other variables and functions.

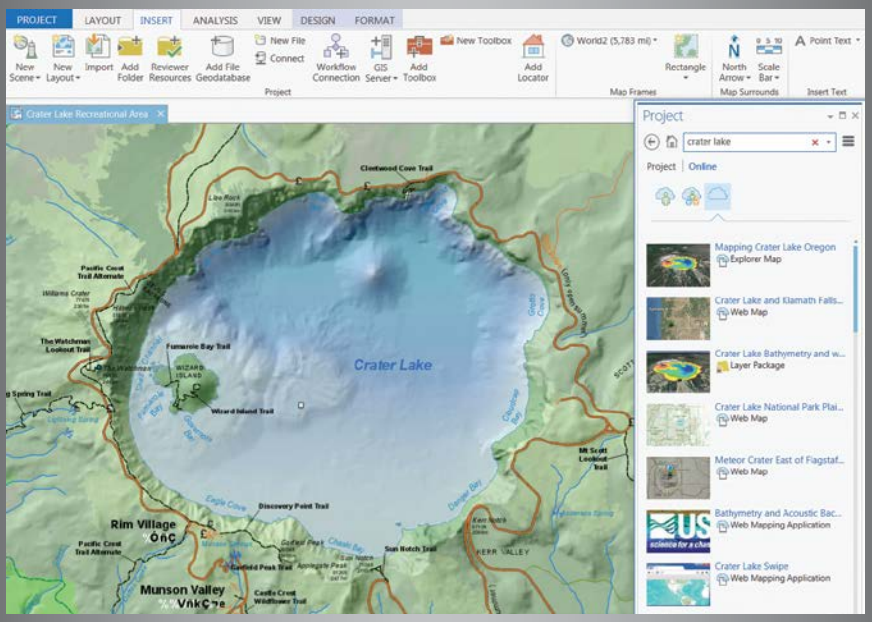
Python is the scripting language of ArcGIS. ArcGIS includes a Python API, ArcPy, that gives you access to all geoprocessing tools as well as an exhaustive suite of scripting functions that help you automate GIS tasks.

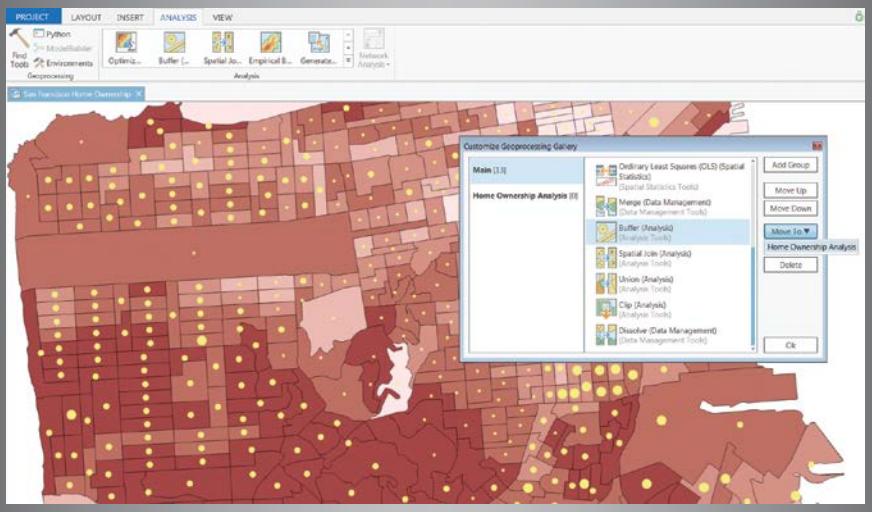
You can view the geoprocessing and spatial analysis history of your project so that you can easily run tools that were previously run in the project with the same or modified settings and better understand the process that created a layer in your map. Geoprocessing history is key to sharing a geoprocessing tool, as you can share any tool that has been run successfully and entered into the project geoprocessing history.

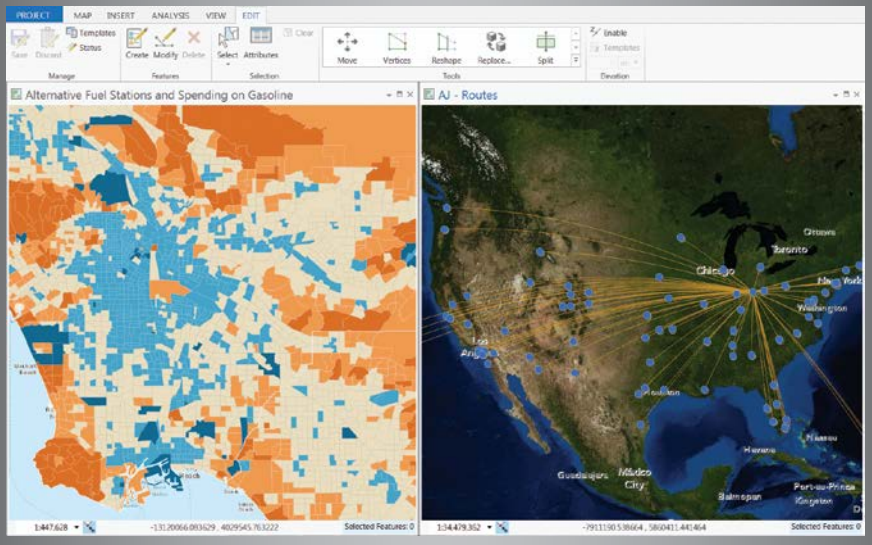
Edit Geographic Data

You can visualize the layers you're editing in both 2D and 3D so you can see your features from all perspectives. Editing involves creating, updating, and maintaining geospatial information that is stored and organized in layers. You can create new features in a layer by drawing them in a map and assigning attributes to define their characteristics. You can update existing features to reflect their current condition based on newly acquired data or information that comes from the field. Features can be repositioned to align with other features in a map, reshaped to represent physical changes, and removed when they are no longer needed. You can use precision drafting tools, including snapping and specified constraints, to guarantee that features are precisely connected to each other and created at the proper dimensions.

If you are part of a larger organization, you need to follow standards when editing to ensure compliance and data integrity. ArcGIS Pro provides the platform for this type of large enterprise editing. Editing within an organization relies on a common set of projects (maps, tools, and apps) and well-defined workflows that are used and







↖ In ArcGIS Pro, your work is organized into projects.

← Geoprocessing provides a rich suite of tools for performing spatial analysis and managing GIS data in an automated way.

↙ ArcGIS Pro provides you with the ability to create, document, discover, and share your geographic information with others.

shared throughout an organization. Projects, layers, and additional resources can be shared throughout the organization for adaption by other groups and departments. This enables the entire organization to access the most up-to-date maps and layers.

Share Your Work

Sharing your work is an important part of ArcGIS Pro. You can share everything from whole projects to maps, layers, tools, and other components of your work. There are two main ways of sharing with others: packaging and publishing. Packaging consolidates the contents into a file that the recipient will typically extract or unzip to use, while publishing builds web-based services.

Project packages and geoprocessing packages are two examples of using packaging to share. Packaging a project is how you share complete projects with colleagues within your organization or others, including contractors, outside your organization. Project packages can either reference your organization's enterprise data or you can consolidate the data and include it as part of the file. You can use geoprocessing packages to share the spatial analysis and data management tools you build with other users so they can apply those tools to their work or easily reproduce your results.

To share a map or scene from your project, you publish web layers. These can be reused within ArcGIS Pro, as well as across the ArcGIS platform, including in browsers and mobile devices. When you publish a layer, it can be consumed either as operational layers (those you typically work with directly or derive as the result of an operation) or as basemaps (those that are often drawn under other content, such as imagery or transportation). You can modify the properties of the layers, including their symbols, and update the service.

How Quick It Is . . .

Developing web apps with ArcGIS

Want to build a new app from scratch in less than three minutes?

At the Esri International Developer Summit in March 2014, Julie Powell did just that on stage during the plenary session. Powell illustrated how—with ArcGIS—a focused, intuitive, and beautiful HTML5/JavaScript-based web app can be put together without writing a single line of code.

"We know you need more than just a great API. You need to be immediately productive. You need tools to get started, so we are constantly working on ways to help your development," said Powell, product manager at Esri. Specifically, she demonstrated a new upcoming wizard in ArcGIS for configuring web applications called Web AppBuilder.

The goal for Web AppBuilder is to create a really simple-to-use experience for application configurers, not add another layer of framework to the development process. Every decision during development of Web AppBuilder was made with that goal in mind. Web AppBuilder lets you spend your time building apps that solve real problems.

But it is a developer tool too. Customization is built into it. You can configure it using the user interface (UI) or dive into the JSON and edit it directly from Web AppBuilder. Because it is built on the ArcGIS API for JavaScript, all the widgets can be styled. There are lots of ways to personalize these widgets and take an app to the next level. A number of widgets are already available. Esri teams will be adding widgets and Esri hopes developers will also share widgets they create.

In addition to widgets, Web AppBuilder lets you customize the overall look of apps through themes. Existing themes can be applied or new ones created. While you are using Web AppBuilder, you are working on a live app, and you can interact with widgets and themes from within Web AppBuilder.

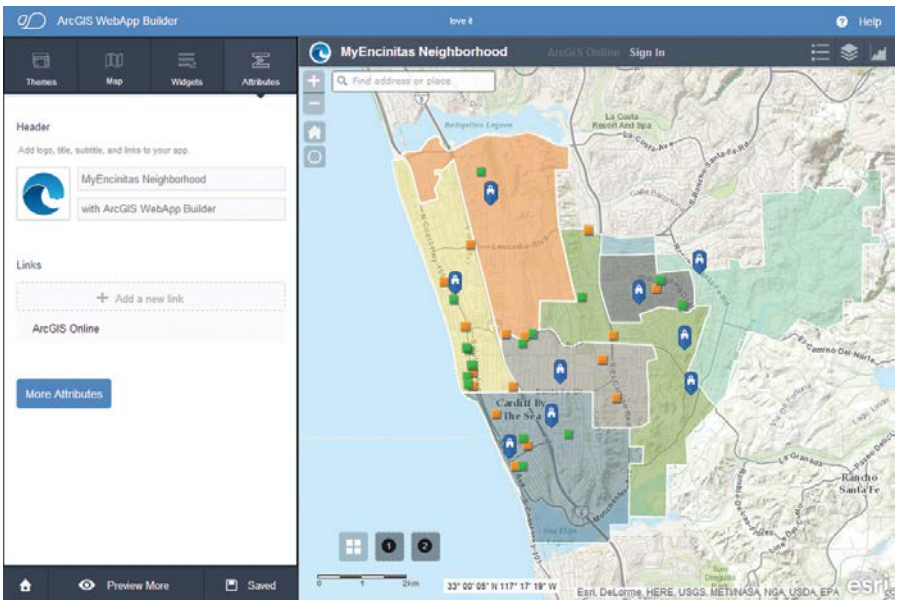
Web AppBuilder is not an isolated program—it is fully integrated with the ArcGIS platform and can be used with either an ArcGIS Online account or Portal for ArcGIS. The workflow-driven, ready-to-use apps it produces run seamlessly across all devices or can be used to create Web AppBuilder templates you can share with others using ArcGIS Online or Portal for ArcGIS, who can take your app, tweak it slightly, and immediately put it to work.

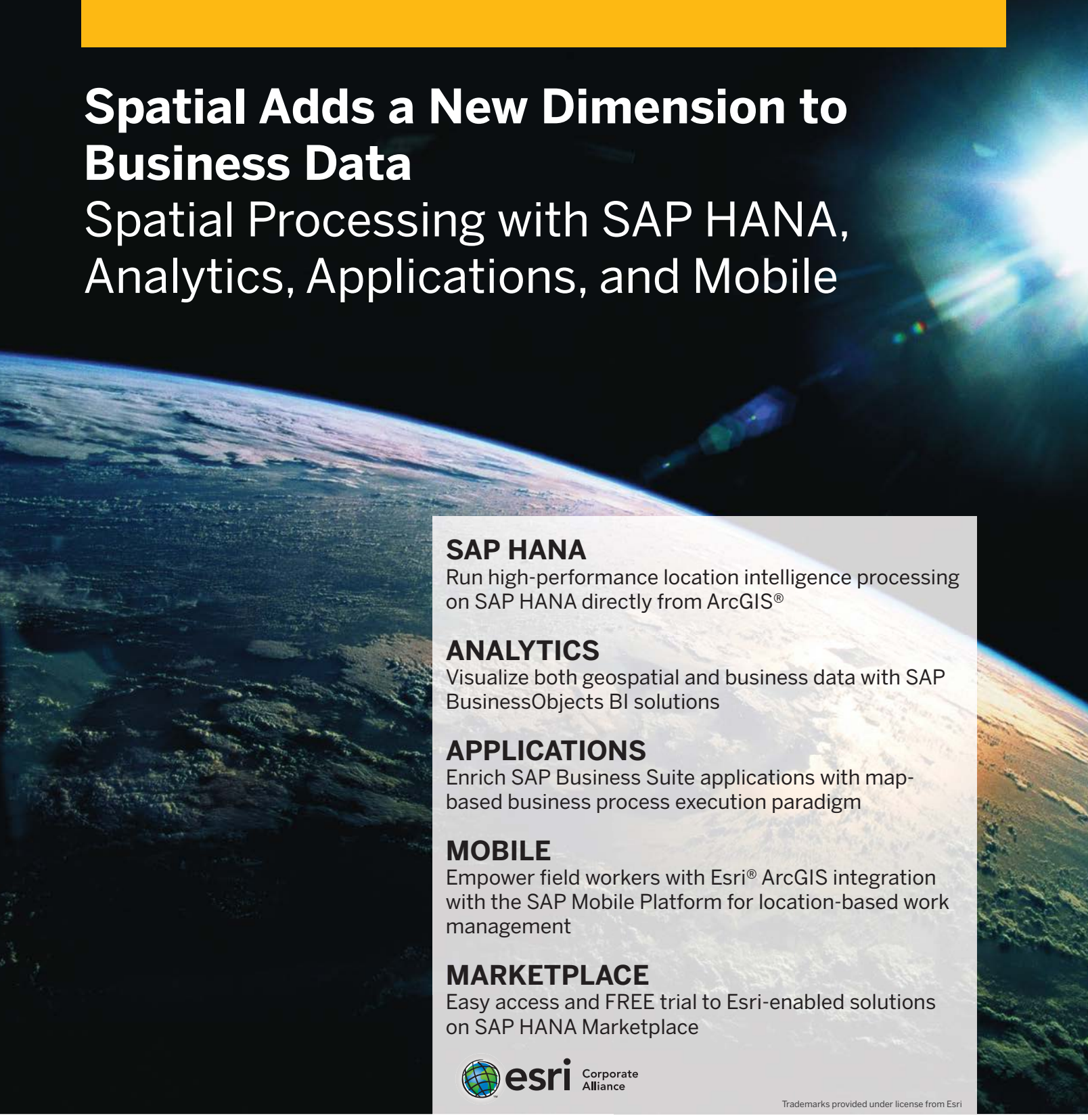
The product was developed in response to customer requests. Browser technology is constantly changing, and support for Flex and Silverlight has become limited.

Therefore, Esri encourages migration from Flex and Silverlight to JavaScript/HTML5 for web GIS. At 4.x, ArcGIS API for JavaScript will integrate additional ArcGIS platform capabilities such as 3D visualization, enhanced vector rendering, and stream layers. These capabilities are not planned for the Flex and Silverlight APIs, which will remain at version 3.x. Because the object model for the Flex Viewer is very similar to Web AppBuilder, the architecture will be familiar to experienced Flex Viewer developers.

Web AppBuilder will be released with ArcGIS Online and Portal for ArcGIS. Because it is built on the ArcGIS API for JavaScript, it can also use 10.1 and 10.2 services. Web AppBuilder is another developer offering from Esri that helps you save time by configuring, not coding. It lets you take advantage of what you already know and reuse your code, whether you are building apps for your organization or the ArcGIS Marketplace.

↓ Web AppBuilder, a pure HTML5/JavaScript-based application, lets you create focused, intuitive, and beautiful WebApp s in 2D and 3D without writing a single line of code.





Spatial Adds a New Dimension to Business Data

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Ready-to-Use Native App for Mobile Devices

Discover, visualize, use, and share maps from your smartphone or tablet with Explorer for ArcGIS—whether you are a GIS professional or someone with no knowledge of GIS.

Explorer joins the collection of ready-to-use apps that includes Collector and Operations Dashboard for ArcGIS. This new app is designed for people who need to explore data in a geographic context and use maps to help make better decisions.

With Explorer, you can access any of your organization's maps, apps, or data hosted on ArcGIS Online or on-premises in Portal for ArcGIS. Built as a native app, Explorer has initially been released for iOS devices. A version for Android will follow in a few months, with Windows and Mac versions expected in the first quarter of 2015.

Start Explorer and it signs you in to your organizational account and takes you to the home screen. In any map you open, you can not only search for places and addresses but also for features.

Maps can include presentations that contain slides with live maps. Presentations can be used to brief decision makers and others. You can interact with the live maps in these presentations, zooming, panning, or sketching on them. Maps can be shared via e-mail and text message or by using platform-specific methods such as AirDrop (for iOS).

Future releases of Explorer will expand functionality and take advantage of capabilities such as 3D.

Anyone can download Explorer for ArcGIS from the Apple App Store and try the sample maps included in the app. ArcGIS Online subscribers, ArcGIS Online evaluation version users, and Portal for ArcGIS users can download the app, sign in, and begin using it to explore their organization's maps and data. For more information, visit esri.com/explorerapp.

← Explorer for ArcGIS, a new ready-to-use app, helps anyone explore data in a geographic context and use maps to help make better decisions.

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Customize Your Story

By Kent Anness, Kentucky Division of Geographic Information, State of Kentucky

The idea of using a map to tell a story is not new. Maps have always been the perfect tool for explaining where something exists (or occurred) and how that relates to other events that are part of the story or message being delivered.

Well, the GIS gurus at Esri have come up with some nifty templates that make it easy to build an interactive Story Map app using your data. If you have a story to tell, all you need is some simple point data, photos, or videos, a little narrative text, and an ArcGIS Online account. Individuals, bloggers, students, and others can use ArcGIS.com for free. Just create a public account (look for the link at the bottom of the ArcGIS.com sign-in page).

Map App

Here in the Bluegrass State, we are very lucky to have an abundance of thematic data layers that are appropriate for storytelling, so the staff at Kentucky Division of Geographic Information (DGI) began pulling together the resources necessary to create an effective Story Map app. We created feature services on our ArcGIS for Server instance, but we could have just as easily uploaded shapefiles or comma-separated values (CSVs) to ArcGIS.com.

The first Story Map app was one highlighting the lodges at Kentucky's state parks. We collaborated with the marketing and GIS staff at state parks to make this happen. They supplied some outstanding photos and reviewed their GIS data to make sure everything was in order.

We created a web map on ArcGIS.com using the data, the photos were placed on a web server, and the Map Tour Story Map app template was downloaded from Esri. Wiring up the template to our data was a breeze, but our app had the same look and feel of all the other Story Map apps. We needed to make ours unique and engaging.

The *Esri Insider* blog post "Creating and Customizing a Story Map—From a Non-GISer," supplied just the information we needed. If you understand CSS, can leverage the developer tools in your browser, and know your way around Adobe Photoshop, you can easily brand your Story Map app. I have described the steps I used to customize the Kentucky State Forest Story Map app.

Deciding on a Color Scheme

I visited the Kentucky Division of Forestry website, where I copied the new logo. The colors used in the logo were the basis of the

↓ A Story Map app about Kentucky State Park Lodges was the first the Kentucky Division of Geographic Information customized.

site's color scheme. Using Adobe Photoshop, I got the hexadecimal values for those colors. With those values, I touched up the underlying HTML using Xcode on the Mac. *[Xcode is an integrated development environment that is a free download from Apple.]*

As noted in the blog post, the inspect element feature in the browser could be used to identify some of the styles driving the Story Map app template. Starting at the top, I first changed the background color of the header to match the green color in the logo.

Creating a Custom Header

Next, I worked up a nice graphic for the header using a beautiful photo provided by the Division of Forestry. I added a title and subtitle as part of the graphic and did not use the configuration option, leaving those values empty.

The height of the graphic was 115 pixels, so the height of the header was defined accordingly. Take a look at the code in Listing 1 to see how background value color, header graphic, and height of the header were defined within a single style tag.

```
<style>
#headerDesktop {background: #305c27 url(images/
background_header_image.png) no-repeat . important;
height: 115px;}
</style>
```

↑ Listing 1: Defining background color, header graphic, and header height

Another stylized feature I've added to some of our Story Map apps is a 6-pixel border between the header and the body of the map. I added the style directly within the header div and used the gold color in the logo. This really made it stand out.

```
<div id="header" style="border-bottom-style:solid;
border-bottom-width: 6px; border-bottom-color: #b28e14;">
```

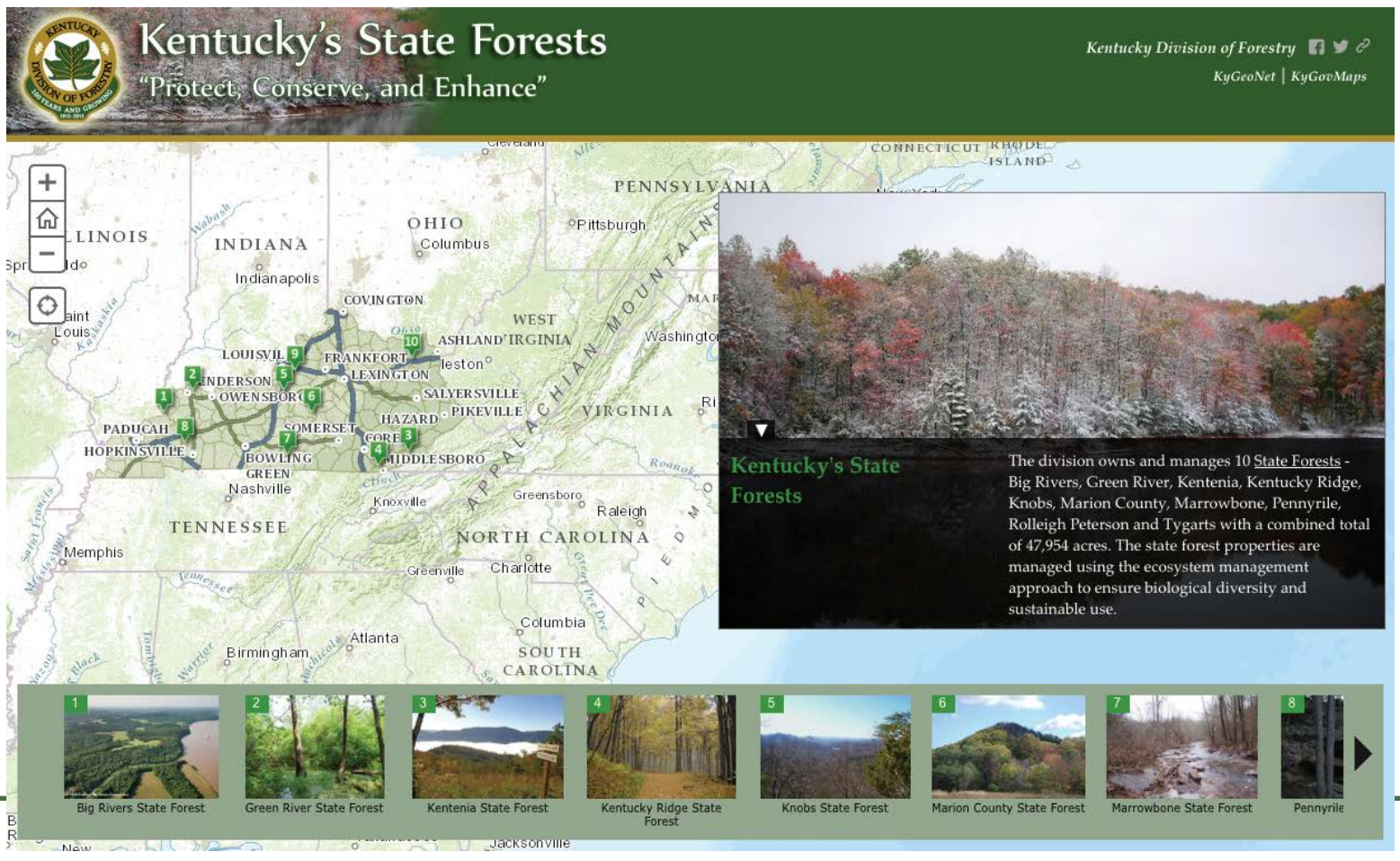
↑ Listing 2: Adding border

Styling the Rest of the Map

All the links on the right-hand side of the header can be styled too. In this instance, I changed the font color to white so the links could easily be read on the green background. I picked a font that looked good with the text used in the header graphic. Listing 3 shows the style tag with the values needed to achieve the desired appearance.

```
<style>
.social .msLink a {font-family: "Palatino Linotype", "Book
Antiqua", Palatino, serif;
font-style:italic;
font-size:14px;
color: #FFFFFF;}
</style>
```

↑ Listing 3: Styling links



↑ The header graphic was created in Adobe Photoshop.

We chose standard green markers for this forestry-related Story Map app. I did a screen capture of the app and got the hexadecimal value of the marker color using Photoshop. This color was used for the name in the picture panel (Listing 4). The font family was set to match the font used for the links in the header. Consistency in type styles makes for a polished looking app.

```
<style>
#picturePanel .name {font-
family:"Palatino Linotype", "Book
Antiqua", Palatino, serif; font-
weight: 600; color: #33971e;}
#picturePanel .description {font-
family:"Palatino Linotype", "Book
Antiqua", Palatino, serif; font-
weight: 400; font-size: 14px;}
#picturePanel .description a {font-
family:"Palatino Linotype", "Book
Antiqua", Palatino, serif; font-
weight: 400; font-size: 14px;}
</style>
```

↑ Listing 4: Picture panel styles

Moving to the footer, I chose a nice green color that complemented the color scheme.

```
<style>
#footer {background: #94a98f .
important;}
</style>
```

↑ Listing 5: Styling the footer

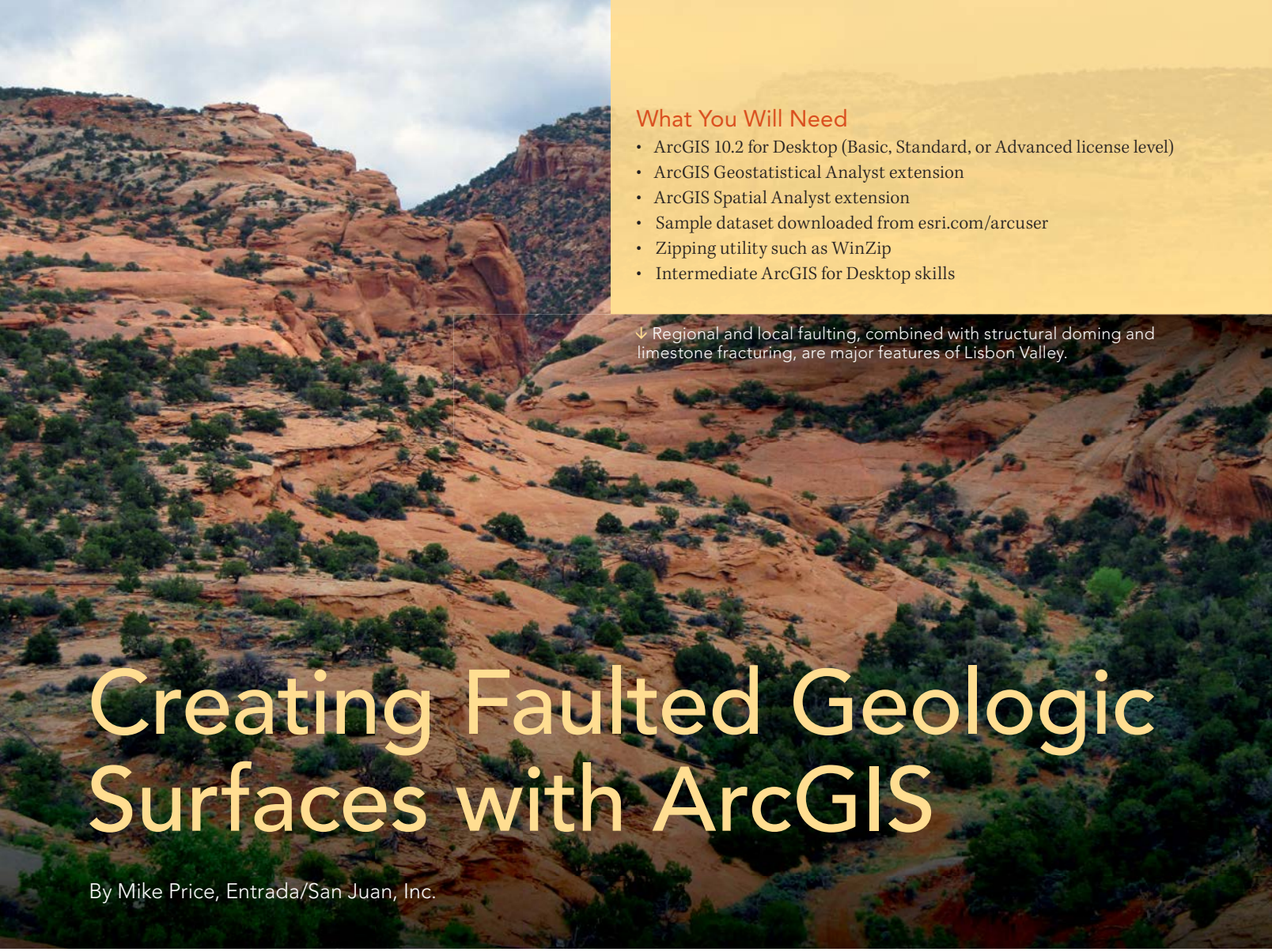
← The colors in the site were keyed to the logo.

Using the Same Approach

So, with very little coding, I was able to take a stock Story Map app and give it a unique look and feel that sets it apart from others. The same approach was employed to customize Kentucky's other Story Map apps. Look at them and you'll notice the color scheme for each was derived from each entity's logo or the colors on its website. Taking the time to customize a site will ensure that it stands out from the growing crowd.

About the Author

Kent Anness is the GIS manager for the Kentucky Division of Geographic Information in Kentucky State government. He has a bachelor's degree in geography from the University of Kentucky. Anness has been working with GIS for more than two decades.



What You Will Need

- ArcGIS 10.2 for Desktop (Basic, Standard, or Advanced license level)
- ArcGIS Geostatistical Analyst extension
- ArcGIS Spatial Analyst extension
- Sample dataset downloaded from esri.com/arcuser
- Zipping utility such as WinZip
- Intermediate ArcGIS for Desktop skills

↓ Regional and local faulting, combined with structural doming and limestone fracturing, are major features of Lisbon Valley.

Creating Faulted Geologic Surfaces with ArcGIS

By Mike Price, Entrada/San Juan, Inc.

GIS analysts use point data to model complex trend surfaces. Field data is often collected at irregularly distributed locations, and attributes are sometimes difficult to consistently quantify. Also, barriers such as geologic faults, watershed boundaries, and urban canyons may influence local interpolation.

The tools in the ArcGIS Geostatistical Analyst extension allow GIS users to analyze spatial trends within complex point datasets and model predictive surfaces that best represent data trends. Empirical Bayesian Kriging (EBK) provides powerful data analysis tools, including variography of data in space. Kernel Smoothing interpolates irregular surfaces and predicts standard error throughout the model. By including polyline or polygon barriers, Kernel Smoothing With Barriers can accurately model point data within discrete subgroups.

This tutorial teaches how to use the ArcGIS Geostatistical Analyst and Spatial Analyst extensions to explore and evaluate data using data that describes an oil field in Lisbon, Utah, and synthetic data created just for this exercise. Read the accompanying article, "About Lisbon Valley," to learn more about this geologicly interesting area.

The exercise begins by using the EBK tool in Geostatistical Analyst to explore geologic borehole data. Then Spatial Analyst is used to interpolate a geologic/structural surface (formation top) using the Spline With Barriers tool. Precinct elevation values and a surface for the same geologic/structural surface will be created using Kernel Smoothing With Barriers tool in Geostatistical Analyst. Finally, a Prediction Standard Error (PSE) for the Kernel Smoothing predictive surface will be created. The resultant Kernel Smoothing surface is compared to the surface created with Spatial Analyst using Spline With Barriers. For an overview of the Geostatistical Analyst tools used in this tutorial, see "A Little More about Two Geostatistical Methods" in this issue.

Getting Started

First, download the sample dataset from the *ArcUser* website (esri.com/arcuser) and unzip the archive on a local computer.

1. Start ArcMap, navigate to \Lisbon_UT, and open Lisbon_Valley_UT.mxd. This map document opens in layout view and shows

the locations of drill holes and subsurface faults. It includes data from three file geodatabase feature class layers—Drill Holes, Subsurface Faults, and Clipping Grid.

2. In the table of contents (TOC), open the attribute table for Drill Holes and explore its fields. This table includes 91 drill holes, both real and synthetic. Study the data in the MI_Top_M field. It will be analyzed and modeled throughout this exercise. Close the table.
3. Switch to data view and choose Bookmark > Lisbon 1:50,000.
4. Update the map document by specifying a default geodatabase. In the ArcMap Standard menu, choose File > Map Document Properties. Set the Default Geodatabase to \Lisbon_UT\Geodatabase\UTM83Z12\Lisbon_Geology.gdb.
5. Check Store relative paths and click the button to create a thumbnail. Click OK.
6. Select Customize > Extensions and verify that the Geostatistical Analyst and Spatial Analyst extensions are installed and checked. Open the Geostatistical Analyst and Spatial Analyst toolbars by clicking an open area on any toolbar and selecting Geostatistical Analyst and Spatial Analyst from the available toolbars.
7. Dock the Geostatistical Analyst toolbar in the upper left of the interface and click the drop-down. The Geostatistical Wizard will be used to access the tools used in this exercise. The Geostatistical Wizard can also be accessed by clicking a single button on the toolbar. The drop-down also contains Explore Data, Create Subsets, Help, and Tutorial choices.

Setting Environments

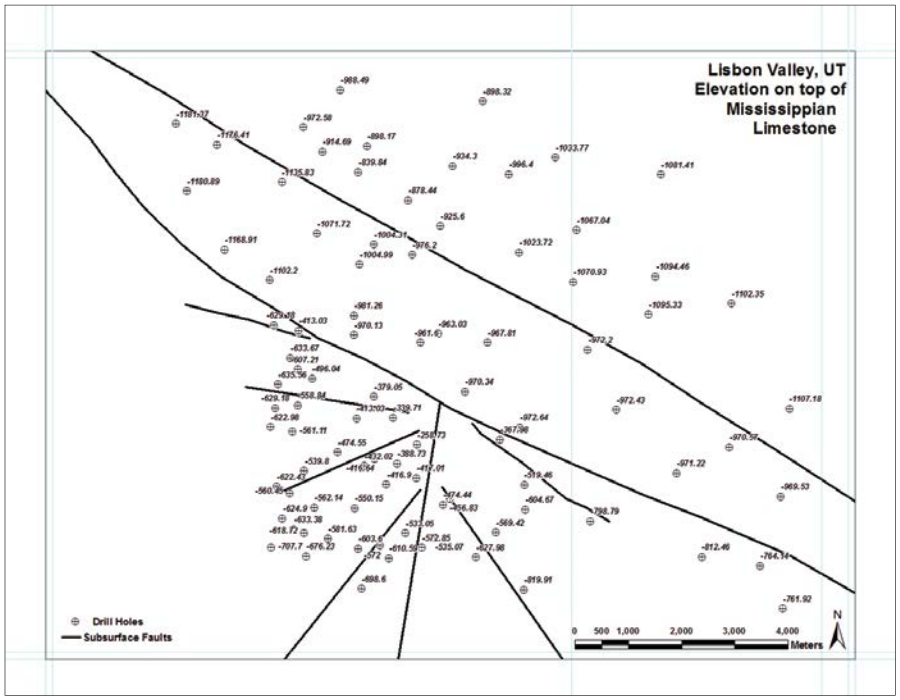
An essential—and occasionally overlooked—step is defining geoprocessing environments for this map. When creating an ArcMap document that includes geoprocessing, it is very helpful to include one or more reference rasters to define and guide processes. Clipping Grid is the reference grid for this exercise. Momentarily display it to see the extent of the model. Note the extent includes all drill holes. With 10-meter raster cells, it will have excellent data resolution.

1. In the Standard menu, choose Geoprocessing > Environments and expand Workspace. Verify that the Current and

Well number	WELL_NO
Collar elevation in meters	ELEV_M
Oil Field	FIELD
Easting for UTM NAD83 Zone 12N, Meters	UTM EAST
Northing for UTM NAD83 Zone 12N, Meters	UTM NORTH
Elevation, Top of Mississippian Leadville Limestone, Meters	MI_Top_M
Total Depth, Meters	Depth_M

↑ Table 1: Fields in Drill Holes layer

↓ Lisbon_Valley_UT.mxd initially shows the locations of drill holes and subsurface faults.

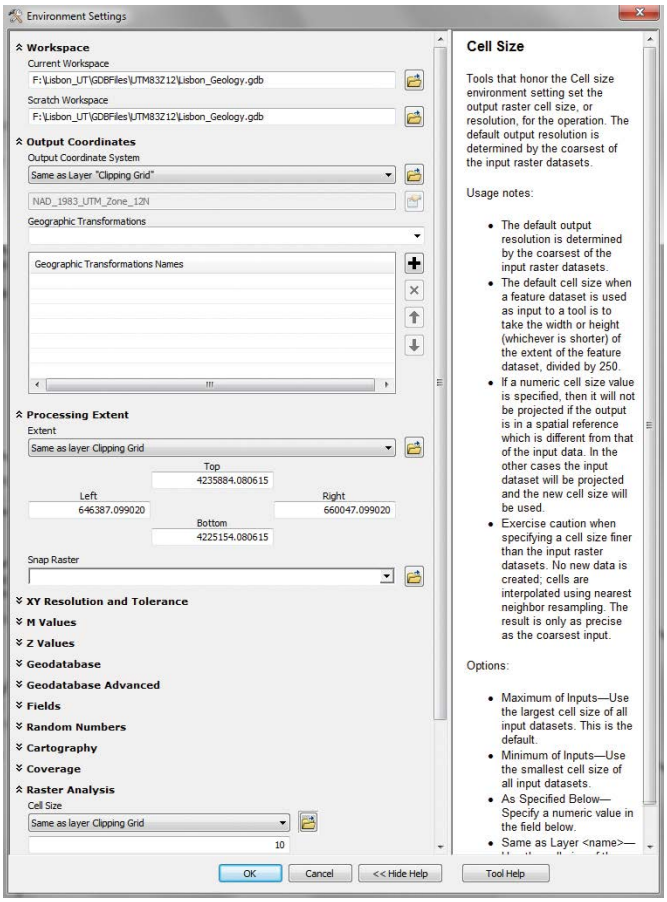


About Lisbon Valley

For more than 50 years, the field has continuously produced oil and natural gas, hosted in fractured Mississippian and Devonian limestones and dolomites that have an estimated age of between 380 and 330 million years.

Structural geologists have extensively mapped and modeled the structure and stratigraphy of the field. Regional and local faulting, combined with structural doming and limestone fracturing, are major features of the reservoir *[in this context, a trapped pocket of subsurface oil].* Leadville Limestone is the oldest major producing formation in the area. The top of this formation provides an excellent stratigraphic and structural reference for the Lisbon Valley area.

This exercise maps the elevation of the top of the Leadville Limestone, as modified by local and regional faulting. The data for this exercise is a combination of modified legacy geologic data and synthetic data. It was created as a training dataset and should not be used for other purposes.



↑ An essential—and occasionally overlooked—step is defining geoprocessing environments.

Scratch Workspaces are both set to \Lisbon_UT\Geodatabase\UTM83Z12\Lisbon_Geology.gdb. This was the same geodatabase specified in the Map Document properties.

2. Expand Output Coordinates and set Output coordinate system to Clipping Grid. When performing geostatistical analyses, it is highly desirable to apply a nongeographic coordinate system so this exercise will use a projected coordinate system, universal transverse Mercator.
3. Expand Processing Extent and set the extent to Same as layer "Clipping Grid".
4. Expand Raster Analysis and set the cell size to Same as layer "Clipping Grid".
5. Click OK to apply these updates and save the file.

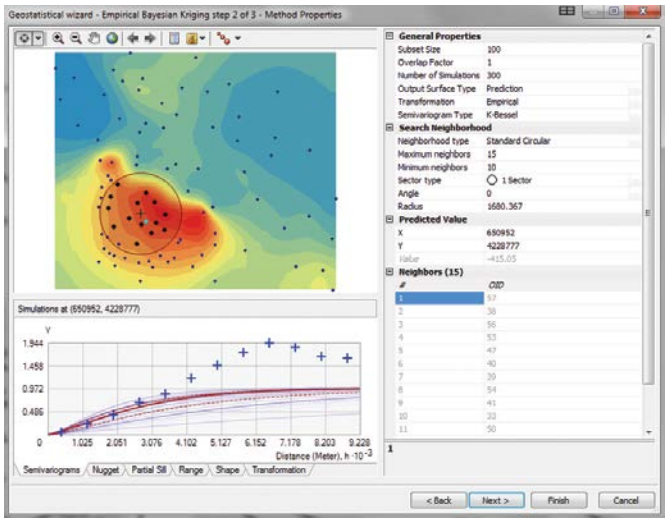
Exploring Data with EBK

In the Geostatistical Analyst toolbar, open the Geostatistical Wizard. Under Methods, there are three separate groups: Deterministic methods, Geostatistical methods, and Interpolation with barriers. Expand the headings for each method to inspect the tools.

1. Choose Empirical Bayesian Kriging (EBK), located under Geostatistical Methods. It opens to the first pane in the wizard, the Input Data pane. Using drop-downs, set Source Data to Drill Holes and specify MI_Top_M as the Data Field. Click Next to continue.
2. In the Step 2 pane of the wizard, update some of the analysis properties under General Properties in this order:
   - Increase Number of Simulations to 300.
   - Change Output Surface Type to Prediction.
   - Set Transformation to Empirical.
   - Specify a K-Bessel Semivariogram Type.

   Do not change Search Radius for the first pass through this data or your results will differ from the examples in this exercise.
3. Expand the Neighbors area and use explore the model by selecting points within the search radius. With each mouse click, the X, Y, and Value (MI_Top_M) coordinates are updated. These are the 10 points used to predict the value at the circle's center. Inspect the EBK surface displayed in the wizard and notice that there appears to be three separate point groups: a major group in the southwest, a smaller northeast group, and a central band trending from southeast to northwest. Although faults are not shown on this map, they are important. EBK does not include polyline or polygon barriers, so this exercise will test two alternate interpolation methods.
4. Still in the Step 2 pane, explore the Nugget, Partial Sill, and other tabs. Click Next to continue.
5. The Step 3 pane displays the Cross Validation matrix for the EBK analysis. Points can be sorted using Error. Outlier points can also be selected. Select points at both ends of the sorted data to highlight outliers. Look at the other Cross Validation tabs for Error, Standardized Error, and Normal QQPlot. Click Finish.
6. In the Method Report window, click the Save button and save the parameters as an XML file. Save the EBK parameters in a new folder named \Lisbon_UT\Results, accept the default name, and click OK.
7. The EBK prediction surface layer will be generated and appear in the map document. In the TOC, move it below Subsurface Faults and inspect the relationships between the prediction and the faults. Areas of similar predicted values extend slightly across faults. There are at least three distinct regions that could be

↓ In the Step 2 pane of the EBK wizard, update analysis properties under General Properties.



separated by major northwest trending faults.

8. Right-click the Empirical Bayesian Kriging layer and select Properties. Click the Symbology tab. Hillshade, Contours, Grid, and Filled Contours can be displayed. Check Contours and Filled Contours. To see the displayed Contours, change their symbology to a single dark line. Check Presentation quality and Refine on zoom. Click OK.
9. Save the map document.

Using Spline with Barriers

EBK predictions use points on both sides of a fault. Let's try an interpolation/prediction method available with the Spatial Analyst extension that respect fault barriers.

1. In the TOC, collapse the Empirical Bayesian Kriging layer and turn it off. Choose Bookmark > Lisbon 1:50,000 to adjust the displayed extent.

A Little More about Two Geostatistical Methods

Empirical Bayesian Kriging

Empirical Bayesian kriging (EBK) is a geostatistical interpolation method that automates the most difficult aspects of building a valid kriging model. Other kriging methods in the ArcGIS Geostatistical Analyst extension require manual adjustment of parameters to generate accurate results. However, EBK automatically calculates these parameters through a process of subsetting and simulations.

EBK also differs from other kriging methods by accounting for the error introduced by estimating the underlying semivariogram. Other kriging methods calculate the semivariogram from known data locations and use this single semivariogram to make predictions at unknown locations. This process implicitly assumes that the estimated semivariogram is the true semivariogram for the interpolation region. By not taking the uncertainty of semivariogram estimation into account, other kriging methods underestimate the standard errors of prediction.

For a detailed description of EBK, read "Empirical Bayesian Kriging Implemented in ArcGIS Geostatistical Analyst" by Konstantin Krivoruchko, published in the Fall 2012 issue of *ArcUser*.

Kernel Smoothing

Kernel smoothing is a variant of local polynomial interpolation. It is equivalent to the universal kriging model when all spatial variation is described by the trend and the semivariogram model simply describes spatially uncorrelated measurement error (called the nugget effect in geostatistical literature). When barriers are present, the distance between points is calculated as the shortest sum of the series of lines that do not intersect the polylines.

No interpolation model can predict values at the unsampled locations without some error, whether small or large. Therefore, a good method should include a measure of prediction uncertainty so the quality of predictions can be evaluated. Kernel smoothing has a measure of prediction uncertainty, which is uncommon among deterministic interpolation methods.

↑ For more than 50 years, the Lisbon oil field has continuously produced oil and natural gas, hosted in fractured Mississippian and Devonian limestones and dolomites.

2. Open the Search box and locate Spline With Barriers (Spatial Analyst).
3. In the tool, select Drill Holes as the Input point features and select MI_Top_M as the Z value. Choose Load Subsurface Faults as the Input barrier features, leave Output cell size as 10, and Smoothing as 0. Save the output raster in \Lisbon_Geology.gdb as LV_SPL_PRE_01. Click OK.
4. After the spline raster appears, move it down in the TOC below the EBK layer. Right-click LV_SPL_PRE_01, select Properties, and open the Symbology tab. Change Show: to Classified and use the symbology import browser to load SPL Prediction, Meters.lyr, located in \Lisbon_UT_Geodatabase\UTN83Z12.

Inspect the splined raster and notice the abrupt changes across faults. Use the Identify tool to explore the raster. Although this output looks acceptable, there is no way to measure error throughout the model. Let's return to Geostatistical Analyst and try Kernel Smoothing. Close ArcToolbox, turn off LV_SPL_PRE_01, use the Lisbon 1:50,000 bookmark to adjust the extent, close Search, and save the project.

Using Kernel Smoothing With Barriers

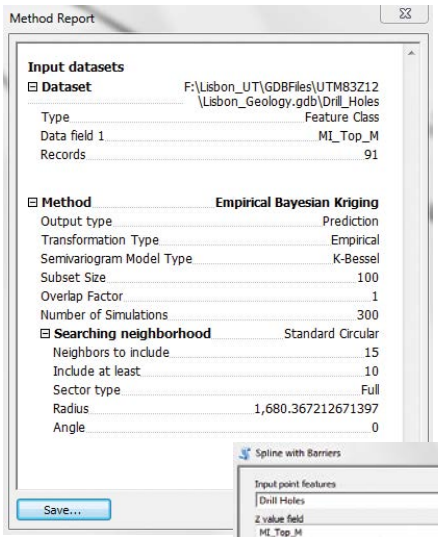
1. Return to the Geostatistical Wizard and, under Interpolation With Barriers, select Kernel Smoothing.
2. In the Kernel Smoothing Wizard, set Drill Holes as the Source Dataset and MI_Top_M as the Data Field. Set Subsurface Faults as the Barrier Features Source Dataset and click Next.
3. After the Kernel Smoothing prediction surface appears, accept all defaults and zoom in on the active prediction surface. Notice that fault barriers now appear in the wizard and that the model appears to respect them.
4. Move the selection circle through the model by clicking the crosshair on various points and inspect predicted values. The default search radius or Bandwidth is now nearly 2,700 meters. Click Next.
5. Inspect the Cross Validation charts on the Predicted and Normal QQPlot tabs. The points fall much closer to the Regression line. Click Finish.
6. Click the Save button and save the model summary as an XML file called Kernel Smoothing in the Results folder in the Lisbon_Geology.gdb. Click OK.

Enhancing Kernel Smoothing Model

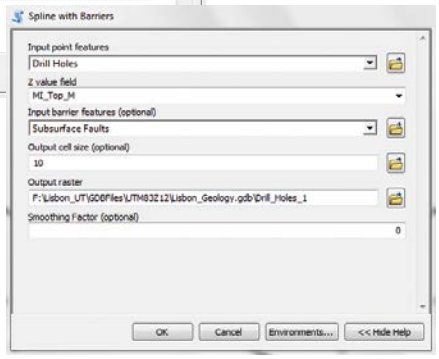
1. In the TOC, move the Kernel Smoothing layer just above Clipping Grid, right-click it, and select Properties.
2. Open the Symbology tab, check Filled Contours, and select Classify. Under Classification, change Method to Equal Intervals, set Classes to 18, and set Customize Min and Max to True (this last step is very important).
3. In Graph Properties, set Bars to 19. At the top of Breaks, set a Min break at -1150. Move to the bottom and set a Max value of -250 (below sea level). Click OK to reclassify. The classified intervals are now 50 meters wide.
4. Check the Presentation quality and Refine on zoom options so more raster detail will be displayed and the jagged edges along faults will be minimized. Click OK.
5. Export the Kernel Smoothing Prediction surface as a geodatabase raster. In the TOC, right-click on the Kernel Smoothing layer, select Data > Export to Raster. Save the prediction raster in Lisbon_Geology.gdb, naming it LV_KS_PRE_01. Be patient as it loads. Move it just above Clipping Grid, collapse its legend, and turn it off.

Modeling Predicted Standard Error (PSE)

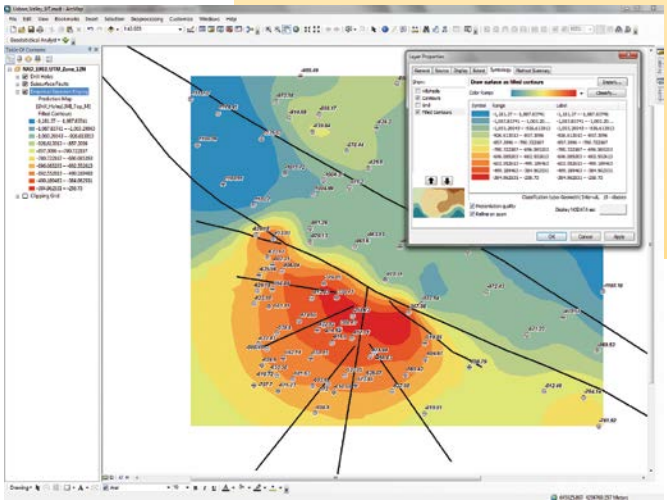
Because Kernel Smoothing is a tool available in Geostatistical Analyst, a predictive elevation surface and an estimate of standard error across the surface can be created. First, the error threshold throughout the model will be estimated in meters. Error will likely be lowest within clustered points and may be highest on the edge of drilling and near barrier faults.



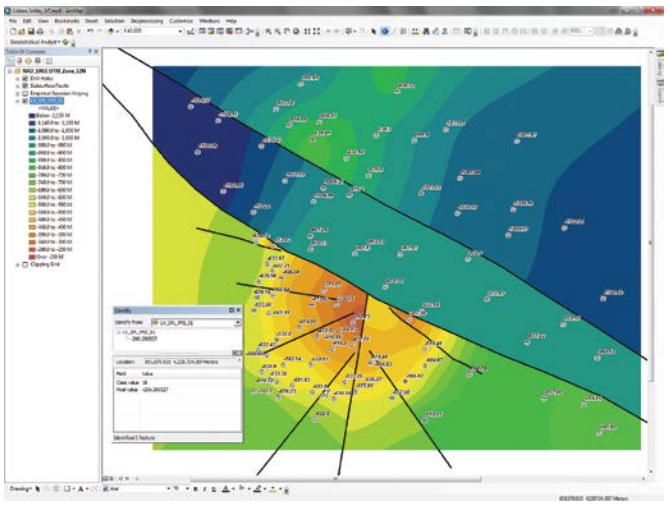
← In the Method Report window, save the parameters for EBK as an XML file.



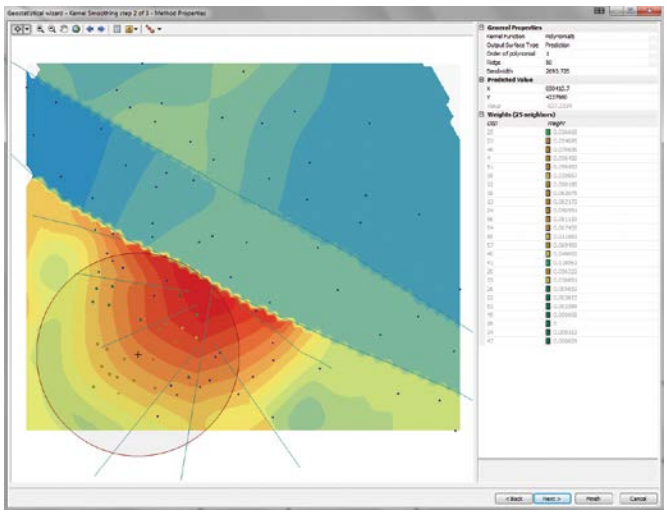
Use Subsurface Faults as the Input barrier features for creating the splined layer. →



↑ Adjust the symbology for the Empirical Bayesian Kriging layer and check Presentation quality and Refine on zoom.

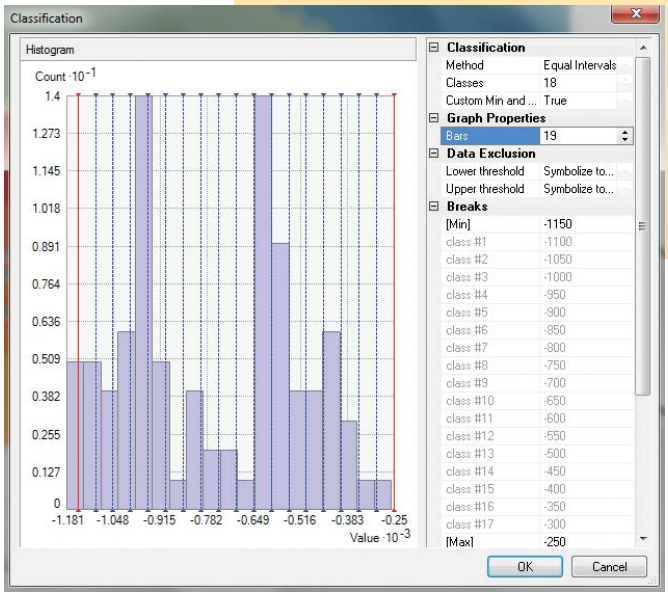


↑ Although Spline With Barriers produces a raster that respects the fault line, there is no way to measure error throughout the model.

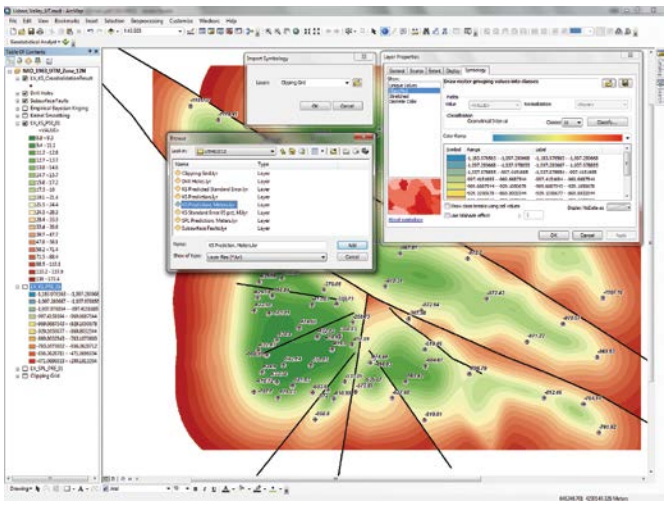


↑ Return to the Geostatistical Wizard and choose Kernel Smoothing from the Interpolation With Barriers section.

1. Save the file and return to the TOC. Right-click Kernel Smoothing and open Method Properties.
2. In Wizard Step 1, change Output Surface Type to Prediction Standard Error. A new raster will appear. This raster displays the predicted margin of error for the Mississippian limestone top throughout the model. Error in meters is smallest in the drilling clustered in the southwest portion and greatest along outer margins and along faults. Within the drilling cluster, predicted error is highest near barrier junctions involving three faults, especially within narrow fault blocks.
3. Click Next to display the Cross Validation charts. Reinspect these charts, especially those on the Error and Standardized Error tabs.
4. The next step will plot these points on the map. In the lower right side of the wizard pane, scroll down to Export Result Table and click the plus sign next to it. Export the points to Lisbon_Geology.gdb and name the file LV_KS_CrossValidationResult. Click Finish. Verify that this new layer loads at the top of the TOC. Do not save the Method Report.
5. Right-click Kernel Smoothing, select Properties, and open Symbology. Change the Classification Method back to Geometric Intervals, and set Classes to 20. Leave all other default values, click OK, check both Presentation quality and Refine on zoom, and click OK again.
6. Turn on LV_KS_CrossValidationResult and open its table. Select Error and sort the table in ascending order. Use sorting and selection to identify points with the highest positive and negative errors. You should find that they are often near the model edge or in areas of tight barrier polyline convergence, as expected.
7. Export the Kernel Smoothing raster and save it in Lisbon_Geology.gdb as LV_KS_PSE_01. Update the legend using KS Prediction Standard Error.lyr. Finally, use Layer file KS Prediction, Meters.lyr to update the legend for LV_KS_PRE_01 and save the file.

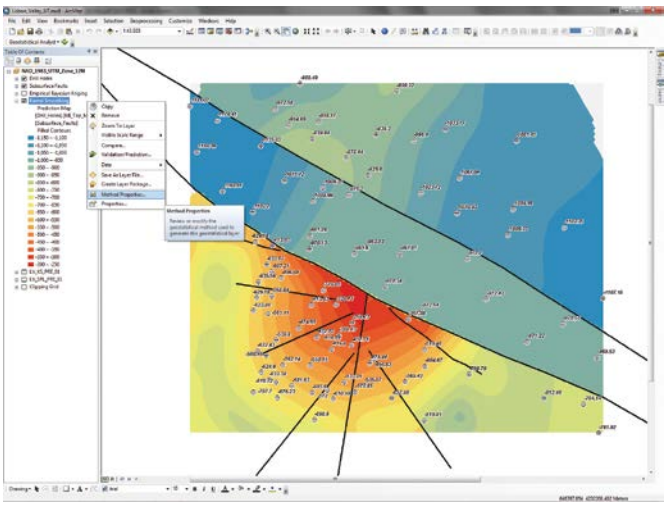


↑ Change the classification, classes, min and max breaks, and number of graph bars.



↑ After exporting the Kernel Smoothing raster as LV_KS_PSE_01, use the KS Prediction, Meters.lyr file to enhance the symbology.

↓ Right-click the Kernel Smoothing layer and choose Method Properties.



Conclusion

This exercise showed how to model the elevation of the top of the Mississippian limestone in Lisbon Valley, Utah, using only formation top elevations and fault barriers to generate a reliable predictive elevation surface. Predicted standard error across the surface was also created. These surfaces were exported as rasters.

Acknowledgments

Thanks to Konstantin Krivoruchko and the Esri Geostatistical Analyst team for their help in developing the exercise workflow. Thanks, also, to the many geoscientists who have visited Lisbon Valley and developed an extensive and enduring understanding of the area.

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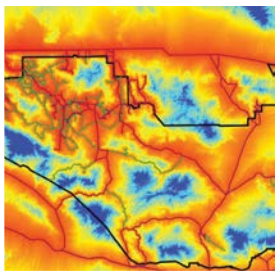

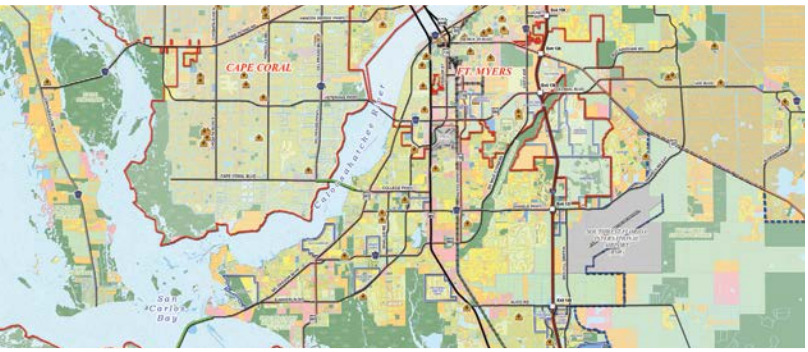

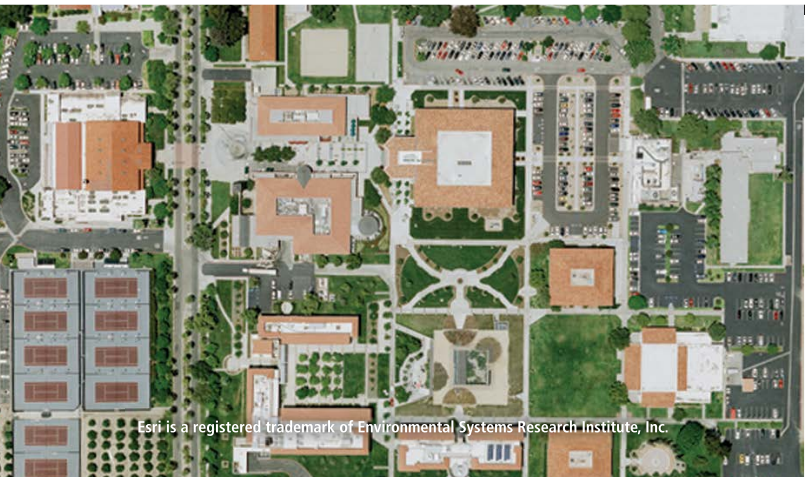

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Making Better Decisions with GIS

Solving a Public Health Problem Using Location-Allocation

By Monica Pratt, Harry Moore, and Tim Craig, Esri

GIS can help local governments deal effectively with budget constraints while delivering the best possible service to citizens by helping officials make fact-based decisions. In this example, a public health department has eight permanent clinics. Last year, the department deployed eight mobile clinics to better serve county residents. The location of mobile clinics in the previous year were based on a best guess.

What You Will Need

- ArcGIS 10.2 for Desktop (Basic, Standard, or Advanced license level)
- ArcGIS Network Analyst extension
- ArcGIS Online organizational account
- Sample dataset from *ArcUser* website
- Intermediate ArcGIS for Desktop skills

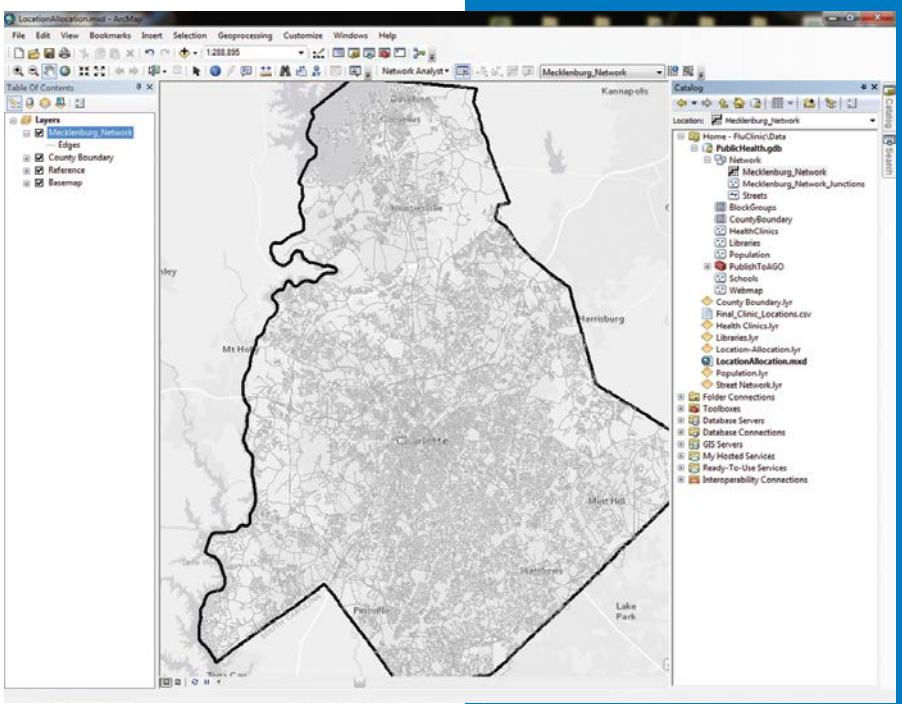
The budget this year has been reduced. There is only enough funding for four mobile clinics to augment the permanant ones. Consequently, the department needs to maximize the coverage of each clinic.

Location-allocation analysis, a tool in the ArcGIS Network Analyst extension, determines an optimal location for one or more facilities that will service demand from the surrounding population. Retail businesses use location-allocation to determine where to open a new store. Government agencies can use location-allocation to site libraries or fire stations or—in this example—mobile health clinics for providing flu immunizations. ArcGIS for Desktop and Network Analyst will help the county make more informed decisions on mobile clinic locations.

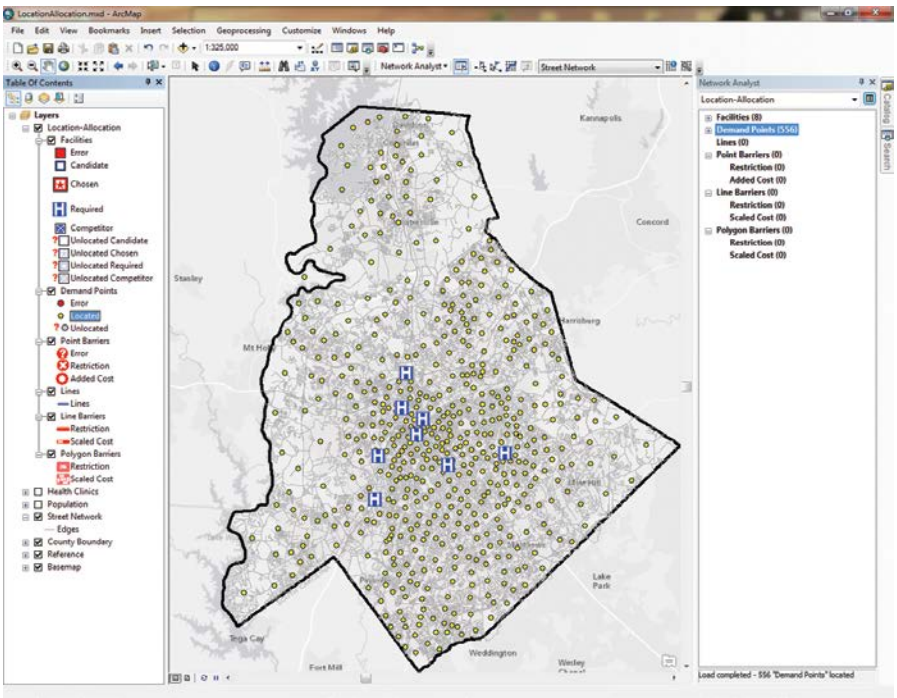
Getting Started

Download the sample dataset from the *ArcUser* website (www.esri.com/arcuser) and open on a local machine.

1. Start ArcMap, navigate to the location of the sample dataset, and open LocationAllocation.mxd, located inside the FluClinic folder.
2. Choose Customize > Extensions and make sure the Network Analyst extension is available and its toolbar is active.
3. Under File > Map Properties, set PublicHealth.gdb as the default geodatabase, verify that relative paths is checked, make a thumbnail, and click Apply and OK.
4. Save the map document.

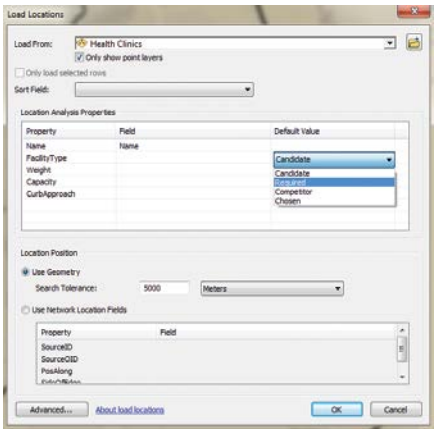


After opening LocationAllocation.mxd, use the Catalog window to add the Street Network.lyr file. →



← In the Network Analyst window, load Health Clinics as Facilities and Population as Demand Points.

↓ For Health Clinics, set Facility Type as Required in the Load Locations dialog box.



Data for This Problem

The sample dataset contains all the required data. This analysis will require data on the locations of the permanent clinics, on the county's population, and the county's street network. Because mobile clinics were previously set up in libraries, using libraries as sites makes sense because people are familiar with them as mobile clinic locations and can easily find them. Consequently, location data for libraries is also needed. For this example, to simulate patient locations, US Census block group centroids were used.

To perform location-allocation analysis in Network Analyst requires a network dataset. This is basically a street centerline file that has attributes, such as speed limits or travel times, assigned to each road segment. A network dataset can be built using Network Analyst. In this case, the network dataset that is included with Data and Maps for ArcGIS has been included in the sample dataset and will be used.

1. In the Catalog window, drag Street Network.lyr from the FluClinic folder and drop it on the map. If necessary, relink it to its data source, Mecklenburg_Network in the network dataset in the PublicHealth.gdb.
2. Once added to the map, turn off Street Network.lyr in the table of contents (TOC).
3. Now that a network dataset has been added to the map, the Network Analyst tools are enabled and the Location-Allocation layer can be created. On the Network Analyst toolbar, click Network Analyst > New Location-Allocation.
4. The Location-Allocation layer should appear in the TOC. The Facilities (Health Clinics) and Demand Points (Population) can now be loaded into the Network Analyst window. Save the map document.

Loading Clinics and Population Data

By default, the Network Analyst window should have opened when the map document was opened. If it is not open, open it by clicking the Network Analyst window button on the Network Analyst toolbar.

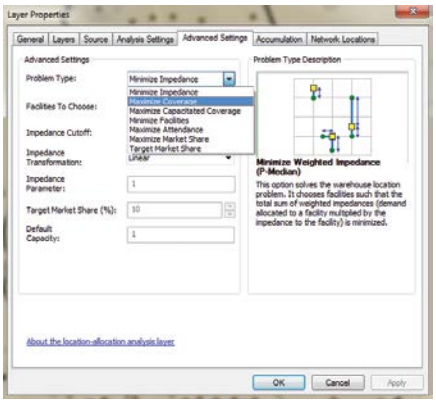
1. Use the Add Data button to add the Health Clinics and the Population layers to the TOC. Turn them off and drag them below the Location-Allocation layer.
2. In the Network Analyst window, right-click Facilities and choose Load Locations. Select Health Clinics.lyr from the drop-down next to Load. Accept the defaults for all properties except Facility Type. Set Facility Type as Required. These clinics are permanent, so the tool should always use them. Once added to the Facilities layer, these points are automatically added to the map.
3. In the Network Analyst window, right-click Demand Points, select Population as the layer to load from, and accept all defaults. Wait while the Demand Points layer populates with simulated patient data.
4. Save the map document.

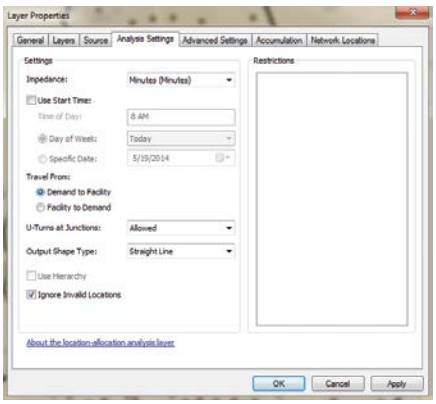
Identifying the Problem

Think about which problem should be solved by this analysis. Is the goal to minimize impedance? Not really. Impedance is an aspect of the solution but does not address the real problem. Is the goal to minimize the total number of facilities for the demand? No, actually it is the opposite. The goal is to select clinic locations within a reasonable distance from most residents. Consequently, Maximize Coverage is the correct analysis choice. It will generate a solution that identifies optimal locations for a finite number of clinics that would serve as many residents as possible.

Looking at the Existing Situation

1. Right-click the Location-Allocation layer in the TOC and choose Properties. Click the Analysis Settings tab. Verify that Minutes is selected for Impedance. Click the radio button to set the





↑↑ Right-click the Location-Allocation layer in the TOC and choose Properties. On the Advanced Settings tab, choose Maximize Coverage, set Facilities To Choose to 8, and type "10" for Impedance Cutoff.

↑ Still in the Layer Properties but now on the Analysis Settings tab, set Travel From: to Demand to Facility.

direction of travel to Demand to Facility to simulate patients traveling to clinics.

2. Click the Advanced Settings tab. Set Problem Type to Maximize Coverage. Under Facilities To Choose:, specify 8 for the eight permanent clinics. Set Impedance Cutoff to 10 to indicate that 10 minutes is the maximum time a patient would be willing to spend traveling to a clinic.
3. Click Apply, then OK.
4. With all the options set, the analysis can be run. Click the Solve button on the Network Analyst toolbar. When the analysis is complete, it should show that 366 of 556 residents are within a 10-minute drive of a permanent clinic. This is about 60 percent of the population. More clinics will be needed to provide acceptable service to residents.

Adding Mobile Clinics

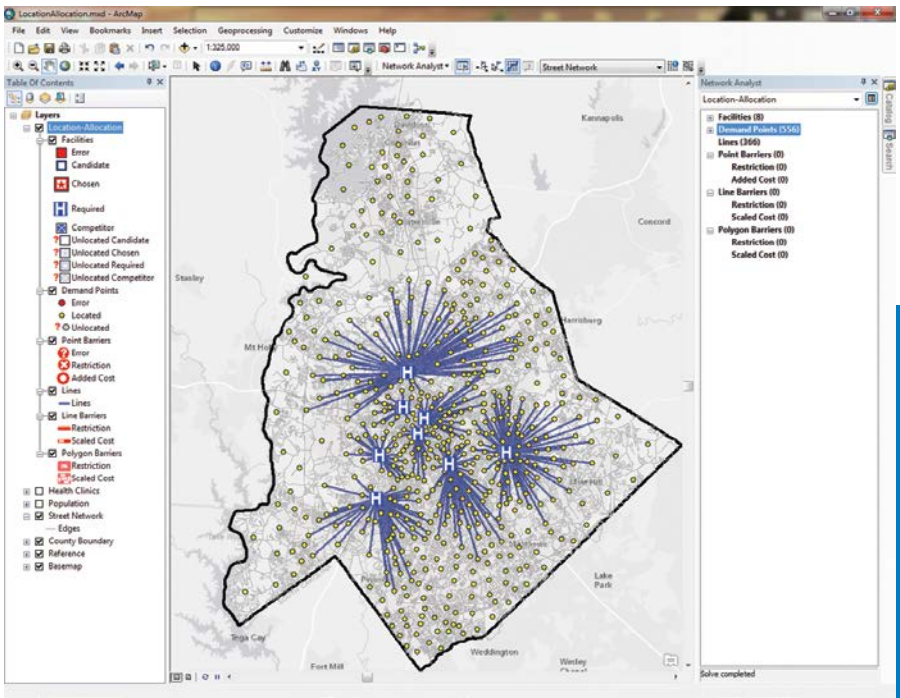
The budget will fund four additional mobile clinics so more patients can be served. The challenge is identifying areas that are not being served and locating mobile facilities that will improve service to those areas. The experience of previous years indicates that libraries work well as mobile clinic locations because residents can easily locate them, and they have been used as mobile clinic sites before. Although there are a lot of libraries, there is only funding for four clinics, so the solver will be used to find out which libraries will best serve the demand.

1. To determine which libraries will make the best mobile clinic locations, drag the Libraries.lyr file from the Catalog window to the TOC. Turn this layer off.
2. Right-click Facilities in the Network Analyst window and choose Load Locations. Choose Libraries.lyr and accept all defaults. Unlike the Health Clinics.lyr, which contained the permanent clinics, the Libraries will be used to generate candidate sites, so do not change Type from its default of Candidate.
3. After loading the Libraries.lyr, right-click the Location-Allocation layer in the TOC and choose Properties. Click the Advanced Settings tab again and change Facilities To Choose: to 12. That will be the total number of facilities—the eight permanent clinics that will be automatically included because they are required and the four best library locations for a total of 12 locations. Click Apply then OK.
4. Click the Solve tool again. The results of the analysis will show the optimal choices for four libraries to host mobile health clinics, indicated by green check marks, as well as the permanent clinics shown with hospital symbols. Non-optimal library locations will be shown as blue question marks.
5. In the Network Analyst window, look at Lines to see that 516 of 556 residents are within 10 minutes of a clinic. That's 92.8 percent of residents, which is a substantial improvement.

Communicating Results

The locations of these mobile clinics can be communicated to the public by embedding a

↓ Run Solve on the permanent clinic locations to find out how much of the population is not being served. Only about 60 percent will be served using only the permanent clinics.

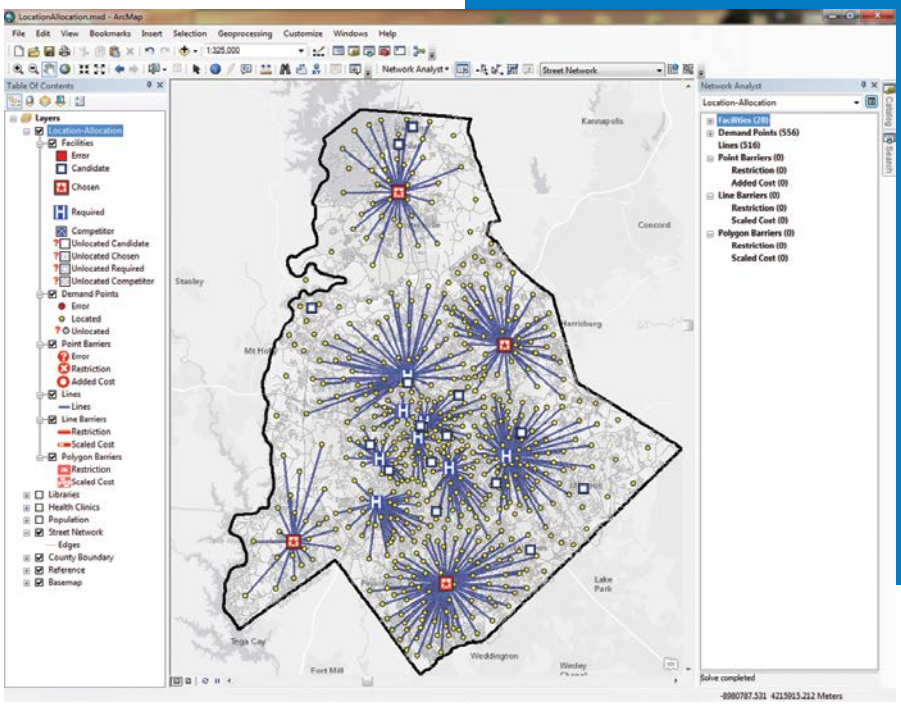


web map in the county health department's website. The results of the analysis can be published directly from ArcMap in ArcGIS for Desktop as a service hosted on ArcGIS Online, then shared as a web map.

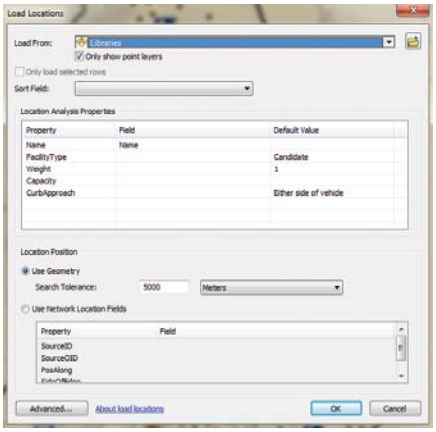
Once the service has been created on ArcGIS Online, open it in the ArcGIS.com map viewer. Make any adjustments desired to the map. Click the Share button from the ArcGIS Online interface. Click the EMBED IN WEBSITE button. The HTML code needed to embed the map in a website is automatically generated. Simply copy and paste it into the desired web page. It will look just like the web map you made with the results on ArcGIS Online.

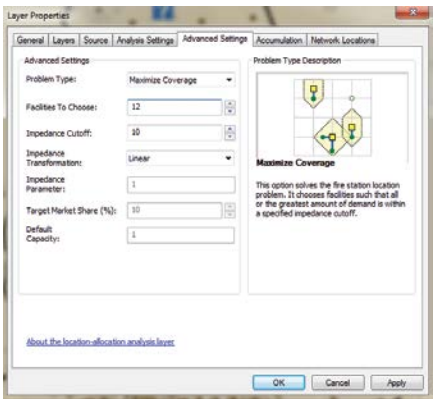
Summary

Using GIS to optimally locate the additional clinics is far superior to "just eyeballing." This analysis uses the actual street network and an analysis of the demand that factors in maximum travel time for patients. By using ArcGIS for Desktop with the Network Analyst extension and some simple datasets for clinic locations, population, library locations, and a network dataset that included travel time, it took little time to identify which libraries were the best sites for mobile clinics and ensure good service to residents while staying within the budget by adding only four clinic locations.



↑ After running Solve again with these new parameters, the four candidate sites will bring the percent of the population served to 98.2.





↖ To choose which of the libraries would be good locations for mobile clinics, first load the library locations and leave FacilityType as Candidate.

↙ After adding the libraries, change the Facilities To Choose from 8 to 12 to account for the four mobile clinics that must be sited.

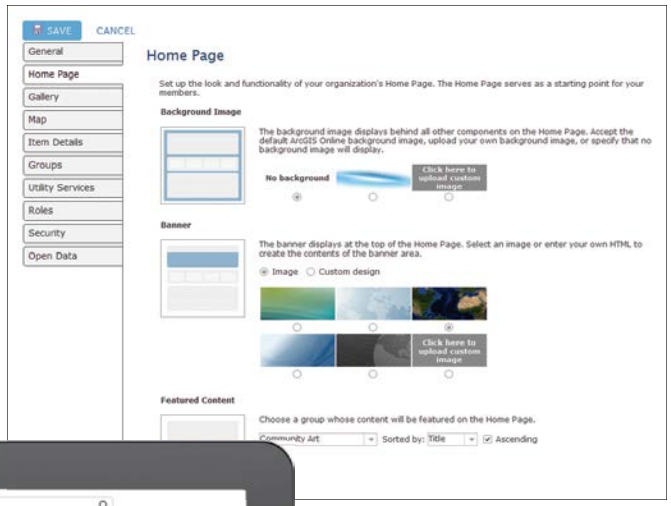
Acknowledgments

This article was based on a demonstration created by Harry Moore and Tim Craig of Esri's California regional office for the Sharpening Your Skills seminar series. Data for this exercise was supplied by Esri, the City of Naperville, Illinois, and the Minnesota Department of Natural Resources. View a video of this demonstration and others in the Sharpening Your Skills series at esri.videos.com.

Using Groups to Deliver Access to Maps and Apps

By Bern Szukalski, Chief Esri Tech Evangelist

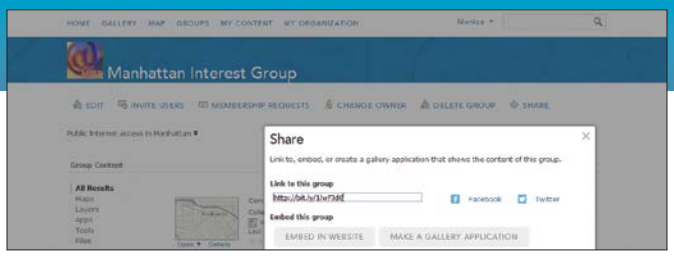
Groups offer a way to organize items for wider access and are also used as building blocks for your organization home page. They can be used in easily configured gallery template applications and embedded in websites and blogs. As items are added or removed from a group, the corresponding gallery apps or embedded galleries will automatically reflect the updated group content. Here are a few ways you can use groups to deliver access to maps and apps.



↑ Set a Group as the source for the featured content ribbon by choosing My Organization > Edit Settings and selecting the Home Page tab.

← As an administrator, you can use Groups to populate the featured content ribbon and gallery for your organization's home site on ArcGIS Online. The Utah Department of Transportation UPLAN site does this.

↑ Set a Group as the source for a gallery by choosing My Organization > Edit Settings and selecting the Gallery Page tab.



↑ The first step in sharing a Group, making a Group gallery app, or embedding a Group gallery is to open the Group and click the SHARE link on the far right side.

Use Goups for Featured Content and Gallery

Organization administrators use groups to populate the organization's home site featured content ribbon and the organization's gallery. These are set by choosing MY ORGANIZATION > EDIT SETTINGS, selecting theAv Home Page tab, and then choosing the group to use for Featured Content. Gallery contents are set by selecting the Gallery tab, then choosing the group to populate the organization Gallery.

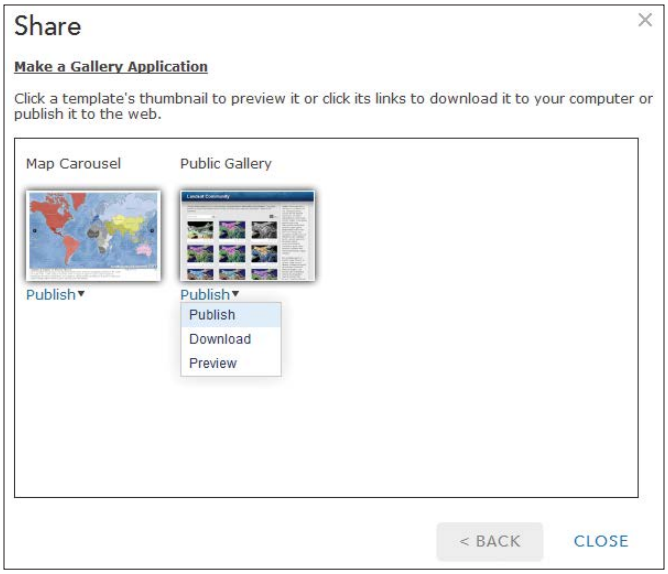
Share a Group

Open the group, click SHARE, then use the shortcut URL link.

Make a Group Gallery App

The group gallery template application is an easy way to quickly create a searchable gallery of maps and apps. It can be used for both internal (within your organization) or public access needs.

1. To use the gallery app, click SHARE, then MAKE A GALLERY APPLICATION.
2. Choose Publish to create a new application item.
3. Provide a name, description, and tags.
4. Save and configure the gallery application using the configuration panel.
5. Once completed, share the application with your organization or with everyone. Remember that only publicly shared items in the Group will be visible outside the organization.



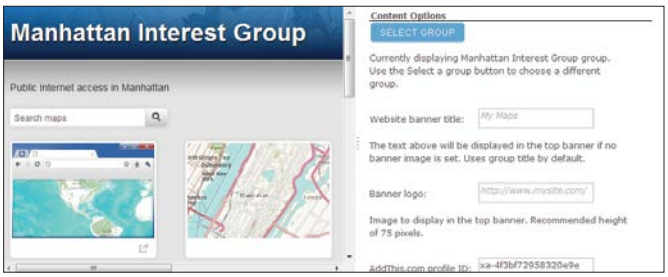
↑ From the Share dialog box, click MAKE A GALLERY APPLICATION to make a group gallery into an app, then choose Publish from the drop-down under Public Gallery.

Embed a Group Gallery

Embedding a Group using a gallery ribbon is even simpler than making a gallery app.

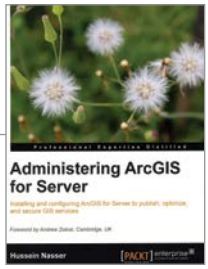
1. From your Group, click SHARE, then EMBED IN WEBSITE.
2. Next, choose the layout style you want and options for displaying web maps.
3. Copy and paste the HTML into your website or blog.

For more information, visit the ArcGIS Online section of the ArcGIS blog (blogs.esri.com/esri/arcgis/category/arcgis-online/).



↑ After choosing MAKE A GALLERY APPLICATION, click CONFIGURE APP to modify the banner, logo, and other features of the gallery app, then copy and paste the HTML into your website.

GIS Bookshelf



Administering ArcGIS for Server

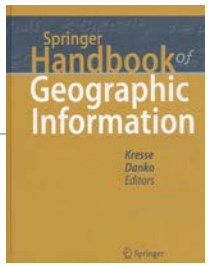
By Hussein Nasser

GIS users, analysts, database administrators, and programmers who have a basic knowledge of ArcGIS can benefit from this book's clear explanation of how to implement and optimize ArcGIS for Server. It covers installation; authoring web services; consuming, planning, designing, and optimizing GIS services; clustering and load balancing; and securing ArcGIS for Server. *Administering ArcGIS for Server* provides both step-by-step tutorials and explanations of the underlying technology. You will also learn how to plan, analyze, and publish and consume GIS services from various platforms including mobile and tablets. This information can help you design the implementation that will best meet your organization's requirements and run efficiently and effectively. Packt Publishing, 2014, 246 pp.; ISBN: 978-1782177364

Building Web and Mobile ArcGIS Server Applications with JavaScript

By Eric Pimpler

Esri is encouraging the use of the ArcGIS API for JavaScript to build custom and out-of-the-box web and mobile applications. *Building Web and Mobile ArcGIS Server Applications with JavaScript* contains step-by-step exercises for developing these applications for ArcGIS for Server. Designed for beginner to intermediate web and mobile developers who want to create fully functional applications, it does not presume knowledge of GIS but provides information on GIS in the context of implementing geographic functionality such as mapping, spatial and attribute queries, identification of features, finding features by attribute, geocoding, and geoprocessing tasks. Adding toolbars and user interface widgets and integration with ArcGIS Online are also covered. Packt Publishing, 2014, 248 pp., ISBN: 978-1849697965



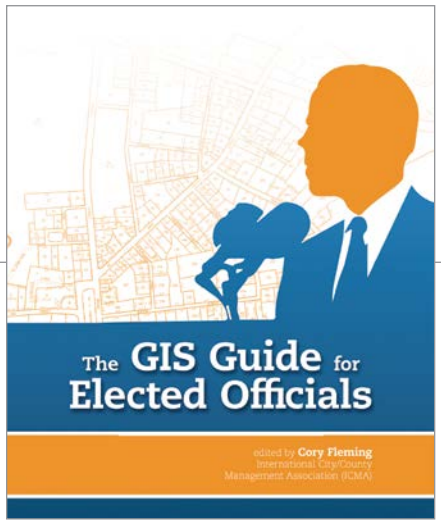
Springer Handbook of Geographic Information

Edited by Wolfgang Kresse and David M. Danko

This comprehensive reference is divided into three sections: Basics and Computer Science, Geographic Information, and Applications. Geographic information cuts across a vast array of subject areas by supporting their spatial components. However, this inherent diversity is often overlooked. This massive handbook addresses that oversight by including not only standard subject areas, such as cartography and geodesy, but also Internet mapping and specialized applications based on geographic information for agriculture and health. Consisting of contributions by 56 authors, the *Springer Handbook of Geographic Information* is more like a collection of textbooks that summarize a broad collection of subject areas. It contains 600 illustrations, extensive references, and a list of the terms and definitions of the ISO 19100 Standards. Springer, 2012, 1,100 pp., ISBN 978-3-540-72680-7

The GIS Guide for Elected Officials

Edited by Cory Fleming



This collection of use cases illustrates the variety of problems that GIS can help governments solve. *The GIS Guide for Elected Officials* is a resource for government officials who want to better understand how to use GIS to answer location-based questions related to service delivery, workflows, and citizen engagement. GIS can help answer questions such as:

- Are calls for service originating from the same neighborhood about the same problem? If so, why?
- How can work crews respond more efficiently to service calls?
- Does citizen satisfaction with city services vary across the community?

The opening section explains what GIS is and how it works for government. The next two sections describe, through examples from jurisdictions large and small, how GIS is used to support policy decisions and streamline government operations. The final section tells elected officials what they need to do to support the creation of their own GIS programs.

The use cases in *The GIS Guide for Elected Officials* address the many and varied challenges facing government, from assessing potential markets for start-up businesses to responding to disasters to identifying urban food deserts. Elected officials can learn how to build and maintain a strong GIS program while dealing with rapidly changing technology and shrinking government budgets.

The book's editor, Cory Fleming, is a senior project manager with the International City/County Management Association (ICMA), who currently directs ICMA's 311/CRM Technical Assistance Services. She writes about the use of data for the improvement of local government service delivery and performance measurement.

Esri Press, 2014, 212 pp., ISBN: 9781589482722

GIS Insights Improve School Management

By Jim Baumann, Esri Writer

GIS has improved the process of assigning students to schools and transporting them as well as managing physical assets for one of the largest school districts in Texas.

The Garland Independent School District (GISD) is located in north-central Texas, adjacent to Dallas. The district encompasses approximately 100 square miles and serves the Dallas suburb cities of Garland, Rowlett, and Sachse. With an enrollment of about 58,000 students, it is the thirteenth-largest school district in the state of Texas.

Enabling Choice

GISD's "district of choice" policy allows parents to choose where their children will attend school, based on established criteria for ethnic balance. Annually, the district has a one-month selection period for both secondary and elementary schools. Once the selection period ends, the district's Student Services department begins the process of assigning students to campuses based on building capacity, grade-level capacity, and seat availability. Other criteria, including campus demographic data, are considered before making the final decision on school placement. To help with student travel and support the district of choice policy, the district's GIS department developed a Flex application for distance routing. With this application, officials can determine the location of a student's home and local schools within the immediate vicinity.

Converting AutoCAD Files to Geospatial Data

Garland maintains 7 high schools, 12 middle schools, 47 elementary schools, and 2 pre-K schools, as well as a number of administrative offices and special-use facilities. Managing these facilities for compliance with governing standards, current use, past maintenance, and potential renovation and remodeling projects became increasingly difficult. It was decided that an automated system was needed to prepare plans and data for quick and easy access.

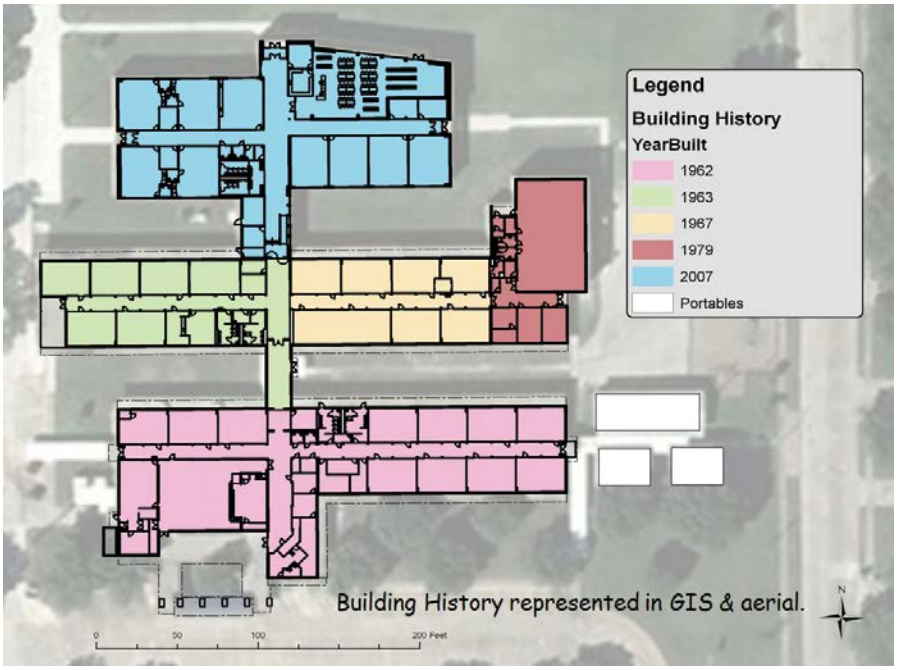
For several years, the district used Autodesk's AutoCAD for facilities management. The district's AutoCAD facilitator was responsible for converting all paper drawings into AutoCAD drawings and maintaining facility floor plans during the district's $385 million

bond program. Approximately four years ago, the facilities department began implementing a GIS to be used in conjunction with AutoCAD. The district retained all facility floor plans in AutoCAD while using GIS to provide easy access to site plans, floor plans, room numbers, and data referenced to them.

With the arrival of GIS analyst James Walker, the decision was made to create a separate GIS department and convert all existing AutoCAD site plans and floor plan files to Esri's ArcGIS format to make greater use of the district's ArcGIS for Server installation.

"Because we have used AutoCAD for so long, it is very important to us that the new GIS-based drawings look exactly like the CAD plans for easy visual recognition among staff members," said Walker. "This means that all the details in the original files must be included in the new ones."

Walker found the conversion process challenging because existing floor plans often included small features such as door swing paths, stairwells, and other details that totaled 30,000–40,000 polylines when converted to ArcGIS. For example, curves were made up of many very short line segments rather than a single continuous line. "When you brought a converted AutoCAD drawing into the geodatabase, it could take 10 minutes or more to draw because of its complexity," said Walker. "So I built a module for our AutoCAD processing model to simplify the drawings."



Walker's module removes all the unnecessary polylines in the AutoCAD drawings by running a spatial buffer with a dissolve around it. Because he set the buffer value at one-quarter of a centimeter, he got a half-centimeter line on either side of the polyline. The result is that all the thousands of tiny polylines become one complex polygon that draws very quickly.

In addition, Walker uses Esri's ModelBuilder to extract data from the AutoCAD drawings and create new layers in the geodatabase. "We apply structured queries to the polygons and annotations in AutoCAD to extract GIS feature classes

from roof plan outlines and their related buildings," said Walker. He used the same method on the construction history of both the original buildings and other structures that were subsequently attached to the original buildings. By doing this, he created about a half dozen new layers from the original AutoCAD files that could then be used to analyze the condition of district buildings.

Standardizing Room Numbering

Reconciling the various classroom numbering conventions found throughout the district was another significant benefit from implementing GIS. In the past, photocopies of school floor plans were distributed to the maintenance, security, technology, energy management, and other departments. The same photocopied floor plan could remain in use for several years, despite the fact that building renovations or modifications had occurred or the room numbering had been changed. In some cases, departments had different versions of the floor plan for the same school.

"Because the existing CAD system maintained multiple unconnected drawings for a school, there was no way to know whether or not a room number was used more than once," said Walker. "So it was possible for a classroom on the first floor and a utility closet on the second floor to have the same room number."

Another aspect of room number standardization is its impact on security and emergency response. School entrances and exits throughout the district are now numbered in such a way that they are in compliance with police and fire department guidelines. This allows first responders to react quickly and efficiently once they arrive at a campus. "We'll soon begin to incorporate the new numbering system with GIS views and printed maps that relate to the current construction of each facility," said Walker.

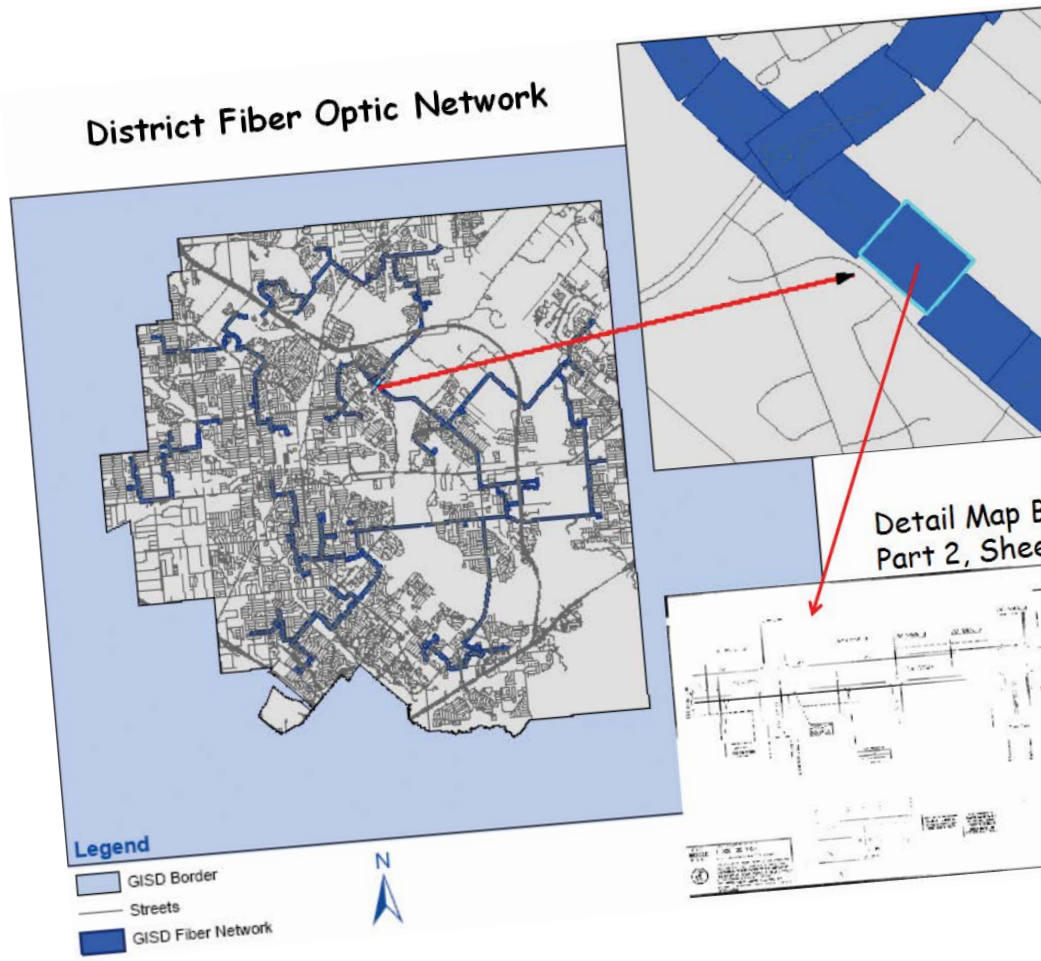
Thinking Outside the Classroom

Managing building use is an ongoing challenge in many school districts. Because demographic data is joined to the classroom a student is assigned to, it is possible to analyze the campus as a whole as well as individual rooms. Each building is reviewed annually in conjunction with enrollment projections, program offerings, and staffing requirements. For example, elementary schools often have both regular and English as a Second Language (ESL) kindergarten classes, but as students progress, the need for ESL classrooms begins to vary from school to school.

GIS is also used to analyze the building construction data collected so that the district can track the conditions of major building components, such as flooring; roofing; and heating, ventilation, and air conditioning systems. Data collected includes installation date, manufacturer, installer, and product information. This data assists various departments in developing their budgets for replacement based on the age of a component and aggregating yearly budget projections across the district for similar replacement work. This allows some basic life cycle costing of major facility components within the district. In future years, it will also provide valuable information for bond projections.

In addition, the GIS department recently helped the district's transportation department with the implementation of a new GIS-based routing system. Currently, the district transports approximately 28,000 students on 250 buses daily, totaling 3.5 million miles per year. To supplement and enhance this system, GISD is using the ArcGIS Network Analyst extension to build an extensive street and sidewalk network.

"We are beginning to expand our use of GIS," said Walker. "We plan to implement a GIS process for data collection. As we gather and centralize more data, we will begin to perform more detailed analyses with our data to better understand the dynamics of the district and provide increased services to school district employees and our students."



A (Not-So) Secret Strategy for Passing Certification Exams

With two certifications under his belt, Mark Valentino has a good understanding of what it takes to pass the exams for Esri Technical Certification.

Experience is the key, he believes.

"There are details that only experience can give you," he said. "If you just know that you push this button and pick these things to get a result—without knowing how complex the process is or what it takes to do that analysis—you will have trouble."

Valentino is a GIS analyst at Freese and Nichols, Inc., a multidiscipline consulting firm in Texas. Valentino discovered GIS while in the US Army. His assignment required making a lot of presentations that used maps. However, the maps made by analysts were too precise for his purposes.

"So being a good employee, I said it was time to do them myself. I got a copy of ArcView GIS 3.0 and a crash course on how to put together a map." He enjoyed his mapmaking projects so much that when ArcView 8 was released, Valentino explored more aspects of the software and "just kept going with it." He was hooked.

He followed a similar path to technical certification, participating in the exam's beta program. Valentino became one of the first Esri certified ArcGIS Desktop Professionals. He remembers how excited he felt in 2011 when he learned he had passed his first certification exam. He recently earned the Enterprise Administration Associate certification and is considering additional certifications.

In the three years since the launch of the Esri Technical Certification program, more than 3,800 certifications have been awarded. Technical recruiters and hiring managers have embraced certifications as a means to simplify the hiring process. Certifications help quickly identify qualified candidates for key technical positions. Many organizations cite improved customer service as a major benefit of supporting work force certifications. Esri partners recognize the advantage of employing Esri certified staff to win customers and differentiate themselves from competitors.

Although improved earning potential is often thought to motivate individuals to become certified, a 2013 survey by Esri testing partner Pearson VUE and Firebrand found that 75 percent of respondents who had achieved certification did so to improve their reputation among peers, improve their confidence, and work on more complex tasks. As of May 2014, about 800 individuals had listed their certifications in the Directory of Esri-Certified Individuals.

Quick Certification Facts

- The program opened to the public on January 17, 2011.
- There are three domains and 20 exams supporting three ArcGIS versions.
- A beta exam may contain twice as many questions as the final exam.
- To date, the most popular exam is ArcGIS for Desktop Associate.

Although many organizations have just one GIS professional who is effectively a jack-of-all-trades, even the most accomplished jack will likely not come close to using all the tools available in ArcGIS. Given this reality and the exams' broad scope, preparing for a certification exam can be a challenge.

To supplement his experience when preparing for exams, Valentino has taken Esri training courses, read Esri Press books, and used other free resources such as the ArcGIS Help documentation. His advice to other candidates preparing for an exam? "Start with the help files and get to know all aspects of the software and all extensions and possible uses. All the information is there."

Learn more about Esri Technical Certification at esri.com/certification.

US Highpointer Clubs Tap into Web GIS

ArcGIS Online helps with the journey and the destination

By David Kelley, University of St. Thomas

The author created ArcGIS Online maps that two highpointer organizations use to help members and others plan trips.

Highpointing is the sport of ascending to the point with the highest elevation within a given area (the "high point"). Examples include climbing the highest point of each US state, reaching the highest contours of each county within a specific state, and ascending the highest mountain on each continent.

This pastime is practiced all around the world, especially in the United States. Highpointers seek to climb either to the highest point in each of the 50 US states or to the highest points in each county within a specific state.

These enthusiasts trek to the summit of remarkable mountains such as Alaska's Denali or Washington's Mt. Rainier as well as less notable hilltops such as Rhode Island's Jerimoth Hill or a 10-foot (3-meter) contour in Franklin County, Florida. The heterogeneous nature of these summits is usually considered part of the appeal. The travel and cultural experiences en route to the climbs are often valued as highly as the climbs themselves.

The most active highpointing organizations are the Highpointers Club (www.highpointers.org) and the County Highpointers Club (www.cohp.org). Highpointers Club members seek to summit all the US state high points. The members of the County Highpointers Club are collectively attempting to reach the highest points in all 3,143 US counties.

To date, more than 240 people have completed all 50 state high points, with about 10 more people added to the list annually. Difficulty of ascent varies considerably from state to state. High points in about 20 states can be ascended by automobile, while most of the rest can be reached via an easy hike. Only a dozen or so require serious effort that can test an individual's fitness and skills.

Peaks like those in Connecticut, Massachusetts, or Rhode Island are relatively easy to get to, while others in places like Alaska, Arizona, or Hawaii are distant or isolated. Cost and logistics are significant factors when planning to visit many or all of these 50 peaks. Climbers rely on current information from a variety of sources.

The key source for up-to-date information on state high points is the Highpointers Club, founded in 1988 to provide a forum for education about the high points, aid in the preservation and conservation of the high points and their environs, and provide members with planning tools to accomplish their climbs. The website provides a trove of valuable information about access to state high points, especially for those located on private land.

A Better Solution

One glaring omission on the Highpointers Club website was an interactive map that would let members locate and explore specific high points and the surrounding topography. The site merely provided a monochrome picture of the 50 US states with a gray star showing the relative location of each high point. Members felt that a robust and interactive map would help climbers plan better ascent routes based on terrain difficulty, identify logical parking spots and trail access points, and plot regional circuits to bag more than one peak in a multiday trip. The map would have to

↓ The author, David Kelley, created this ArcGIS Online map showing the locations of US county high points with latitude-longitude and elevation data provided by Tom Dunigan of the County Highpointers organization.

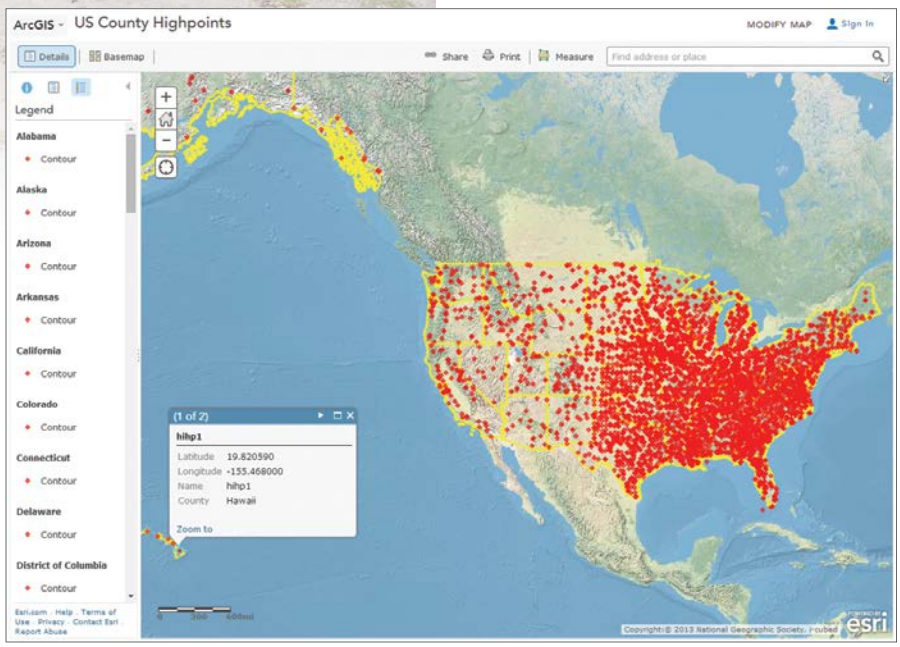
↓↓ Another interactiave map created by the author showing the locations of state high points with latitude-longitude and elevation data

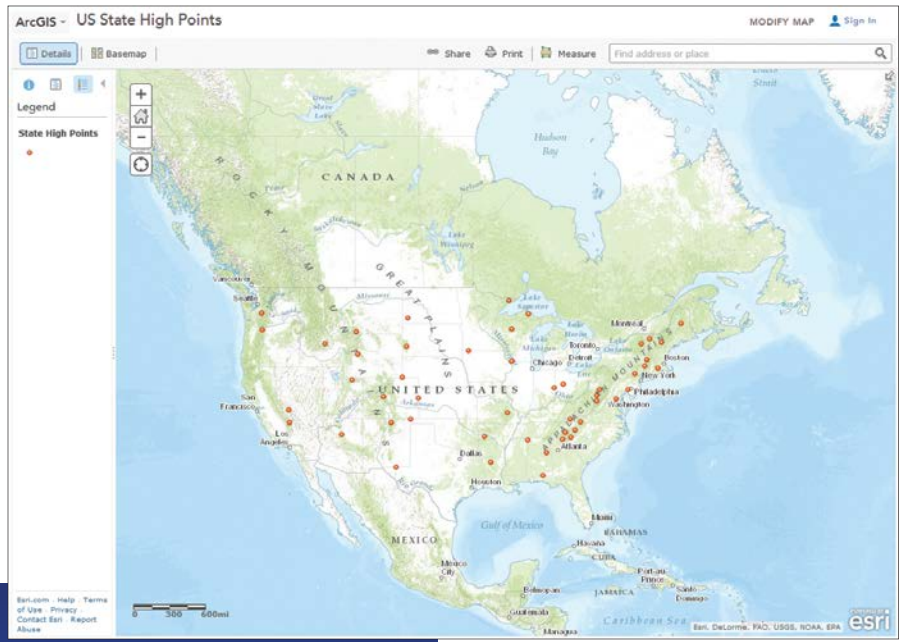
be customizable for the organization, easy to use, and free.

The cleanest solution was to turn to Esri's ArcGIS Online. Club members wanted an interactive topographic map with cultural references, such as borders, roads, surface water bodies, and labels, that was accessible through the Highpointers website and would not require software installation or setup. ArcGIS Online fit the bill splendidly.

The basemap used to develop a US State High Points map was the World Topographic Map service provided by Esri. This map includes administrative boundaries, cities, water features, physiographic features, parks, landmarks, highways, roads, railways, and airports overlaid on land-cover and shaded relief imagery. GPS coordinates for the state high points were obtained from the America's Roof website (americasroof.com) and used to create pop-up windows for each high point. Map pop-ups include the name of the high point and the state it is located in, the high point's GPS coordinates and elevation, and a link to Wikipedia for more information on the peak.

The map, with its interactive functionality, was easily embedded into the main Highpointers Club web page. "It lets you zoom in to the highest detail on the topographic. There's almost no online map that will let you do it that fast or elegantly!" said Roger Rowlett, club secretary and webmaster. Initial feedback has been positive, and the map receives roughly 1,000 visits per month.





County Highpointers Never Say Die!

County highpointers are a different crew altogether. Rules for their accomplishments state that members have to visit all the high point contours for a county to get credit, and many counties have multiple high points. Some members have climbed more than 1,000 county high points, and some states have counties where no one has yet accomplished this goal.

The base layer used to develop a US County High Points (COHP) map was compiled using the USA Topo Maps provided by Esri. These maps are seamless, scanned images of United States Geological Survey paper topographic maps with scaled detail. GPS coordinates for the high points were obtained as GPS eXchange (.gpx) files from the COHP website.

Pop-up windows include the GPS coordinates, contour name, and county. COHP webmaster Adam Helman said, "This is a potentially beneficial addition to the COHP website—and so I have created a link to it from the Information Maps page, indeed, replacing the outmoded link to Pinpoint Maps, which is noninteractive and incomplete."

Members of both organizations can also access the US County High Points and US State High Points maps using Esri's free ArcGIS app for smartphones and tablets.

For more information, contact Dr. David Kelley, Department of Geography, University of St. Thomas, St. Paul, Minnesota (e-mail: dwkelley@stthomas.edu, website: www.stthomas.edu/geography).

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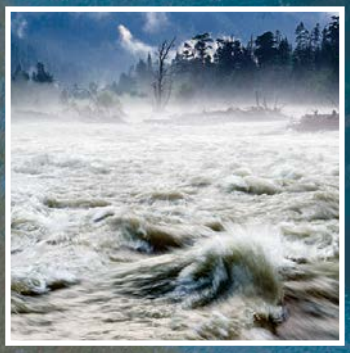

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