Government Matters

ESRI • Fall 2009

GIS for State and Local Government

Surprise Bridges the Gap between CAD and GIS

Located in Arizona's Sonora desert, the city of Surprise is a booming Phoenix suburb with a small-town feel and big-city amenities. One of those amenities is the city's geographic information system (GIS), which has helped Surprise meet the geospatial information technology (IT) requirements of one of America's fastest-growing cities. At the peak of the housing boom, from 2006 to 2008, Surprise issued more than 800 new house construction permits per month.

"GIS is the foundation on which both the city's land information and asset management systems are based," explains City of Surprise GIS Division manager Lloyd Abrams.

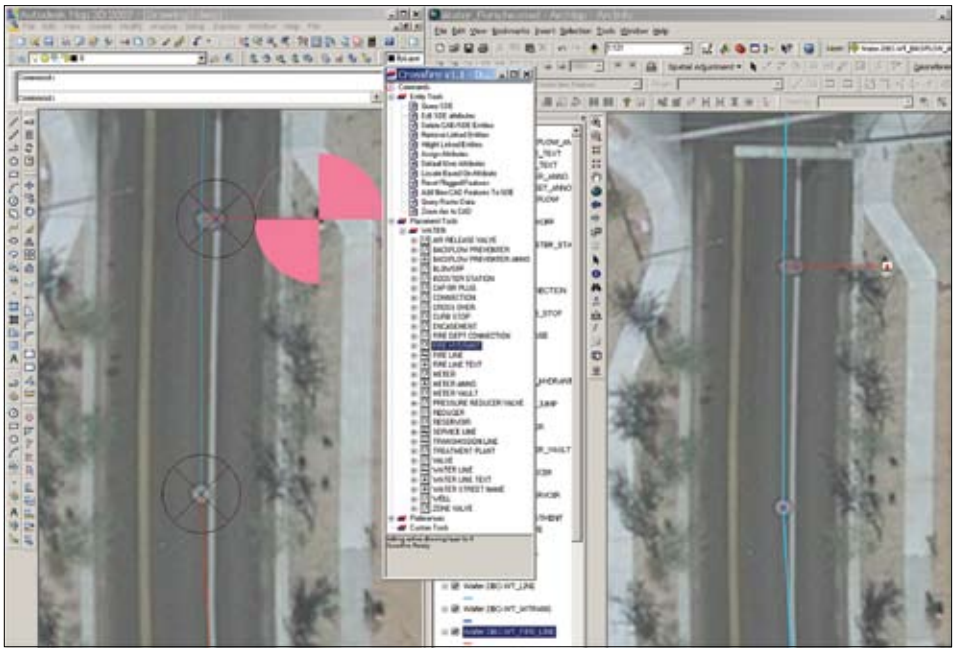
From addressing to planning to emergency routing, nearly every department in the city relies on its enterprise GIS for accurate and current geographic information. However, Surprise's spatial data has not always been available to its employees as a GIS enterprise-wide luxury. In recent years, data was provided by disparate departments and various developers, surveyors, and engineers in a CAD format. The GIS division then had to manually integrate data from AutoCAD into an ESRI shapefile before it was accessible to employees working in an ArcGIS Desktop environment.

Once in desktop GIS, select employees could perform advanced spatial analysis, model operational processes, and visualize results on maps. The interval between receiving CAD data and being able to view it in the city's GIS could sometimes be lengthy, and CAD data was frequently incoming. Surprise had invested in an accurate survey control network that city departments and developers alike were required to utilize while acquiring and submitting data. Says Abrams, "The network ensured that incoming data fit well into the city's GIS basemap, but it wasn't a seamless transition."

Anticipating a housing boom and the onslaught of incoming data related to urban sprawl, Surprise began to migrate its CAD data into an enterprise GIS. Centrally stored in a Microsoft SQL Server-supported relational database management system (RDBMS), AutoCAD map data became accessible via an intranet portal based on ESRI ArcGIS Server.

The upgrade to server GIS gave Surprise the power to streamline business practices and workflows within all city departments. Surprise's permitting system, engineering activities, and utility maintenance tasks all benefited greatly from the GIS investments. However, Abrams' department of four employees was still tasked with the manual translation of incoming CAD data from developers before it could be stored in the new GIS geodatabase.

With years of an established, CAD-based maintenance workflow and the investment in software and expertise, Surprise began shopping for a software solution that could automate the frequent and time-consuming CAD-to-GIS migration progress.



Accessing ArcGIS from Inside the AutoCAD Environment with Crossfire

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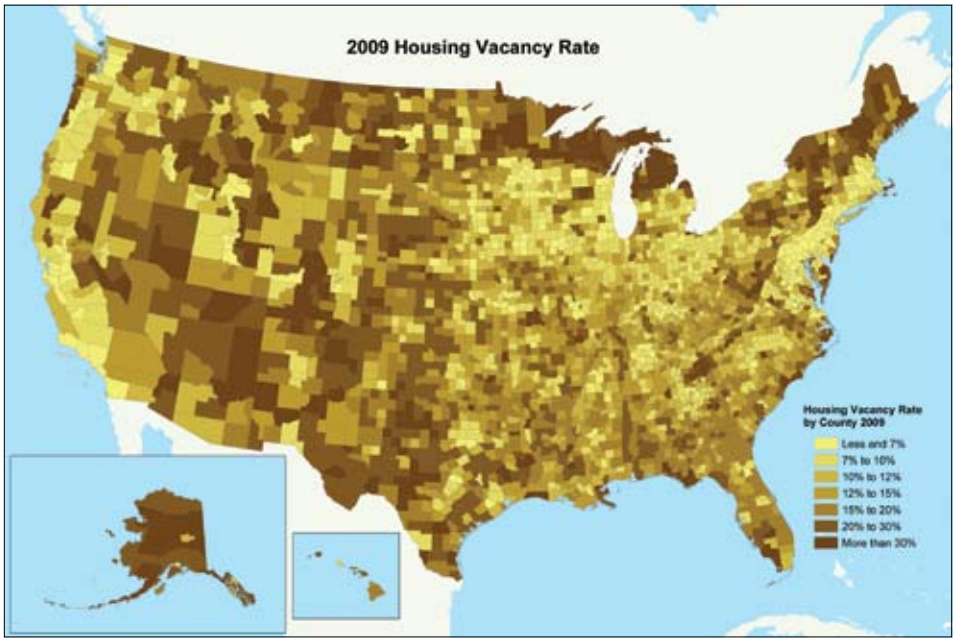
ESRI Data Helps Governments Meet Citizens' Needs

Understanding the 2009 Demographic State of the United States

As the recession drags on, governments are stretching to provide more services to more people while collecting less money due to reduced property values and lower sales tax revenues. To do this effectively, governments must first understand the demographics of their populations compared with the United States. Are their populations younger, older, more affluent, or less educated than the national norms? Governments can also learn whether the local median income and home values are above or below the national medians. This information is useful when applying for grants for services or promoting the area to prospective residents and businesses. ESRI's newly released Updated Demographics explains these details and many more to paint a clear picture of the 2009 demographic state of the United States.



ESRI's Updated Demographics provides a wide range of current data including the 2009 housing vacancy rate. The counties shaded in darker colors have higher rates of vacancies.

Housing

The economic downturn has deeply affected the housing market. Foreclosures were up 81 percent in 2008, with sharp increases since January 2009. The 2009 median home value is $162,000, down 11.3 percent from 2008. This decline in 2008–2009 has affected more than two-thirds of U.S. counties. The vacancy rate is now 11.2 percent, up by more than 8 percent; the 2009 homeownership rate of 66.2 percent is slightly less than the 2000 rate. There is some good news: favorable prices of foreclosed homes and low interest rates in some areas are beginning to attract first-time buyers.

Understanding the demographic characteristics of neighborhoods helps governments minimize the impact of the extended housing market downturn. Recovery efforts can be targeted to areas in the greatest need of federal programs that assist distressed homeowners with mortgage adjustments and free mortgage counseling. Sound demographic data helps governments market the good qualities of an area to prospective businesses and residents.

Aging

The population as a whole continues to age, with the median age up to 36.9 years. With updated data about the ages of a population, government agencies can better manage issues relating to seniors such as providing conveniently located senior centers; managing the impact of more seniors who require urgent care facilities and hospitals; and furnishing more affordable, accessible public transportation.

Diversity

The face of the U.S. population is also changing. The U.S. Diversity Index is now 60.5, representing a 1 percent annual increase in the index since 2000. The most diverse states are California, New Mexico, and Texas. The Hispanic population in 2009 is 48.7 million, more than 15.7 percent of the U.S. population. During 2000–2009, the Asian population grew by more than 3.4 percent annually. The multiracial populations now stand at 9.1 million and are growing at an annual rate of 3.2 percent.

Providing the right services to increasingly diverse populations is challenging. Sensitive, tactful messaging to reach language-isolated populations or those intimidated by authority is required. Government staff must be conversant in multiple languages to properly understand and assist new arrivals in the schools that serve the needs of different races and ethnicities and must provide additional services to students who are not fluent in English or have specific religious considerations.

Growth

Even though the overall population is becoming more diverse, population growth has slowed pervasively in most areas due to decreased immigration and emigration; more than two-thirds of U.S. counties have been impacted by this slowdown. Understanding these migration patterns enables governments to better position services to the existing populations and accurately promote the area to prospective residents and businesses. Skilled workers leave to

find jobs, tax revenues shrink, and worsening schools create less desirable areas for prospective businesses and residents. However, some suburbs around major metropolitan areas continue to grow including

- Flagler County, Florida
- Kendall County, Illinois (Chicago metro area)
- Rockwall County, Texas (Dallas-Fort Worth metro area)
- Pinal County, Arizona (Phoenix metro area)

Data for Decision Making

What does this situation mean for the economy? The housing slump and credit crunch coupled with lack of consumer confidence are adversely affecting economic growth. Job growth is sluggish. Some employment opportunities are available, but when those seeking work can't sell their homes, they can't move to take new jobs. The nonseasonally adjusted unemployment rate is up to 10.6 percent. The lower labor force participation rate is due to layoffs or because discouraged workers have stopped looking for jobs.

ESRI's updated demographics provides the data governments need to understand their populations and address these and other problems. Led by chief demographer Lynn Wombold, ESRI's data development team has a long history of excellence in market intelligence. The

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ESRI Online

Listen to New Podcasts

Visit www.esri.com/podcasts to see the latest Speaker and Instructional Series podcasts. Here's a glimpse at what you'll find:

- Instructional Series
  Creating Optimized Web Maps at 9.3.1
  Learn about the new Map Service Publishing toolbar in ArcMap and how it can help you author well-designed map documents for fast map services.
- Speaker Series—Interviews with ESRI Community Members
  Boston Showcases Solar Power Potential with ESRI's Web GIS
  Listen to Greg Knight, senior GIS applications developer with Boston Redevelopment Authority, discuss an online map that shows solar installations and allows visitors to calculate the solar power potential of rooftops.

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Check out these Facebook pages:

- Official ESRI Homeland Security GIS Summit
- Official ESRI UC
- Official ESRI DevSummit
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Follow ESRI and participate in conversations on Twitter with these hash tags: #ESRI, #ESRIUC, #ESRIMOBILE, and #ARCGIS.

Find Resources

Visit resources.esri.com to find the information you need including help documentation, tutorials, videos, ArcGIS templates, models, and scripts.

Attend a Free Online Training Seminar

Live training seminars bring the GIS instruction you need to your desktop. Technical experts lead these hour-long sessions, which are streamed live. Should you miss the interactive presentation, you can access the recording online. Visit training.esri.com for more information.

Attend the 2010 FedUC

ESRI invites anyone who works with the federal government to be part of the largest geospatial conference dedicated to federal agencies. Join other leaders, decision makers, and GIS professionals at the 2010 Federal User Conference (FedUC), to be held February 17–19 at the Walter E. Washington Convention Center in Washington, D.C.

- Hear Jack Dangermond discuss the future of GIS in government including how GIS is shaping the America Recovery and Reinvestment Act.
- Explore GIS applications from managing data to planning renewable energy projects to intelligent transportation.
- Exchange best practices for achieving greater transparency and accountability.
- Connect with other GIS professionals and decision makers.
- Pose your questions to ESRI staff including industry specialists, instructors, technical support staff, and product and development teams.

Learn more at www.esri.com/feduc.

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Surprise Bridges the Gap between CAD and GIS

"All data from developers was still coming in to us in a CAD format," stresses Abrams. "To keep it flexible for developers, we wanted to keep that business practice alive but still be able to quickly update the data into our GIS."

The solution to Abrams' dilemma was found just 20 miles away, at the root of the urban sprawl. Phoenix-based ESRI business partner Engineering Mapping Solutions, Inc. (EMS), introduced Abrams to Crossfire, a standalone software solution that provides access to ArcGIS from inside the AutoCAD environment. Developed and brought to market by EMS, Crossfire was created using features from the software development kits (SDK) of both ArcGIS and AutoCAD. By relying on the core development tools of the software solutions concurrently, Crossfire is able to achieve complete data compatibility. The solution allows a seamless path between CAD and GIS data without the need to manually change file formats, raster datasets, or geodatabase formats. Crossfire's automated editing features, user-friendly interface, general overall flexibility, and easy implementation process were exactly what the city needed.

Since implementing Crossfire, many of the GIS Division's lengthy editing chores have been retooled in the ArcGIS environment, thanks to the newfound CAD-GIS interoperability. A single utility pipe split, for example, is best handled using the out-of-the-box commands provided in ArcGIS. For larger, more datacentric tasks—such as adding an entire subdivision of utilities (water and sewer) as well as land base layers including centerlines, address annotation, and parcels—the toolset inside Crossfire is the preferred approach.

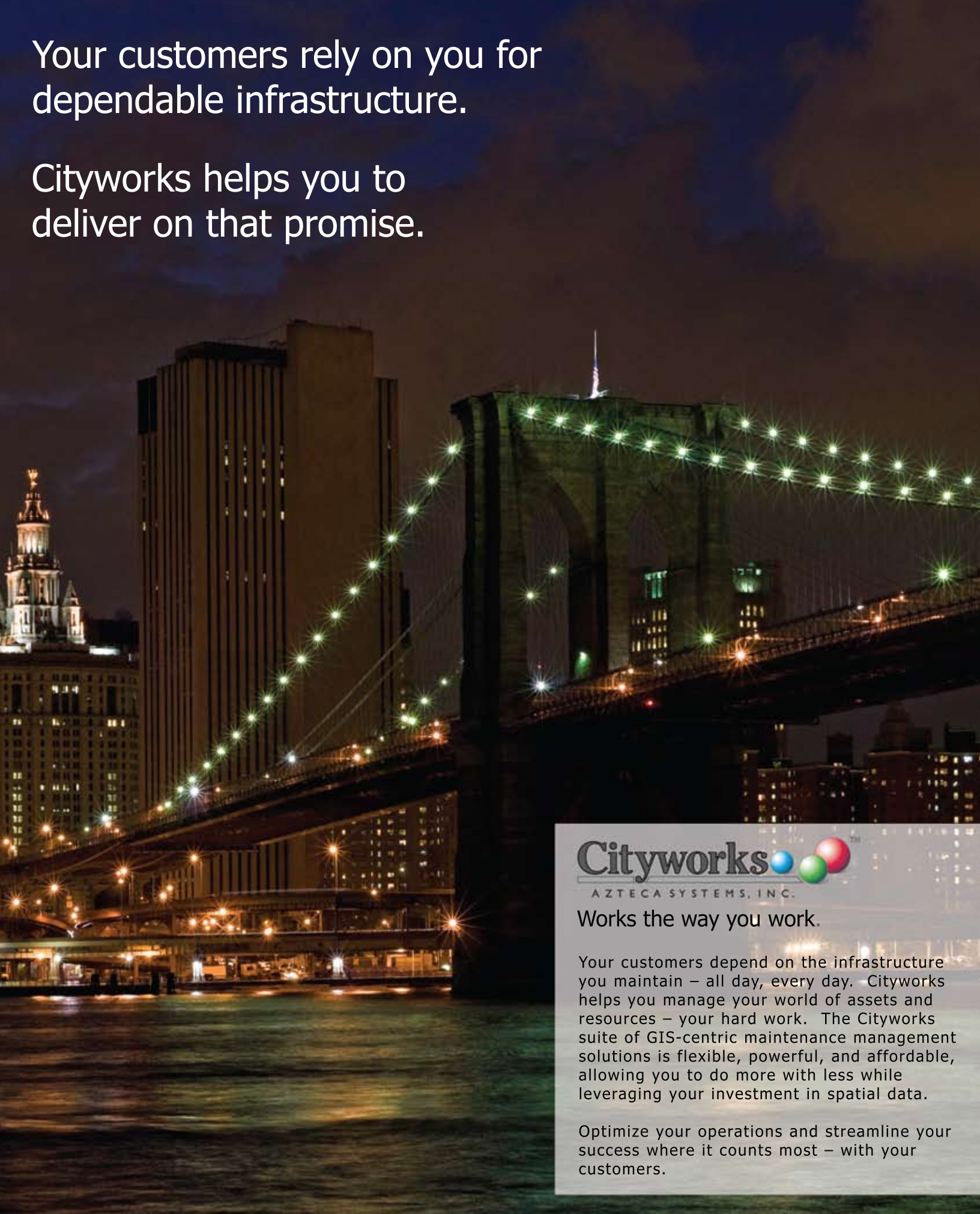
"With minimal adjustments to our long-established CAD-based workflow, the staff is able to maintain all GIS data housed in ArcGIS directly, using Crossfire," says Abrams. "It allows us to continue to use the custom tools that have worked well for us over the years. Crossfire enables us to leverage our investment in CAD software and staff expertise and still meet the city's GIS needs."

The recent ease in the CAD-GIS integration process has allowed Surprise to augment and better utilize its enterprise GIS both from within and outside the city. Now that its crucial CAD data is easily and quickly available in a GIS environment, Surprise is moving forward with a public-facing Web site that will give its citizens access to information via a GIS-based portal.

Being able to visualize its data from a geospatial perspective has promoted a shift in thinking within the city. "Our GIS has increased our efficiency in communicating, collaborating, making decisions, and thinking spatially," says Surprise Information Technologies Department manager Randy Jackson. "Not only do maps adorn the walls of many departments, but the geospatial elements of our assets are embedded in almost all our data. Being able to visualize data in a geospatial context makes us more confident when it comes to making major decisions and dealing with the day-to-day issues."

For more information, contact Phil Ponce, Engineering Mapping Solutions, at phil@emsol.com. GM

Crossfire preserves the integrity and symbology of CAD blocks when extracting data from ArcGIS Server.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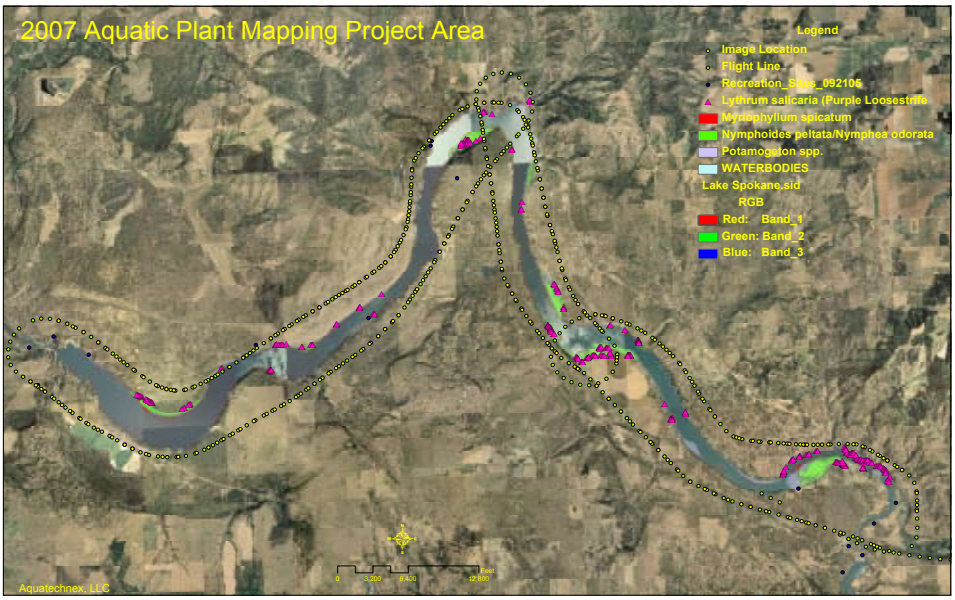
Bonner County, Idaho, Manages Invasive Weeds with GIS

By Cori Keeton Pope, Trimble Mapping & GIS



This project map shows the flight lines created by a Trimble GeoXT in yellow. The green dots represent an aerial image collected at that exact data point; during analysis, biologists can then click on each of the green dots to view additional details about the image in a separate window.

The control of nonnative, invasive weeds is of great concern in ecosystem management. Scientists and land managers recognize these invaders as one of the primary causes of biodiversity loss as well as a critical threat to local ecosystem processes and plant community structure and composition. As invasive weeds spread to new areas, negative economic and environmental impacts increase. Only through the use of innovative techniques can organizations manage this problem.

To combat this threat, governments like that of Bonner County, Idaho, are using GPS data collection and GIS mapping techniques to identify the presence and concentration of invasive weeds and combat these thorny foes.

Bonner County faces a severe threat from the noxious aquatic weed Eurasian milfoil. Biologists believe that the weed was introduced to the United States during World War II when milfoil fragments were pumped into the ballast systems of navy ships. Once the ships returned to America, the inadvertently infected water was discharged to make room for new supplies.

This weed is thought to be particularly dangerous because it rapidly replaces native aquatic vegetation, degrading water quality and habitats and harming local wildlife and fisheries. The dense weeds can grow up to one foot per week on the lake bottom and establish dense mats on the water's surface.

The effects of Eurasian milfoil encroachment were particularly severe at Lake Pend Oreille, a lake and river system in Bonner County. The weed mats were choking marinas and beaches, keeping tourists away and hurting the area's economy.

Bonner County Public Works Department hired aquatic weed control expert Aquatechnex to perform a combination of nautical and aerial surveys to determine the exact extent of the infestation and develop a comprehensive treatment plan.

Data Collection

For the initial mapping of Lake Pend Oreille, Aquatechnex collected aerial photography, flying above nearly 100 miles of shoreline to establish an accurate basemap. The aircraft was equipped with a Trimble GeoXT handheld computer with integrated Global Positioning System (GPS) capabilities and a Nikon D70 camera. The combination of these two systems turns the Nikon into a GPS camera, collecting an aerial image and a GPS location and linking the photograph to that GPS location.

Flight protocols were designed and implemented to maximize water penetration, and Aquatechnex collected a seamless stream of images with a 30 percent overlap that covered the entire area of interest. The team captured the precise flight line of the aircraft by automatically logging GPS data points every five seconds using Trimble TerraSync data collection software.

Next, imaging software linked the GPS data points along the flight line with the nearly 400 aerial photos collected during the flyover. These images were then available in ArcGIS Desktop and could be viewed by clicking an image point of the plane's flight line.

Aquatechnex also used Trimble GPS Pathfinder Office software to process the differential GPS corrections and export the data to ESRI ArcPad software for use of the resulting basemap in the field. This data gave the field team a more complete picture of the lake area and a comprehensive understanding of the locations of the noxious weeds. With this aerial mapping approach, the Aquatechnex team surveyed, analyzed, and reported on nearly 100 miles of shoreline in only five days, saving the county tens of thousands of dollars over conventional mapping techniques.

"Anytime you're faced with a weed management issue and you're working on the water, there are no reference points," said Terry McNabb, an aquatic biologist and owner of Aquatechnex. "That's why we had to develop an aerial shoreline analysis model using remote sensing, GPS, and GIS mapping technologies from Trimble and ESRI. It's a highly accurate and cost-effective way to map a sizeable weed infestation like this. With the GeoXT handhelds, together with digital imagery, we were able to complete a very accurate survey for approximately $6,000 in contrast to conventional aerial mapping and field methods, which would have cost up to $60,000."

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GIS Saves Lives, Protects Property

Pinpointing Emergencies Delivers Faster Response Times in Washington County, WI

By David Haines, GISP, AICP Project Manager, R.A. Smith National

Managing address data is time consuming and difficult, yet necessary to many organizations' business operations. It is especially important for 911 dispatch centers tasked with protecting lives and property.

As a proven tool for storing, managing, and retrieving address information, GIS can dramatically improve a community's first-responder time. Accurate and complete address information allows a caller's exact location to be pinpointed on an aerial map. Within seconds, dispatchers and responders have a substantial amount of information that dramatically decreases unnecessary delays, increases the community's safety, and enhances property protection.

Washington County, Wisconsin, is an example of a local government making use of GIS to provide its county dispatch center with accurate address information. In early 2006, Washington County was preparing to implement a new countywide 911 dispatch system. Integral to the success of the system was ensuring the validity of all county address data. The county retained ESRI business partner R.A. Smith National to provide GIS services for the address validation project, which used ESRI's ArcGIS Desktop software and ArcSDE technology (now part of ArcGIS Server).

First Steps

The initial part of the project involved developing a geodatabase model that would support both the Positron 911 dispatch application input requirements and the county's day-to-day geocoding needs. The model needed to be robust enough to support both traditional addresses (100 N. Elm St.) and coordinate addresses (W172N10415 Division Rd.); the complexities associated with streets with multiple names, buildings with multiple addresses, and subunits (apartment and suite numbers); and finally, regular updates by the City of West Bend, a municipality within Washington County that separately maintains its address data.

The ability to effectively route 911 calls to the appropriate community's responder was another critical aspect of this project. To do this, the range of addresses in the county's Master Street Address Guide (MSAG) table had to match the county's street centerline address file. Gaps and overlaps in address ranges were eliminated. Then, Washington County and the City of West Bend's street centerline address data was converted to the new geodatabase model.

The second part of this project was creating and inputting more than 40,000 address points into Washington County's GIS. Address points were created for any possible address, including nearly every structure in Washington County. (The exception was the City of West Bend, which had previously created address points for its community.) Address points identify a more exact location than an address range because the points are correlated to a structure. A high level of accuracy was achieved by using a variety of sources for addresses, including utility and telephone billing records, property tax records, and a commercial mailing list.

Positive Impact

Sergeant Jill Raffay of the Washington County Sheriff's Department has seen a significant improvement in the department's ability to efficiently handle incoming 911 calls as a result of the GIS. Offering an example, Raffay explains,

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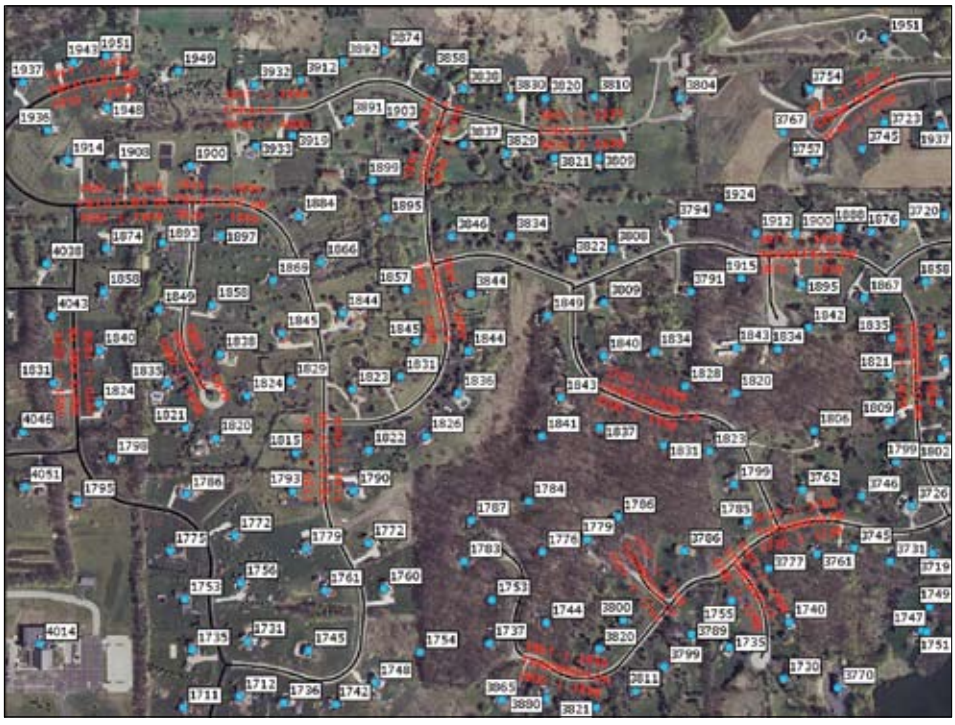

More than 40,000 address points were created and added to the GIS used by Washington County, Wisconsin.

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Bonner County, Idaho, Manages Invasive Weeds with GIS

Through this extensive yet efficient mapping process, Aquatechnex determined that approximately 4,000 acres of the Lake Pend Oreille system was infested with Eurasian milfoil, and the company was able to identify more than 100 specific locations of infestation.

The next step was to validate these findings by boat, using GPS to navigate to each place where aquatic plant beds were observed and recorded. For the mission, the team members established an ESRI ArcGIS project file with a geodatabase set up for weed mapping. Using the mapping software, they created polygons of probable Eurasian milfoil beds and all aquatic plant communities that were visible in the county's photography as a map layer. The team created 143 polygons that gave an approximate dimension of each aquatic weed bed observed.

With the detailed location information collected, the mapping teams returned to the Aquatechnex offices, where they downloaded and processed the location data using the Trimble GPS Analyst extension for ESRI ArcGIS Desktop software. By interpreting the aerial imagery with the field GPS data, the polygons clearly delineated the location and density classification of the weeds.

Treatment Plan

When the assessment of the extent of the weed invasion was completed, Bonner County applied for a federal grant and received $1.8 million to execute a comprehensive and sustainable weed management effort. By working with the county, the U.S. Army Corps of Engineers, and the Idaho Department of Agriculture, Aquatechnex biologists were able to develop a treatment plan to eradicate Eurasian milfoil by focusing on four aquatic herbicides that meet the requirements of the U.S. Endangered Species Act protecting designated critical habitats for bull trout.

Using boats equipped with GeoXT handhelds, the Aquatechnex team navigated to the exact location of each weed infestation quickly. Biologists treated up to 1,000 acres of the Eurasian milfoil infestations per day, at a total cost of about $430 per acre. To monitor the effectiveness of the treatment plan, the State of Idaho hired an independent expert from Mississippi State University. A year after the initial weed management plan went into action, the university confirmed that the 4,000 herbicide-treated acres experienced "very good to excellent control."

The invasive weed Eurasian milfoil damaged Lake Pend Oreille and the local economy.

This project clearly demonstrated the benefits of high-accuracy GPS mapping and navigation in the development of sustainable weed management programs. The efficient capture of weed infestations over very large areas was made possible through the use of state-of-the-art Trimble GPS solutions and ESRI GIS software. Detailed assessment and treatment of the affected areas also benefited from GPS and GIS solutions. With this technology, private organizations and federal, state, and local agencies can successfully work together to control noxious weed infestations and restore natural habitats.

For more information, visit www.trimble.com/mgis or e-mail mapping_gis_news@trimble.com. GM

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GIS Saves Lives, Protects Property

"We receive multiple cell phone calls reporting the same accident at varying locations. The level of detail shown on the maps, such as on- and off-ramps, enables us to locate the exact location of an accident. The GIS maps have improved our response time and saved us so many times, especially with the number of accidents that have occurred during the bad weather we experienced in early 2008."

Eric Damkot, GIS manager of the Planning and Parks Department, Washington County, agrees. "We were pleased with the successful outcome of the project, which R.A. Smith National turned around within the requested three-month time frame. The address points have improved data accuracy for the county's 911 dispatch system and brought a higher level of quality to many of the county's geocoding projects."

Among others, the highway and health departments are also taking advantage of the new GIS.

To learn more about this project or how GIS can assist with public safety applications, contact David Haines, GISP, AICP, at 262-317-3375 or david.haines@rasmithnational.com. GM

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ESRI Data Helps Governments Meet Citizens' Needs

combined expertise of the team's economists, statisticians, demographers, geographers, and analysts totals nearly a century of data and segmentation development experience. The team has crafted data methodologies, such as the demographic update, segmentation, the Diversity Index, and Retail MarketPlace, that are now industry benchmarks.

ESRI's demographic data is available as ad hoc databases in a variety of geographies and formats; as part of the data package in ArcGIS Business Analyst desktop software; in reports and maps from Business Analyst Online, ESRI's on-demand analysis tool; with ArcGIS Business Analyst Server; and in ESRI's Sourcebook products.

For more information about ESRI's current-year demographic data estimates and five-year projections and other population and consumer-related data, visit www.esri.com/data. GM

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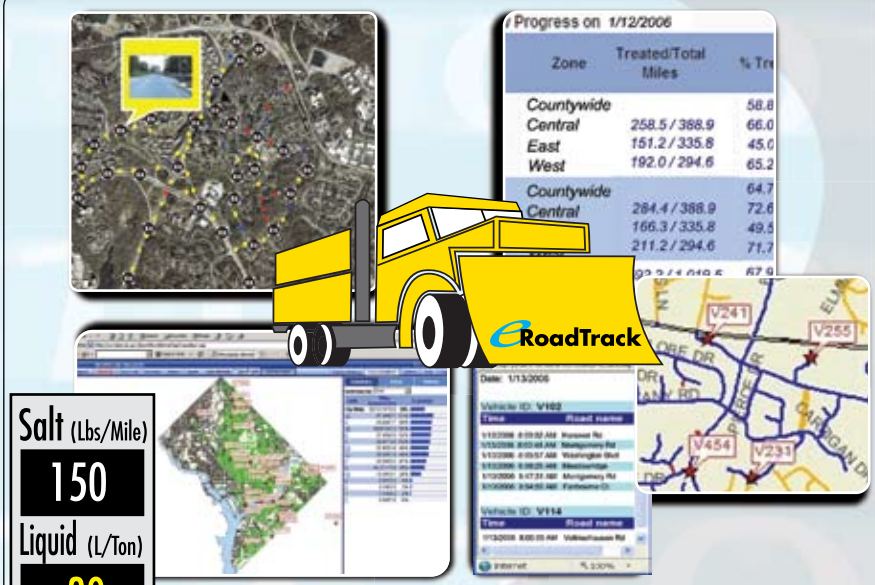

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