Esri News
for State & Local Government
Winter 2023

Connecting People to Opportunity

The San Francisco Municipal Transportation Agency (SFMTA) has leveraged geographic information system (GIS) technology capabilities to develop the SFMTA Equity Toolkit. The toolkit was designed to help transportation professionals address social and economic issues and create a more equitable transportation system for their diverse city.

Service Improvements

Several factors, both large and small, impact the opportunities for people to improve their quality of life. Reliable, affordable transportation is often critical in accessing educational opportunities, jobs, and housing to enhance economic and social mobility. The US Department of Transportation recognized the importance of transportation, stating:

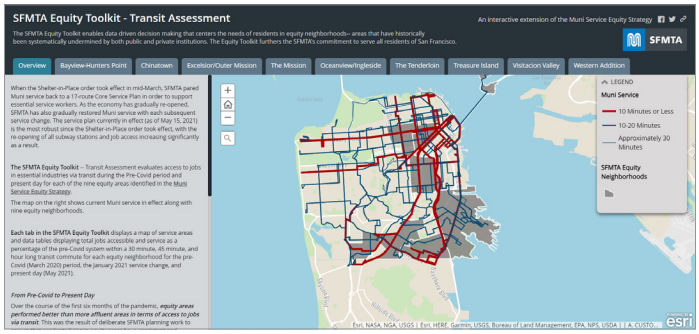
"Equitable and safe access to transportation is a civil right. Transportation touches every part of American lives and makes the American Dream possible, getting people and goods to where they need to be, directly and indirectly creating good-paying jobs and helping improve quality of life, especially after the COVID-19 pandemic."

Because access to transportation means access to opportunity, providing equal access to transportation options has become key for many transportation agencies across the country.

The effects of the COVID-19 pandemic have highlighted the importance of transportation for many essential workers as well as the glaring disparities in transportation access.

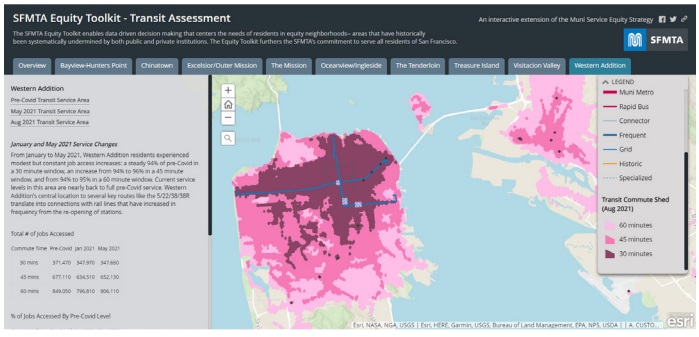
This has been a wake-up call for transportation professionals to design more equitable public transportation networks. Backed by data and analysis, services can be targeted to the communities and areas that rely most on public transportation. In doing so, transportation systems can meaningfully empower socioeconomic mobility.

continued on page 10



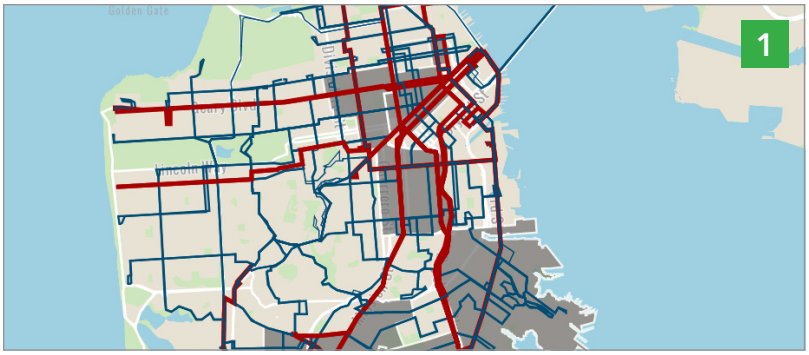
↑ Shown above is the current Muni service in effect along with nine equity neighborhoods.

↓ The Equity Toolkit helps San Francisco Municipal Transportation Agency (SMFTA) improve Muni service for San Francisco's most transit-dependent residents and essential workers by identifying and fixing gaps in service.



Inside This Issue

Winter 2023



1 Connecting People to Opportunity

3 GIS for Economic Development: Time for a New Direction

4 Newark, Delaware, Reimagines, Rethinks, and Rebuilds Public Works and Water Resources with GIS

6 Alaska Community Uses Damage Assessment Solution to Aid Recovery

8 How Puerto Rico's Geographic Approach to Opioid Misuse Allows It to Save More Lives

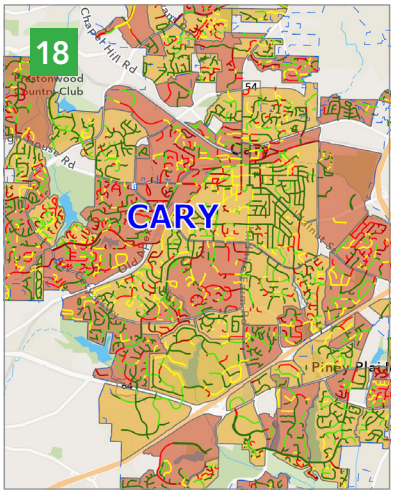
12 Esri Small Nonprofit Grant Initiative Levels the Playing Field for Environmental Organizations

14 Chatham County Expedites Appraisal Process through GIS

16 Johnstown, Colorado, Proves GIS Is for Governments of All Sizes, Even Those without Massive IT Infrastructure

18 Dashboard Makes Street Rating Data More Valuable

21 Houston Public Works Manages Enterprise GIS with Performance and Optimization Solution



Subscribe to *Esri News for State and Local Government*

Residents of the United States can subscribe and receive future print editions of *Esri News for State and Local Government* at **go.esri.com/govnews**.

Manage Your *Esri News for State and Local Government* Subscription

Make changes to your subscription information at **go.esri.com/manage-subscriptions**.

Advertise in *Esri News for State and Local Government*

For more information regarding advertising opportunities in *Esri News for State and Local Government*, download the media kit at **go.esri.com/Ads4SLG**.

Submit Your Content

We encourage Esri partners, startups, nonprofits, and customers to submit an article for inclusion in future content. Visit **go.esri.com/ShareStory**.

Esri News for State and Local Government is published quarterly by Esri at 380 New York Street, Redlands, CA 92373-8100, USA. *Esri News for State and Local Government* is written for state and local government users of Esri software and distributed free of charge.

University of Massachusetts Global A nonprofit affiliate

GIS for Economic Development: Time for a New Direction

By Dr. Sheila Lakshmi Steinberg and Dr. Aaron Schmerbeck – University of Massachusetts Global

GIS technology is a powerful and often underutilized tool that can be tapped to bring people and resources together. While many people are aware of GIS as a tool, they may not fully grasp how it can be applied to the field of economic development.

Economic development is a diverse field that creates business, economic, and community development opportunities for people and places, but the use of GIS in the discipline has been limited. Many in this field limit GIS use to simple site selection. In the big picture, economic developers have not yet used GIS to its full potential, both in the effort to achieve economic resilience for communities and as a tool for drawing out and identifying local resources and strengths.

Economic development unites multiple disciplines through a common goal of improving the standard of living within communities. Economic development can focus on leveraging a region's assets and recognizing potential challenges. These assets can include natural resources, education and training institutions, infrastructure, and industry presence (or lack thereof). Often, economic developers will formalize a plan or vision for the community through economic opportunity and sustainability.

Economic developers, planning departments, and city leaders can easily expand the use of GIS beyond site selection and into decision-making and resource management. GIS tools can be utilized to analyze data and support strategic decisions at a policy level. For example, increasing availability of affordable housing and finding housing for more people in the potential local workforce might be goals of the community. Using GIS, analysts can identify where the workers live, their necessary mobility patterns, and what resources might support their transportation needs.

Economic indicators, such as poverty, median income, and unemployment rate, can all be used to focus effective investment and community redevelopment. Community development often goes hand in hand with economic development and is used to identify and build existing local skills, infrastructure, and talent to provide more opportunities. When economic opportunities are created for people, communities become stronger. Stories need to be told about the unique skill sets that local people bring to the table in terms of community and economic development efforts. This can all be accomplished through GIS.

The workforce of economic development is changing, and increasingly, more professionals in this field are women. This new workforce is further drawing on the creativity and stamina of women. What is also needed is a bigger, more holistic picture that focuses on topics like economic resiliency and the utilization of GIS for management of people and resources across spaces and places. Given the aging cities, the changing climate, and the general need for redevelopment, GIS can play a major role in infrastructure improvement, including identifying key patterns of people and place. There is a need for the education that we are providing our students at University of Massachusetts Global to help them establish hands-on, data-driven problem-solving skills, enabling their contributions to a diverse economic development workforce.

GIS technology can equip economic developers with the tools to provide economic opportunities within the community and direct resources toward business recruitment, retention, and expansion (BRR&E). This process might consider the talent pipeline (education and training institutions); suppliers; and industry concentration, as industry clustering often evolves. Similarly, many in the field of economic development today need to consider things like geographic location, demographics, markets, and who populates a geographic location depending on the time of day (like commuters to downtown or areas around schools/factories) as part of their planning process.

Through the use of GIS, a more holistic view of resources, people, and opportunities can be embraced by the field of economic development. Our new certificate is a cobranded effort between University of Massachusetts Global and Esri to give students the big picture of how spatial thinking and analysis can be used to address issues such as infrastructure risks and the need for enhancing economic opportunity and resilience.

For further information about our new Graduate Certificate in Economic Development Using Location Intelligence program, visit umassglobal.edu/landing-pages/gis.

Newark, Delaware, Reimagines, Rethinks, and Rebuilds Public Works and Water Resources with GIS

Newark, located in New Castle County in northern Delaware, encompasses over nine square miles and has a population of more than 31,000 people. Eight years ago, the City of Newark hired Mark Neimeister, a water operations superintendent, to lead the city's GIS implementation. At the time of his hiring, assets were managed with paper and, according to Neimeister, "It was a mess to maintain." There were a handful of ArcGIS Desktop users with personal geodatabases managing a rough stormwater network and helping the planning department with some basic planning exercises.

Leadership and Vision

In 2014, led by the Public Works and Water Resources (PWWR) department, the city made the decision to invest in an Esri enterprise agreement providing access to ArcGIS Enterprise and ArcGIS Online, which allowed the city to migrate from paper-based operations and implement an enterprise GIS for utilities. City administrators realized they could increase their level of service and efficiency by applying a geographic approach to city business. Within seven years, the city transitioned to an enterprise GIS, enabling the reimagining, rethinking, and rebuilding of the PWWR department.

PWWR covers a wide array of services with seven divisions, all of which were prime candidates for modernization:

- Water—Drinking water treatment and distribution
- Sewer—Wastewater collection and conveyance
- Stormwater—Stormwater and drainage
- Refuse—Curbside trash, recycling, and yard waste collection
- Engineering—Development plan review, inspections, and engineering support for city projects
- Streets—Repair and maintenance of city streets including snow and ice control
- Fleet maintenance—Maintenance of citywide vehicle fleet

Rebuilding and Rethinking Public Works with GIS

The rebuilding phase began with personal geodatabases migrated to enterprise geodatabases using Esri templates. A consultant was retained to update the utility layers with mobile work. This project covered three years, so by 2017, the features in the utility layers had been located. Brian Laws, an engineering technician, was hired to run the enterprise GIS. Following the consultant's project, summer interns were sent to the field to verify the as-built drawings and update the asset attributes in the utility layers because the city did not have available staff. This involved a lot of work—opening catch basins and inlets, verifying the pipe diameter, confirming flow direction, and so forth. Once completed, the sanitary sewer, stormwater, and water distribution layers and geometric networks could be kept up-to-date with ArcGIS. After the data management process was completed, the rethinking of how to do the work began.

"Staff were shuffling large rolls of paper maps back and forth, and somebody said, 'Can't we just put all of these layers on a GIS map to see everything at the same time?" said Jay Hodny, a GIS technician for the city.

Out of this idea, the Combined Utility Application was born. It was developed with ArcGIS Web AppBuilder.

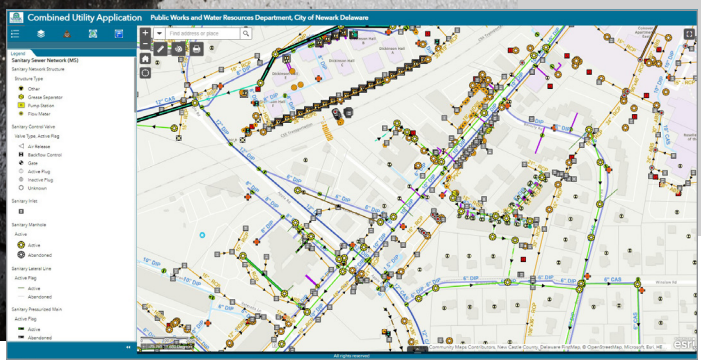
It might look like a simple web mapping application, but it's easily the most utilized application among managers. They no longer open PDFs, and it is constantly updated to show changes, real-time kinematic (RTK) GPS updates, locations, and attributes using ArcGIS Field Maps.

"The application allows management to quickly identify all of the city's public works assets in one solution. In our industry most of the infrastructure is buried, so having the confidence in the type and location of these assets is invaluable, especially in emergencies," noted Neimeister.

The Combined Utility Application started with each of the three utility networks on a separate web map. Within the first year, the department got multiple requests to combine the networks onto a single map to support staff plan reviews and engineering drawings. It instantly became a great reference for everybody.

The next enhancement request for the application was to export a view to a PDF map to complete Miss Utility of Delmarva (a call-before-you-dig service for notifying underground facility owners) design tickets and to fulfill requests from contractors and consultants. So the PWWR team added a print widget. This uses a custom geoprocessing service that allows the user to select specified layouts and sizes via a template to add the city logo, disclaimer, and so forth. This is a time-saver, as these custom digital maps at specified scales can be emailed instead of requiring in-person visits to get a photocopied paper map that is probably out-of-date.

Neimeister had another idea for an enhancement to the Combined Utility Application: using ArcGIS Arcade to add hyperlink access to street-view imagery from the feature pop-up window. This is very valuable, as this series of historical photos can help mobile workers find locations for assets in the field, like water valves or hydrants. It has become a popular feature,



↑ Combined Utility Application

↑ Bulk/Yard Waste Scheduling Application

especially for utility locating and marking. Crews can see how things have changed over time, for example, when a valve has been paved over.

Approximately 40 managers and mobile workers use the Combined Utility Application daily via Apple iPhones and iPads, which has tremendously improved efficiency and increased the level of service.

Another popular application is the Bulk/Yard Waste Scheduling solution. In one 18-month period, the city received over 10,000 calls for bulk waste pickup. To manage these requests was an "ugly, paper-based process," explained Hodny. Traditionally, residents would call in the request, staff would record the pickup information on a slip of paper, and that pickup information would be entered into a spreadsheet. The spreadsheet would then be given to a supervisor, who would use it and the paper slips to arrange ad hoc pickup routes based on their knowledge of the local street network—a process that was not always the most efficient. PWWR staff wanted find a better way to do business, so they applied the geographic approach. They wanted to use GIS to not only complete and improve scheduling but also to create an archive so that the process could be analyzed. The answer was a solution that integrates ArcGIS Dashboards, ArcGIS Workforce, and ArcGIS Survey123.

In this single application, users can submit and edit tasks generated from pickup request calls using Survey123. These requests then become assignments in ArcGIS Workforce, and the supervisor assigns them to a worker. The worker, a refuse truck driver, Workforce on an iPad to work through a list. The list is automatically updated to show the next closest assignment based on the driver's location. The dashboard provides real-time access to the list of pickups, the locations of the vehicles in the field, and the status of the pickup. Pickups are color coded: green = completed; red = declined. Once the driver reaches the pickup location, they start the assignment. Once the pickup is done and the assignment is marked as completed, it turns green in the app and the driver moves on to the next one.

If there is something wrong with the pickup— for example, if the item was not at the specified location—the driver will decline the assignment, which turns red in the app. The driver will take a photo to document the issue. The photo is linked to the assignment point and is a useful resource for staff responding to calls asking why the item was not picked up. This eliminates the need to call the supervisor and for the supervisor to call the driver to find out why the pickup was not completed.

A chart is used to track the number of requests. This is important, as there is a daily limit to the number of pickups. This allows users to instantly know when they need to start scheduling pickups for the next available day. Once the app had successfully replaced the paper-based workflow for bulk pickups, it was enhanced to also include yard waste pickups. According to Laws, replacing this manual workflow with a GIS solution "was a no-brainer."

In addition to the increased efficiencies provided by the solution, there is now an archive of completed pickups that can be analyzed. This allowed staff to identify a resident taking advantage of bulk pickups. While there is no charge for bulk pickups and no limit on the number of pickup requests, the city does need to make sure residents do not abuse the service. A driver noticed recurring requests for pickup of significant construction debris at a certain address as well as including at neighboring addresses. Analysis of the archive showed that indeed a resident, who was a construction contractor, was repeatedly requesting bulk pickups at his and his neighbors' addresses. The city notified him that he needed to cease this activity, and he complied.

Innovation Leads to Recognition

The PWWR GIS team was given a 2022 Special Achievement in GIS (SAG) Award at the 2022 Esri User Conference for an application supporting its stormwater area best management practice (BMP) inspections. Previously, inspectors used fillable PDF forms to perform their inspections in the field. These inspection results were then included in a report to the owner. This was an overly complex, manual process. Once the inspectors returned to the office, they would print the completed PDF form, open a Microsoft Word document, edit a cover letter template, have an invoice generated, download any photos taken during the inspection, and then add them to the Word document.

The GIS team used the PDF forms to create GIS feature classes, one for each of the dozen different BMP types, each with its own set of attributes to contain the inspection information. Survey123 surveys were created using the Survey123 Connect desktop app to mimic the PDF forms. Inspectors use ArcGIS Field Maps or a web map to identify and select the BMP for inspection, then a custom URL calls up Survey123 and passes along static data tied to that

continued on page 20

Alaska Community Uses Damage Assessment Solution to Aid Recovery

Matanuska-Susitna Borough is in a mountainous area in southcentral Alaska that is home to agriculture, transportation corridors, tourism industries, and outdoor recreation. The county-style government serves about 107,000 residents in approximately 25,000 square miles—roughly the size of West Virginia. Known as Mat-Su, it is one of the fastest-growing areas in Alaska.

However, many areas of the borough are remote and lack the infrastructure needed to be connected to more populated areas, like the cities of Wasilla and Palmer. Mat-Su's GIS team understood the need to ensure that the borough was equipped to provide services for residents in times of emergency, especially residents living in sparsely populated areas. By implementing GIS technology organization-wide, departments like Emergency Services have been able to work cross-functionally to streamline data collection and management, and can respond appropriately.

As a government agency, Mat-Su Borough is excited about how mapping tools have been spread across the organization and implemented for faster processes. Leah Jones, GIS programmer/analyst at Mat-Su Borough, said, "We've already got assessors, code officers, and permit inspectors that are using Esri tools daily. When they get pulled into an emergency to help, it's intuitive for them—they're not having to get training or trying to figure out how to log in. They can hit the road running and help, and we can collectively work as a team."

Ready When Disaster Strikes

The GIS team and emergency management staff have always had a good working relationship, but they did not use geographic information systems that worked together in a seamless, efficient way.

In 2015, a large fire hit the Willow area of Mat-Su Borough, and in 2018, there was an earthquake. During both events, the Department of Emergency Services used its own geocoding system to collect data and assess damages. The GIS team then reviewed this data and analyzed the locations of damage reports. Due to the disparate systems being used, the team was often unsure if the damage reports were accurate.

"We would end up having to go back through every single response and look at assessment photos, our parcel base, and where the point was at," Jones explained, "and tried to put the puzzle pieces together, [wondering], 'Was this damage really at this location, or was it supposed to be two houses down or three miles away?'"

In January 2022, a windstorm downed trees and caused power outages and major damage to homes and buildings. The hurricane-force wind gusts were up to 91 miles per hour over the course of several days, and some residents did not have power restored for more than a week—all while temperatures were around zero degrees. Many areas of the borough sustained significant damage.

As a result, the team discovered it needed a more uniform way to collect, assess, and manage data after a critical incident and be better prepared for

the next emergency event. The GIS team rapidly deployed Esri's Damage Assessment solution. This solution is used to conduct initial damage assessments after a natural disaster or other type of catastrophic incident. The solution supports rapid data collection, management, and reporting of damage to expedite the deployment of appropriate recovery resources.

The GIS team began its solution implementation by determining who needed what type of reporting information, such as individuals, business owners, or local government officials seeking qualified reimbursement.

"It was important for our emergency manager to have commercial claims separated. We view commercial claims as individual assistance, but the State of Alaska and the federal government don't. We had to document enough damage in either category to justify declaring a disaster and opening up emergency funds," said Kenny Kleewein, GIS manager for Mat-Su Borough.

Once local, state, and federal emergency disaster declarations were made, disaster response and recovery funding was made available so that the borough could apply for aid from the state and federal government to support ongoing recovery efforts. "You have to go through those steps," said Kleewein, "and we had to prove how much damage we had in order to try to justify the next step."

The Damage Assessment solution is aligned with Federal Emergency Management Agency (FEMA) programs to ensure that the information collected meets FEMA's requirements. This alignment proved essential to helping quantify the windstorm damage and efficiently move through the disaster declarations required for appropriate aid.

Building Public Information and Intergovernmental Support

To help residents and business owners easily understand how to apply for state and federal government recovery funding, the GIS team utilized ArcGIS Hub, which was provided with the Damage Assessment solution, to create a hub site. Mat-Su branded the site as the MSB Disaster Damage Reporter and launched a campaign that encouraged public reporting and provided residents with valuable recovery resources.

The team also utilized the public damage report included in the solution to collect residents' photos of property damage. Given the sprawling size of Mat-Su and its many remote areas, the public reports allowed for the borough to receive critical damage information from residents sooner than staff could have been sent out to do assessments.

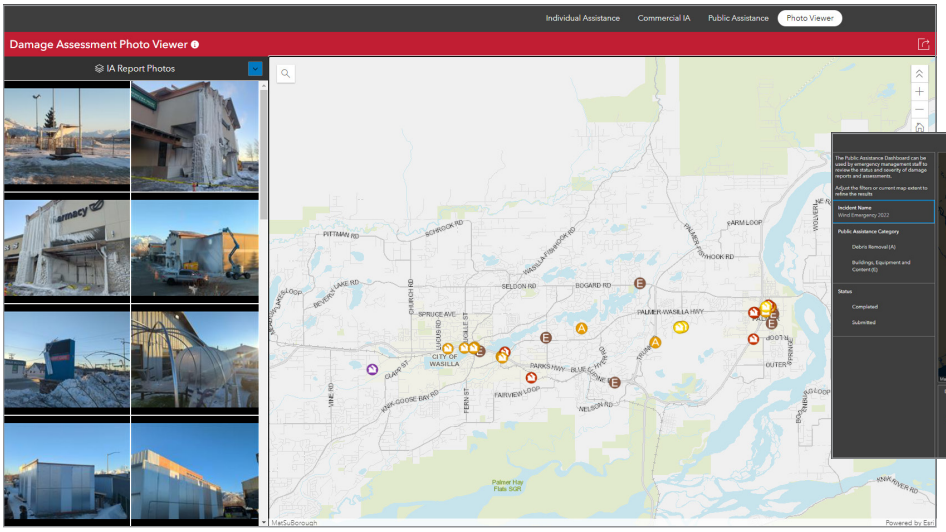
Ultimately, 1,718 damage requests for public assistance were reported, of which 1,681 were for debris removal. These reports were managed using the Damage Assessment solution and generated approximately $1.4 million in recovery funds. As a result of the GIS technology deployed by the borough, staff were prepared to share data quickly with state and federal government agencies, which led to greater efficiencies in processing resident and business applications for aid.

Kleewein remarked, "We were able to run some reports for FEMA staff based on the debris piles and who was affected. They were impressed with how fast we had the information."

Kleewein added, "It's very important that we've captured all this data upfront with the public's assistance as well as our due diligence, so then we can possibly get that return back from the state and federal governments."

The Damage Assessment solution allowed the GIS team to collect data that helped the borough apply for critical state, federal, and local aid. It also helped Mat-Su quickly recover from the emergency and become more resilient for the future. Looking ahead, the GIS team will continue to refine and use the Damage Assessment solution in other weather-related events and natural disasters.

"We're super excited to have the Damage Assessment solution in place, and it's more user-friendly for us as mapping professionals," said Jones.



↑ Mat-Su Borough's Damage Assessment Photo Viewer allows staff to view submitted pictures of damage by location.

↑ Mat-Su Borough's Public Assistance Dashboard is used by internal staff to track and review damage reports.

How Puerto Rico's Geographic Approach to Opioid Misuse Allows It to Save More Lives

In the late 1990s, pharmaceutical companies reassured the medical community that patients would not become addicted to opioid pain relief medications. Health-care providers then began to confidently prescribe opioid medications at a greater rate. Fast-forward to 2017, when an increase in prescription opioids resulted in the widespread misuse of both prescription and nonprescription opioids, leading the US Department of Health and Human Services to declare the opioid crisis a public health emergency.

Today an average of 100 Americans die every day from opioid overdoses. In Puerto Rico, the drug crisis is a bit more severe; according to the National Library of Medicine, the drug overdose mortality rate was significantly higher for Puerto Ricans than non-Hispanic white individuals (28.7 versus. 26.2 per 100,000, respectively). The 2018 drug overdose mortality rate was highest among Puerto Rican men age 45–54 years, providing evidence of health disparity.

To tackle this widespread issue, the Puerto Rico Department of Health is emphasizing a geographic approach to address the epidemic and allocate resources to where they are needed most. By securing Centers for Disease Control and Prevention (CDC) funding through the Overdose Data to Action project, the department was able to design and implement syndromic drug misuse surveillance using GIS technology, setting an example for others to follow.

Organizing Data to Create Targeted Solutions

Puerto Rico's opioid misuse response is focused on collecting and monitoring data of overdose survivors. Rather than tracking overdose deaths, the Department of Health aims to focus on preventing deaths by allocating additional resources. To understand what is taking place at the neighborhood level, the department needed to collect data but realized that there was no streamlined process for drug misuse data collection.

Local nonprofit organizations on the islands were doing their best to reach out and allocate resources to the areas that they believed had the greatest number of residents afflicted with opioid addiction. However, due to the lack of a standardized data collection process, these efforts were not entirely accurate.

To modernize its approach, the Department of Health turned to ArcGIS Survey123 and created the Puerto Rico Overdose Surveillance System to collect this data in a standardized way. It deployed a formcentric solution, which allows the collection of data via web or mobile devices, even when disconnected from the internet. Staff from the department and cooperating agencies can go into neighborhoods to collect data in real time and upload it to one central location. Because the state government could not combat this crisis on its own, the Department of Health partnered with local nonprofit organizations and community clinics and is looking to collaborate with several other local government agencies across the islands as well.

"It has been very challenging to work with local nonprofits, the public health department, and other state departments within Puerto Rico due to this lack of a standardized data collection process," said Francisco Negrón Alemón, GIS programmer, Puerto Rico Department of Health. "But this solution has made this much easier and possible."

The department is currently working with the following organizations to collect data:

- Intercambios Puerto Rico, (Exchanges Puerto Rico) Fajardo
- Iniciativa Comunitaria, (Community Initiative) San Juane
- El Punto en la Montaña, (The Point on the Mountain) San Juan
- Coalicion de Coaliciones, (Coalition of Coalitions) Ponce

All these nonprofit organizations offer services to individuals who suffer from substance use disorders, are experiencing homelessness, or lack basic health care.

Through these unique collaborations, the Department of Health can get greater insight into this problem and keep track of the combined efforts with the use of GIS technology.

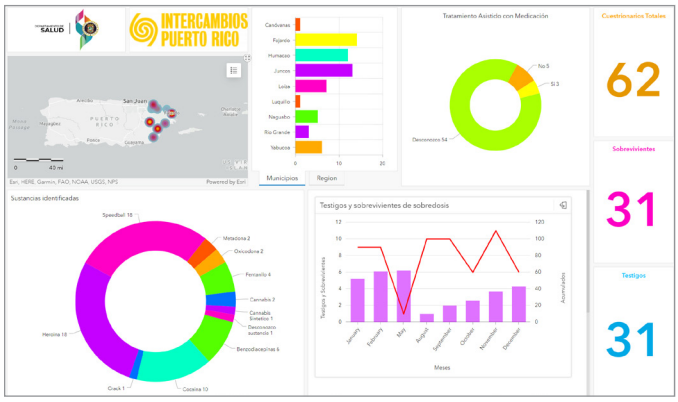
An example of this collaboration is with the nongovernmental organization (NGO) Intercambios Puerto Rico which has multiple programs addressing drug misuse. One of these, La Móvil, provides a vehicle that brings health services to areas where people have the greatest need. Intercambios Puerto Rico considers the fact that less than 10 percent of people at risk for problematic drug use, mental health problems, or similar situations receive the health care they need. With La Móvil, staff use their experience in nursing, psychology, case management, and other disciplines to provide primary services and other support.

Access to the field data collected using ArcGIS Survey123 allows NGOs like Intercambios Puerto Rico to continuously track changing community dynamics and eventually monitor their prevention and response tactics to ensure ongoing success. For the Department of Health, this initiative has a unique perspective due to its bottom-up nature, which presents a significant opportunity to learn from the experience and needs of the community. This collected data enables the development of guides to design, plan, and implement responsive, effective social programs.

Turning Data into Action

Equipped with Survey123, teams from from these organizations head into areas that might be known for illegal drug use. There, they conduct a survey of individuals who have suffered an overdose or people who have witnessed an overdose event, such as bystanders, first responders, and correctional officers.

The biopsychosocial questionnaire, which aims to determine how a person's biological, social, and psychological factors all influence their well-being, first identifies the individual as a survivor or a witness. It then leads into five parts of the survey, asking a series of questions that allow the Department of Health to identify risk and protection factors that are related to substance use and overdose.



↑ Intercambios Puerto Rico survey results filter into an easy-to-read dashboard.

The following are questions from the survey:

- Which substance did you consume that could have caused the overdose?
- Was the most recent overdose reversed with naloxone?
- Before starting substance use, were you a victim of violence?
- How were you introduced to opioids?
- Have you ever used fentanyl?

Survey results are immediately uploaded into the ArcGIS system. Local nonprofit organizations have access to the data collected; they can create dashboards and then analyze the results. From their findings, they can then allocate resources to the areas the survey results show as being affected the most by the epidemic.

What's Next

Allowing local organizations access to this data in real time is merely the first step in this project. With the information from the survey results, the Department of Health is in the process of creating an opioid consumer profile. This will provide it with a greater, more detailed understanding of the individuals affected by the opioid misuse epidemic.

Puerto Rico's Department of Health hopes to expand its collaboration efforts to include local governments, hospitals, and emergency responders across the islands to allow for better data integration. Information can then be used to influence public policy, leading to administrative legislation that can address the crisis in Puerto Rico. With more partnerships, the department is also looking to create the public-facing Puerto Rico Opioid Dashboard, which will contain collected data so that more agencies can utilize the information to better respond to the epidemic.

Using GIS, Puerto Rico's Department of Health can develop strategies that will effectively reach more people with substance use disorders and provide them with the care and resources they need.

Learn more about the steps you can take to address the opioid crisis by downloading our ebook at go.esri.com/GIS4OpioidCrisis.

Connecting People to Opportunity continued from cover

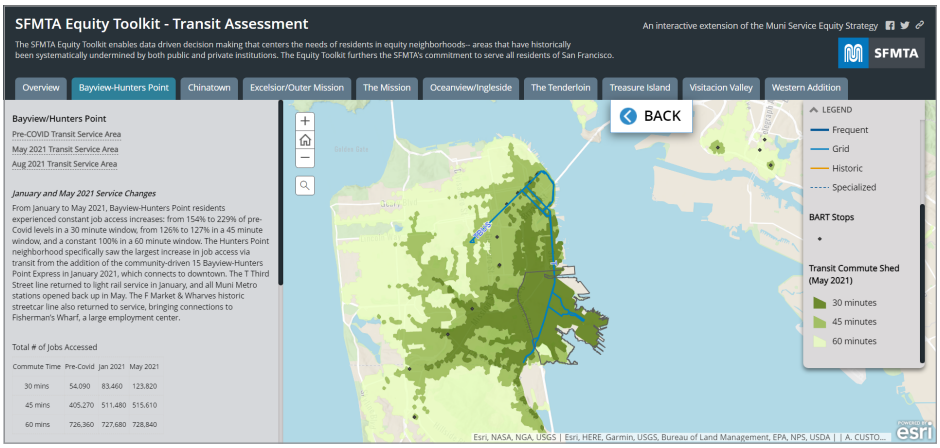
The Muni Service Equity Strategy outlines transit service investments as part of the regular biannual budget process. Improvements are detailed on a route-by-route basis to target a variety of service performance metrics within areas chosen based on specific socioeconomic demographic data.

Equity Toolkit

The SFMTA Equity Toolkit was developed as part of the Muni Service Equity Strategy so that service planners can make better-informed decisions for future Muni service plans. Supported by Esri's GIS solutions, the SFMTA Equity Toolkit uses data layered with mapping to improve access to jobs and key destinations by identifying gaps in the Muni system and enabling transit planning staff to make service change decisions to fill those gaps. Without these tools, it can be challenging for transit professionals to make focused transit service improvements that increase transportation equity and benefit those who use public transportation the most.

The SFMTA Equity Toolkit focuses on nine San Francisco neighborhoods—Bayview/Hunters Point, Chinatown, Inner Mission, Oceanview-Ingleside, Outer Mission/Excelsior, Tenderloin, Treasure Island, Visitacion Valley, and Western Addition—identified in the SFMTA Muni Service Equity Strategy as Equity Neighborhoods.

Equity Neighborhoods are those for which equitable transit is most important, where populations rely more heavily on public transportation. The emphasis on equity is deliberate and crucial—It is centered on uplifting communities and delivering systemic change. "Using the power of data and mapping tools to visualize transit impacts allows us to work at dismantling the systemic barriers that harm communities. Transit systems that prioritize equity can help communities thrive," says Steph Nelson, SFMTA GIS developer and administrator.



↑ Shown above is the transit assessment of Bayview-Hunters Point.

The SFMTA Equity Toolkit uses transit service data from six regional transit agencies—SFMTA, BART, SamTrans, AC Transit, Golden Gate Transit, and Caltrain. The data includes routes, schedules, and frequencies. Using Esri's ArcGIS Network Analyst solution, the SFMTA Equity Toolkit shows how far a customer can get within 30, 45, and 60 minutes by transit from key Equity Neighborhood locations. It compares job access for transit riders before and during the pandemic and how service changes influence access; it also reveals gaps in service for Equity Neighborhoods.

Initial Steps

The Equity Toolkit has its roots in the SFMTA's goal of equitably serving all residents of San Francisco as well as aligning with racial justice movements around the country.

Tracey Lin, senior transportation planner at SFMTA, says: "San Francisco went into lockdown in March 2020. We cut service significantly, from over 70 to 17 transit routes. Decision-making had to be very rapid and emphasized protecting essential workers, frontline staff, and the city we serve. Luckily, we had the Equity Strategy, which identified transit-dependent neighborhoods. We prioritized services on what are known as Equity Routes—Muni lines that serve Equity Neighborhoods—where residents also comprise a large percentage of the city's essential workers."

The availability (or lack) of data also imposed some limitations. Nevertheless, some significant pointers emerged from the toolkit team's research, as Nelson explains: "The original vision was to see how transportation service changes would enable residents' access to ladders of opportunity—key resources that enable people to move out of poverty and into a better quality of life."

"Initially, we applied the 'ladder of opportunity' framework to our analysis, pulling from some recent policy link reports," said Nelson. "We were interested in looking at access to medium- and high-opportunity jobs, and we developed an extensive industry/occupation crosswalk table to translate the policy report findings to San Francisco job data. We ran into a few issues with that, however. Once we moved to regional network analysis, we needed to work with regional job data, and the readily available census data we have access to is provided at the two-digit NAICS code level, rather than the six-digit level, which is necessary for the crosswalk table to work.

"The second and equally important issue is that available reports did not include a gender perspective, and the majority of jobs flagged as 'low opportunity'—also known as 'pink-collar jobs'—are occupations that have historically been more accessible to women (some more transinclusive than others). While it may be true that

'medium- and high-opportunity jobs' as defined in the policy papers we reviewed provide a more promising path toward financial security, many of these occupations are historically dominated by cisgendered men and largely inaccessible to other genders due to socialization patterns and unsafe work environments. While providing women (trans-inclusive) and nonbinary individuals with increased access to male-dominated occupations is a critical component to removing systemic barriers facing our Equity Neighborhoods and beyond, systematically excluding pink-collar jobs would undermine our overarching goals. So, we kept all jobs in essential industries in the mix. We'll be adding the rest in our next phase."

Defining Users and Their Needs

Census data was used to identify the Equity Neighborhoods, including the concentration of low-income households, residents who identify with a race other than white, and affordable housing developments. "A unique feature of the San Francisco area," says Lin, "is the relatively high levels of car ownership in economically challenged households. Planners sometimes focus on areas with low car ownership rates, as these groups are assumed to rely more heavily on transit. But in San Francisco, this line of thinking does not always work. Limited access to public transportation has often been a factor driving high levels of car ownership and underscores the importance of a strong public transit system."

Race tends to be the number one indicator of outcomes throughout San Francisco, which is often tied directly to where people live. Both the Equity Strategy and Equity Toolkit are heavily based on geography and reflect racial equity impacts from transit service changes. With other demographics, things are more nuanced in the Equity Toolkit.

Nelson adds, "In order to measure access within 30-, 45-, and 60-minute ranges, we had to identify specific geographic locations within neighborhoods to serve as center points. However, this approach has limitations that we are working to resolve. For example, when it comes to riders with disabilities, we found no geographic centers for where they live. This was not surprising to us. There were routes polled in our Muni Customer Survey that are regularly used by seniors or riders with disabilities, but because the Equity Toolkit is currently geographically based, these and other rider groups are not currently specifically captured. For the moment, we're using other tools to understand how service changes impact access to jobs and other opportunities for seniors and people with disabilities.

"Similarly, women generally don't live in the same tightly defined areas. We're considering how to address that. Our agency is also just starting to develop a gender equity policy.

"The City of San Francisco does have a Transgender District and several other known LGBTQIA+ neighborhoods, some of which overlap with Equity Neighborhoods as they are currently defined. But we have yet to make use of 2021 US census data on LGBTQ residents—which show higher rates of poverty among this population—to refine our equity neighborhoods."

Gaining Traction

Efforts to build out the toolkit and make it more robust are ongoing. As the urgency of responding to the pandemic recedes, SFMTA staff can take a more comprehensive look at service needs. Service changes implemented in July 2022 represent the "new normal."

"Transit agencies across the Bay Area have been frequently changing service as we recover from the pandemic, so it's all been a bit of a moving target," says Nelson.

In part, this is because multiple agencies are involved. Single- and multiple-agency analyses, as well as trying to reflect rapid service changes and reality, is like, in Nelson's words," having nine balls in the air at once." The team is therefore moving toward two types of analyses: Muni-exclusive and regional.

Although data limitations dictated the scope in the original version, Lin says that the team now has freer rein in terms of development.

According to Lin, "We also publish blog posts about service change analyses, in part to better explain the data to the public and encourage more intentional dignity-infused language, moving away from wonky terms and choosing words that are more respectful, easier to understand and identify with, and less technical.

"Close coordination with the Service Planning team—'Does this analysis look reasonable to you?'—provides a truth check. It would also be nice to be able to explain if sudden job increases or decreases were influenced by service changes on given routes.

"We use General Transit Feed Specification (GTFS) data from sister transit agencies, which has been challenging, but as our information is publicly available, it's important to get things right. It's also why it sometimes takes so long to complete an analysis because we want to be extra careful that the data is right."

Forward Thinking

The access to jobs calculation takes advantage of a Network Analyst methodology identified by Esri's Melinda Morang (https://bit.ly/3LXxzOD) and calculates accessibility for each minute between 9:00 a.m. and 9:30 a.m. and takes the 50th percentile from these runs to estimate job access. One of the frustrations the SFMTA Equity Toolkit team had was that the analysis is run after the service change rather than before. To achieve the ultimate goal of the SFMTA Equity Toolkit, the team is keen to modify both the toolkit and the process to evaluate the impacts of service changes before they are implemented. Lin says this may take the form of an annual evaluation that incorporates the SFMTA Equity Toolkit analysis from which more informed policy decisions could then be made.

"That involves a much more thorough 365-day analysis on which we can base policy decisions," Lin adds.

"The Equity Strategy would be rolled into

continued on page 13

Esri Small Nonprofit Grant Initiative Levels the Playing Field for Environmental Organizations

By Sunny Fleming, Environmental and Natural Resources Industry Manager at Esri

Recently I woke up to a hilarious email. My boss excitedly wrote to tell me that "weird bird people" are applying for the opportunity to take advantage of the $1 million Esri has set aside for small nonprofit organizations through the Esri Small Nonprofit Organization Grant Initiative.

"Weird bird people" are my people. All "weird-ologist" people are my people. I want to see my people taking advantage of the same technologies and capabilities that big corporations and their government partners use to revolutionize how they achieve their goals.

There are over 1.8 million nonprofit organizations in the US, of which roughly 20,000 are focused on conservation and education. Nearly 86,000 are focused on recreation; 10,000 are focused on agriculture. The list goes on and on.

Collectively, you can imagine the sheer impact this has on our environmental and conservation work. It's massive, integral, and should not be taken for granted. I've seen firsthand the power of our Tennessee State Parks Friends groups in facilitating the necessary trail maintenance work and other needs across our state's 57 parks. I've personally been involved with a small botanical chapter, the Tennessee Native Plant Society, and have seen its impact in educating the public and advocating for legislation on various topics impacting our biodiversity.

Right now, we have an Infrastructure Bill and a Climate Bill that emphasize and seek to support the implementation of locally led conservation efforts. The importance of these small organizations to help our nation meet our climate and environmental goals is not to be overlooked. They deserve access to the best technology to help facilitate and further their missions.

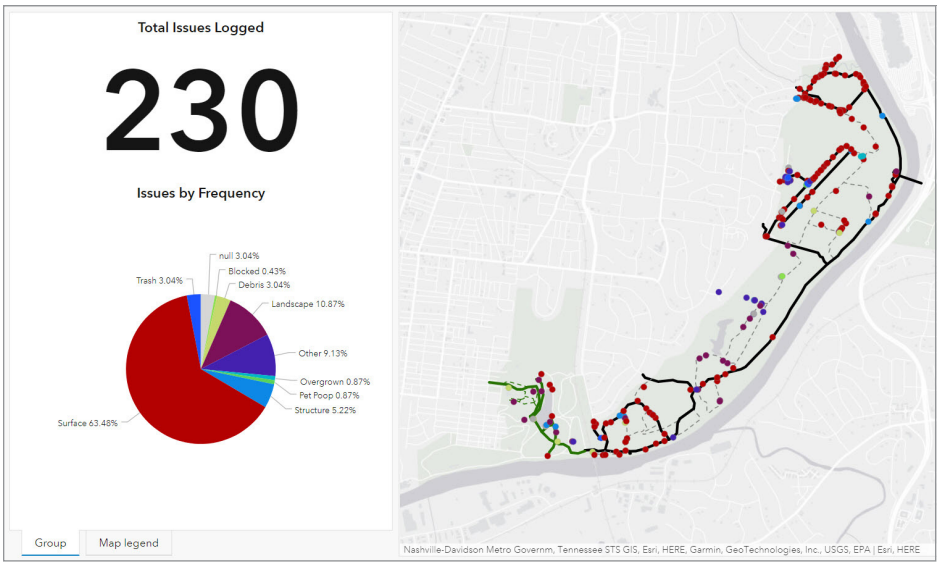
Let's look at some examples of nonprofit organizations using GIS technology to conduct their critical environmental work.

Park Maintenance

During the pandemic, it was my pleasure (and mental outlet) to help the members of the Friends of Shelby Park and Bottoms with their trail maintenance inventory. Shelby Park is a massive park for being in the middle of an urban center—13,000 acres and nearly 20 miles of trails. The maintenance can be a lot of work, and the Friends group plays a key role in maintaining and advocating for what is arguably Nashville's most popular park. Using a simple combination of ArcGIS Survey123, a dashboard created using ArcGIS Dashboards, and a two-hour training, we mobilized 10 volunteers to canvas the park and log maintenance issues. The dashboard allowed the group to easily filter which issues can be managed by volunteers and which ones required more serious work to be passed along to Metro Nashville.

Biodiversity Protection

Sea Turtle Patrol Hilton Head Island (Sea Turtle Patrol HHI) is a small nonprofit out of Hilton Head, South Carolina, that helps hatchling sea turtles shuffle their way safely to the sea. To do this successfully, members must be able to accurately log and visualize the location of the nests when wooden markers were consistently



↑ Members of Friends of Shelby Park and Bottoms use this dashboard, created using ArcGIS Dashboards, to prioritize park maintenance issues.

vandalized or removed or washed away during Hurricane Matthew. Learn more on how the nonprofit is using ArcGIS technology at go.esri.com/Turtle2Sea.

Citizen Science

As someone who obsessively babies the monarch caterpillars in my milkweed garden every year, I have signed up to receive notifications via the Chicago Field Museum's hub for its Monarch Butterfly Research and Protection Initiative. Using ArcGIS Hub Premium, volunteers can have virtual "identities" via their login, which the museum can then use to communicate directly with the volunteers throughout the research life cycle. Hubs can facilitate training, communicate events, and provide the volunteers with the technology required to report their findings. Dashboards summarize the findings immediately, allowing volunteers to see their impact on the project.

Education and Outreach

The nonprofit climate change outreach and advocacy organization Protect Our Winters uses GIS technology to research and communicate the impact of climate change on winter sports—and the downstream impacts on local economies that rely heavily on the winter sports season. When topics like climate change can be abstract to talk about, they become very real when you can see them on a map and relate them specifically to where people live and recreate. By using maps, the group can rally their community behind a call to action.

So, what is your call to action? Apply for Esri's Small Nonprofit Organization Grant Initiative. We've set aside $1 million to support small nonprofit organizations with the tools and the training required to get up to speed and magnify their impact. Go to go.esri.com/EsriGrant4Nonprofit to learn more.

Connecting People to Opportunity continued from page 11

this as well to give a much more comprehensive picture of our transit system. Lin continues: "Service performance gaps and the needed investments to address them are incorporated into our agency's two-year budget process. The toolkit will probably undergo a similar adaptation. That will take us beyond short-term service changes and into the long-term service planning space. We also want to incorporate equity and transit planning farther in the SFMTA Strategic Plan. Again, that's a longer-term setting than we're currently used to with the toolkit."

Nelson points to another GIS equity tool that the agency wants to develop. This tool (in the form of a custom widget for ArcGIS Web AppBuilder) would enable users to run on-the-fly demographic impact analyses for capital investment projects. When a staff member draws a feature on a map, the widget will summarize the demographics of nearby residents, along with the number of jobs and businesses impacted, and whether the project overlaps with sea level rise areas.

"We are careful not to confuse impact with benefit," Nelson cautions. "These kinds of tools allow us to be more context-aware, but just because the demographics of a project impact area may appear to serve our larger equity goals, [it] doesn't mean the project necessarily does. The next step may be to compare demographics of the impact area with that of community meeting participants, as one example."

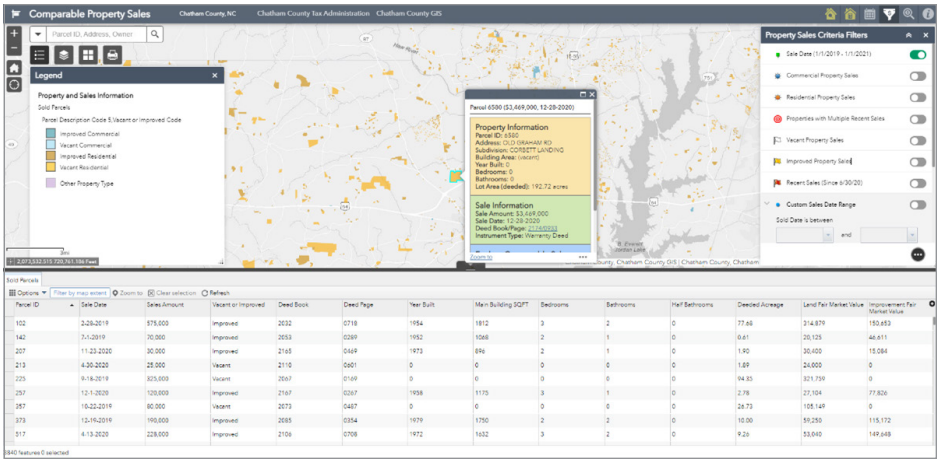
Chatham County Expedites Appraisal Process through GIS

Chatham County, North Carolina, had over 46,000 parcels that needed to be properly and accurately assessed. Through GIS technology, the county pieced together an all-in-one solution for its tax department's recent tax reappraisal process.

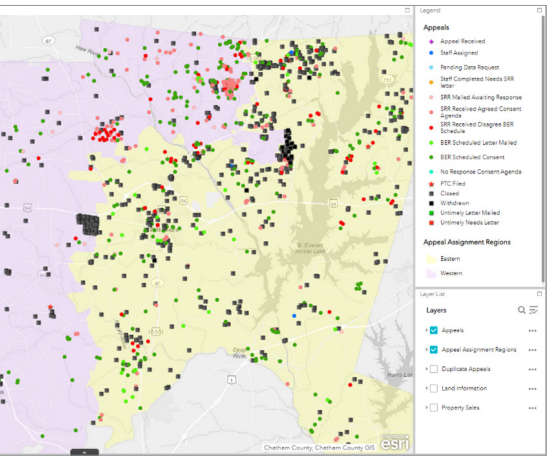
Counties are required to regularly undertake general reappraisals. This involves a tremendous amount of tax administration and appraisal work, and once assessed value notices are provided to residents, a reappraisal project becomes a major public relations matter. It became a priority for Chatham County to provide its residents with easy-to-use tools to explore real estate data related to their property, which would allow them to easily appeal the value in the event of a disagreement. Appraisers also needed a comprehensive appeals management platform to efficiently navigate the appeals process.

Rethinking the Appeals Process

To generate the best solution for managing appeals, the tax department reached out to the county's GIS department for a comprehensive solution to visualize, track, and manage comparable sales and appraisal information for its own internal appraisal process. It was important for this solution to be readily available to the residents to improve public transparency, especially when change value notices were sent to them by the tax department. The GIS department accomplished this major assignment by utilizing three integrated ArcGIS Online solutions, using ArcGIS Survey123 for mobile work photo collection and to create a dynamic online tax appeals form. An operations



↑ The Comparable Property Sales mapping application can be used by appellants to find sales information.



↑ Shown above is a dashboard that supports the tax department's property photo collection assignments.

dashboard and the Comparable Sales application were then created using ArcGIS Web AppBuilder to visualize and manage both field data collected by reappraisal staff and appeals submitted through the online appeals form.

The GIS department began its journey to creating a more functional and transparent platform by developing a photo collection tool using Survey123. This application was utilized by contracted reappraisal staff for the collection of current property photos and helped staff organize multiple photos for different parcels. Over 100,000 photos were taken in the field to capture parcel ID and property address information, and the photos were then used for validation purposes if there were data entry errors. This process was important for the assessors since they needed current photos of each property for an accurate change value notice to be sent to residents. Having all the photos in one place made it easier to keep an accurate record of the property reappraisal and improved overall field efficiency.

A tax appeals form was also created using Survey123, for property owners who have the right to appeal the county's assessed value of their parcel. At the beginning of each year, following a countywide reappraisal, all property owners in the county receive a change of value notice, which presents the properties' new assessed value. One of the unique features this form offers, on the internal side, is that when appellant information is submitted, it can be filtered through this new form so that duplicate submissions are avoided, reducing the possibility of errors. It is common for people submitting appeals to have a long waiting process. The form is automatically sent to the assessors who can immediately start working on it, improving the time it takes. The tax department used this dynamic, user-friendly online form to gather appeal submissions from the public; the submissions were then populated into a dashboard application utilized by appraisal staff for appeals management. This way of collecting public information made it easier for the county's appraisal staff, as they could now manage everything in one consolidated place. Within the appeals dashboard, the tax department can see a variety of variables like appeal submissions, assign appeals to appraisal staff, and update appeal statuses in real time.

The Comparable Property Sales mapping application, which launched in 2021 just before change of value notices were sent to residents, informed people of their properties' new tax appraisal value and of the tax appeals process. To support their appeal, appellants can use this tool to easily find sales of properties similar to their own. The more evidence residents can provide to support their appeal, the more justification they have when submitting their appeal form. This interactive comparable sales application, was launched out of the need for easy access to meaningful sales information.

"GIS technology empowered tax department [staff] to take ownership of their data and allowed them to take it to the next level," said Nick Haffele, GIS director, Chatham County.

Improving Productivity and Transparency

Within a few years, Chatham County was able to leverage GIS technology to better serve its residents and optimize its internal workforce more efficiently. Many residents have expressed their satisfaction with this new appeals process. The tax department has also seen an increase in productivity, thanks to the prominent level of transparency that the Comparable Property Sales mapping application was able to provide the residents, as well as the reduced redundancies and time saved because of the Survey123 appeals form.

"The process designed by our GIS department using Esri products provided a visual map outlining the parcels with appeals and the status of the appeals. Staff were able to track all comments and attach all the documents to each parcel, which resulted in time savings when processing appeals. We also experienced a reduction in paper submissions since the appellants were able to upload all documents and complete the online application form," said Jenny Williams, tax administrator, Chatham County.

Now, Chatham County is working on ways it can enhance the solution for the tax department and encourage other departments to utilize GIS technology as well to make their jobs easier. The county is taking steps to develop a public tax reappraisal hub site that will work in conjunction with the tax department, which will allow it to promote awareness and transparency in the tax reappraisal process. Chatham County has proved that this repeatable solution is obtainable and can be easily replicated by other county tax departments that are looking to streamline the appeals process.

"In response to the success Chatham County had with the real estate appraisal, the Personal and Business Personal Property divisions have requested an online appeals system for their operations. The GIS department is currently in the process of developing similar solutions for them," said Lucian Stewart, applications solutions engineer, Chatham County.

Johnstown, Colorado, Proves GIS Is for Governments of All Sizes, Even Those without Massive IT Infrastructure

Residents have come to expect accessible maps and apps for learning about things—where development is occurring in their neighborhood, where road closures are, where to vote, and much more. It is safe to say that a GIS has become one of the most prevalent technologies in government, supporting operations that include public works, planning, law enforcement, and health and human services. So shouldn't small governments apply the same modern approaches that their peers at larger jurisdictions are incorporating?

Barriers such as limited technical skills; lack of access to training, data, software, and hardware; and budget constraints have sometimes hindered small organizations from adopting GIS technology. But with Esri's local government solutions, that no longer needs to be the case.

The Town of Johnstown, Colorado, is a leading example of how a small jurisdiction is modernizing its operations by adopting GIS technology as a mission-critical tool. For years, Johnstown—a community of about 17,000 residents—experienced stagnant development, and the town did not see a reason to map out the locations of utilities, town limits, or oil and gas lines, as it would waste valuable time and resources that could be dedicated elsewhere. In the past, the town counted on staff members' memory or informal documentation for things like utility locations. But then, the town started to witness unprecedented population growth, and staff knew they needed to take action to continue operations while also accommodating the growing population. GIS is serving as Johnstown's mission-critical tool, allowing staff to quickly generate required datasets, collect accurate field data, and map out the town's utilities.

Cloud-Based GIS Improves Town's Efficiency in Record Time

Johnstown is located in two counties: Weld County, where most residents reside, and Larimer County, where most businesses are located. Each of these counties leverages GIS to empower its workflows, but this didn't necessarily give the Town of Johnstown a comprehensive view into its own data and plans.

Johnstown staff knew that to keep up with the new population growth, they would need their own system to manage land use, development, and growth. Having some GIS background, the town manager, Matt LeCerf, asked the utilities director, Ellen Hilbig, to hire a GIS specialist to streamline the town's workflows into one system. Upon arrival, Steve Holmes, GIS specialist for the Town of Johnstown, was a team of one. As the town had not used GIS before his arrival, he was tasked with creating, combining, and modernizing Johnstown's datasets from scratch.

With the desktop tools provided in Esri's local government solutions and, especially, the cloud-based enterprise agreement (EA) with Esri, Johnstown now has an accurate picture of the municipal boundary and the development projects that are underway. In addition, Johnstown leveraged new tools like deep learning—a subset of machine learning that uses several layers of algorithms in the form of neural networks—in ArcGIS Pro to capture building roofline data for over 8,500 buildings. The data was

↑ Roofline data for more than 8,500 buildings was generated by deep learning algorithms.

captured in just two workdays.

The cloud-based GIS provided the scalability that the Town of Johnstown needed in record time. There was no need to create any further IT infrastructure, as cloud-based GIS runs on any device with an internet connection. Also, Holmes is now able to keep his organization informed on projects by uploading his work onto the town's hub site, created using ArcGIS Hub, an easy-to-configure cloud platform that organizes demographics, data, and tools to accomplish initiatives and goals.

Accelerating Johnstown's Community Development with GIS

Although Holmes is a one-person team, his job requires him to work with multiple departments. As Johnstown grows, new real estate development, construction, and capital projects need to be approved. However, before GIS technology, Johnstown had no record of where oil and gas pipelines were, what parcels or buildings the town owned, or where the town limits are. Staff relied on old drawings and personal memory for utility location information, which lengthened the amount of time it took town leaders to review and approve development activities.

"As developments moved forward, we didn't have record of where our utilities were or reliable annexation data. So it was crucial for the town staff to go into the field to collect this data with GIS technology, which we then easily added into our central systems of record," said Holmes.

Having this data is key when working with developers, and GIS allowed the Town of Johnstown to efficiently do this across the organization. Staff no longer needed to go into the field with clipboards and pens. Instead, they used ArcGIS Field Maps, the all-in-one app that helps mobile workers perform data collection and editing, find assets and information, and report their real-time locations.

GIS Prepares Johnstown for the Future

GIS technology is allowing the Town of Johnstown to openly embrace and prepare for the new growth that is taking place. Despite having limited staff, the town was able to update key datasets, map out essential infrastructure and utility systems, and move forward with modernizing the entire town's workflows—all using one location-based system.

↑ Town of Johnstown Utilities

"Thanks to GIS, we're in a position to more efficiently move our town forward. Without web-based GIS, the Town of Johnstown would not have been able to keep up with the unprecedented growth we've experienced," said Holmes.

The Town of Johnstown benefited from Esri's local government solutions bundle. It assesses your jurisdiction's requirements, population size, and infrastructure to generate a pricing module unique to your needs. To see how your organization can leverage the same tools, go to go.esri.com/LocalGovernment.

> "A cloud-based GIS through ArcGIS Online required very little uplift for me; as a one-person shop, I did not have the time, resources, or IT department to set up a GIS. So this was a major selling point for us, as it didn't require any further infrastructure from us and allows us to easily share the data to all departments and users."
>
> Steve Holmes,
> Town of Johnstown, GIS Specialist

Dashboard Makes Street Rating Data More Valuable

by Coray Davis

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

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

Maintaining Streets

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

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

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

Pavement Analysis and Selection

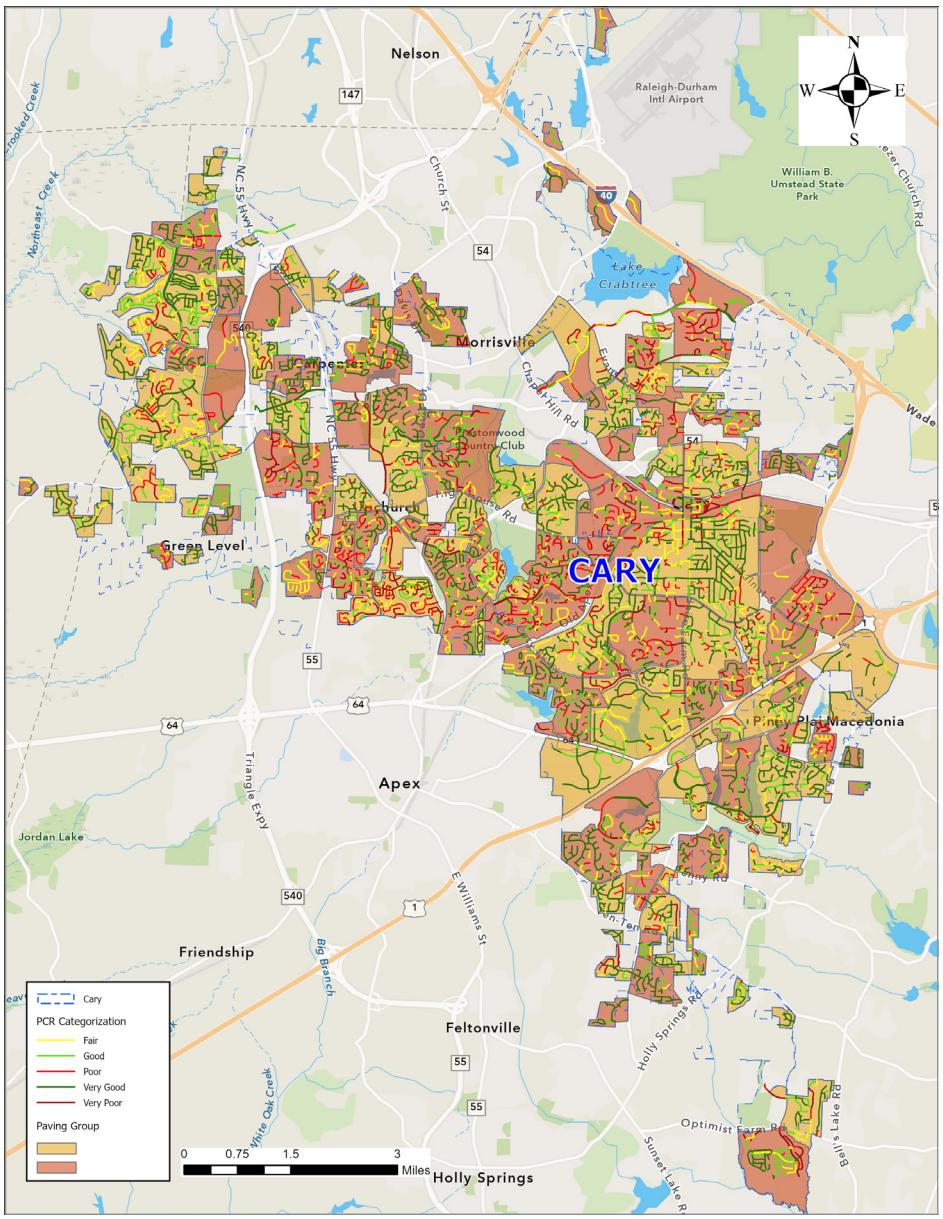
The Transportation Department uses an independent, third-party consultant to survey the condition of public streets. Streets are surveyed by block or segment to collect information, which includes physical characteristics and pavement distress types. Types of pavement distress include alligator cracking,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

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

Within the last five years, Cary created paving groups to analyze streets. These 166 paving groups consist of neighborhood streets used to support the selection and grouping of poorly rated streets for improvements and to simplify construction. As data continued to be compiled, the Transportation Department needed a way to analyze pavement rating data across multiple years to support better informed decision-making.

History Informs Decision-Making

To simplify data management and increase accessibility to data across multiple departments, the Transportation Department used ArcGIS Dashboards to create a pavement condition data dashboard. Once the data was cleaned, validated, and published, the dashboard revealed the condition of streets within each paving group. The dashboard



↑ Paving groups represent neighborhoods and provide for better analysis of street segments.

displays pavement condition data collected over nearly 10 years. Stakeholders across multiple departments could perform interactive querying and have access to all attributes originally contained in the database, but now in a more visual format.

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

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

Sharing Is Caring

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

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

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

The PCS Data Dashboard helps in disseminating information to concerned residents. Cary's 311 system lets residents easily make nonemergency requests for service or obtain answers to general questions. Residents can find out if their street

continued on page 20

Dashboard Makes Street Rating Data More Valuable continued from page 19

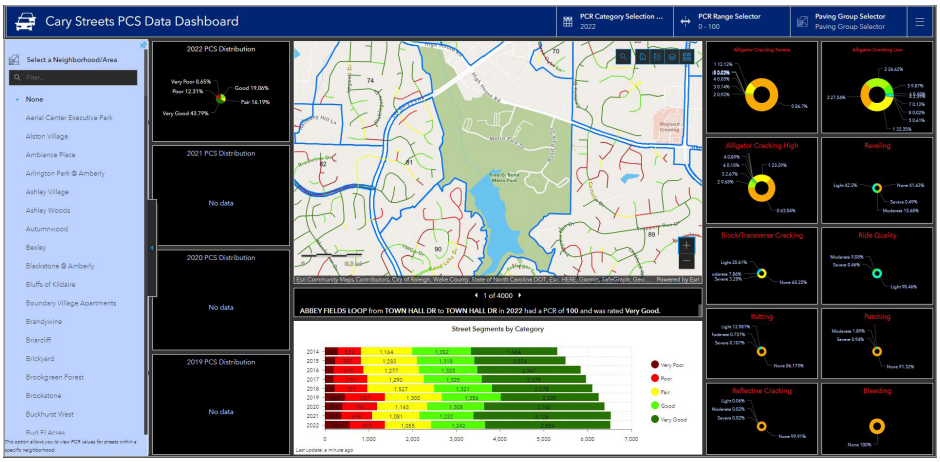
is on the current list for improvements or when streets in their neighborhood were last resurfaced. They may also inquire on issues such as parking along streets, garbage pickup, landscaping repair, and weather-related delays. The dashboard lets Cary staff members quickly identify areas of concern and respond to resident queries with current information to address their concerns.

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

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

About the Author

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



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

Newark, Delaware, Reimagines, Rethinks, and Rebuilds Public Works and Water Resources with GIS

continued from page 5

feature (e.g., type, county name, site name), along with the inspector's name. The inspector fills out the survey and submits it. Python scripting is used along with Microsoft Word Mail Merge to automate the entire report generation process. By the time the inspector returns to the office after clicking the Submit button on the survey, the entire report has been generated. Now the inspector only needs to review the report and email it to the owner, saving a significant amount of time. Additionally, the manager can monitor the inspectors, see all inspections, and check the status at any time.

Expanding PWWR Staff's Impact on the City

The positive impact that PWWR staff are having on the city with GIS is continually expanding. In addition to the three apps highlighted in this story, they have deployed over two dozen other GIS applications across the city, some of which are available to the public.

All these applications were developed in-house and most without writing any code. PWWR GIS staff make great use of online assistance as well as inspiration from Esri blogs and other community resources. Internal apps are hosted in ArcGIS Enterprise, while publicly accessible apps are hosted in ArcGIS Online. PWWR GIS staff continue replacing paper-based, manual workflows to reinforce their culture of continual organizational improvement. They are also having success with creating spatial views that geoenrich nonspatial data obtained dynamically from other city databases (e.g., water meter data) and then visualizing it in ArcGIS. All this work is done with four power users. Their work is supported by executive sponsors like the PWWR director and managers as well as the city manager.

This story is a great example of how a few GIS users, along with strong leadership, vision, and executive sponsorship, can positively impact a municipality's operations by increasing efficiency, delivering an increased level of service, modernizing outdated workflows, and innovating new solutions. It is a blueprint for how to reimagine, rethink, and rebuild an organization with GIS.

For more information on how you can duplicate this success, visit Esri's Public Works and Engineering website, at go.esri.com/GIS4PW.

Houston Public Works Manages Enterprise GIS with Performance and Optimization Solution

Houston, Texas, is the fourth-largest city in America with a diverse population of more than 2.3 million residents, who that enjoy unique attractions such as the Space Center. To ensure this expansive and populous city keeps running efficiently and residents can enjoy a high quality of life, Houston Public Works offers services ranging from producing and distributing water, collecting and treating wastewater, and administering permitting and regulation of construction. More than 4,000 dedicated employees help cover 671 miles of service area.

The geospatial services team at Houston Public Works is responsible for providing GIS operations support and guidance and maintaining the GIS IT infrastructure that's needed for its five business units and its daily operations. Within the business units, GIS subject matter experts are responsible for editing and maintaining their core data, while some also produce solutions such as web maps and dashboards. The team also supports the mayor's office, the public works director's office, and emergency operations, with various applications that need to be available at all hours.

With a complicated infrastructure that includes many servers, dedicated environments for user groups, and a growing number of users and transactions, geospatial services team members wanted a solution that would help them monitor their enterprise system to proactively address any issues and improve reporting. The team partnered with GIS services provider Dymaptic, a longtime collaborator and an Esri partner, to implement ArcGIS Monitor to observe the health of the organization's enterprise GIS. The use of this solution has improved efficiency and troubleshooting to enable the team to better support Houston Public Works operations and services.

Challenge

The large IT infrastructure of Houston Public Works is composed of an enterprise portal and a separate system of two GIS servers that includes a federated portal of three servers and regular map and feature services. According to Anthony Powell, GIS manager for Houston Public Works, the enterprise GIS environment has grown significantly in the past five years with the addition of more critical servers to support the department's efforts.

Houston Public Works staff edit data and build web apps to consume web services as well as enable the public to access some of their data and apps. Powell notes that before he took on the GIS manager role in 2015, the GIS was in a very bad state due to how things were structured and the lack of efficient organization in the environment. Users across the department complained that they were unable to access data, and processes like saving their data were very slow.

"When I started looking at the environment, everything was competing against each other. We had GIS data there, but you also had data from these other systems. So, there were no optimizations," explains Powell. "From an editor versus just someone that was needing to access and read the data, they're all coming from the same environment and competing for resources . . . that were not balanced properly."

The previous enterprise GIS setup also created difficulties for Jane Chen, enterprise geodatabase administrator at Houston Public Works, when trying to monitor and keep up with changes to the database. For example, the department's stormwater team manages a large network

continued on page 22

Houston Public Works Manages Enterprise GIS with Performance and Optimization Solution

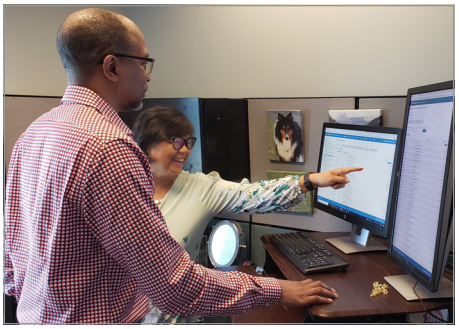
continued from page 21

of pipes, inlets, etc., to handle stormwater runoff. Powell says editors on this team make revisions daily, so there are a large number of transactions to monitor.

The geospatial services team has a replica database for internal use and a sharing database for production applications. Powell notes that as the department expanded, Chen continued to build replicas, which meant more data was being added into the environment for users to edit.

"Each year, more data is being added, [and] more users are being added to maintain that data. So that just increased the complexity of Chen's role and her responsibility as a database administrator. So then we started saying we need some tools to help her monitor the performance of those activities," says Powell.

When Powell began his work, he wanted to start with a clean slate for the new enterprise GIS environment and decided to move away from an Oracle on-premises hosted environment to an SQL Amazon Web Services (AWS) cloud-hosted environment. Chen and Powell created separate environments for users, including a dedicated editing database



↑ Anthony Powell and Jane Chen looking at ArcGIS Monitor metrics.

environment for the editors, one for viewing, and one for publishing. However, they needed a solution to monitor and optimize each system.

Solution

The City of Houston has an existing enterprise agreement with Esri, so Powell began searching for available Esri tools to do the job, which led him to select ArcGIS Monitor. ArcGIS Monitor is a tool designed to observe system health and provide awareness of system usage and performance. To support the implementation of this solution, Powell decided to bring in Dymaptic and its expert knowledge of implementing ArcGIS Monitor.

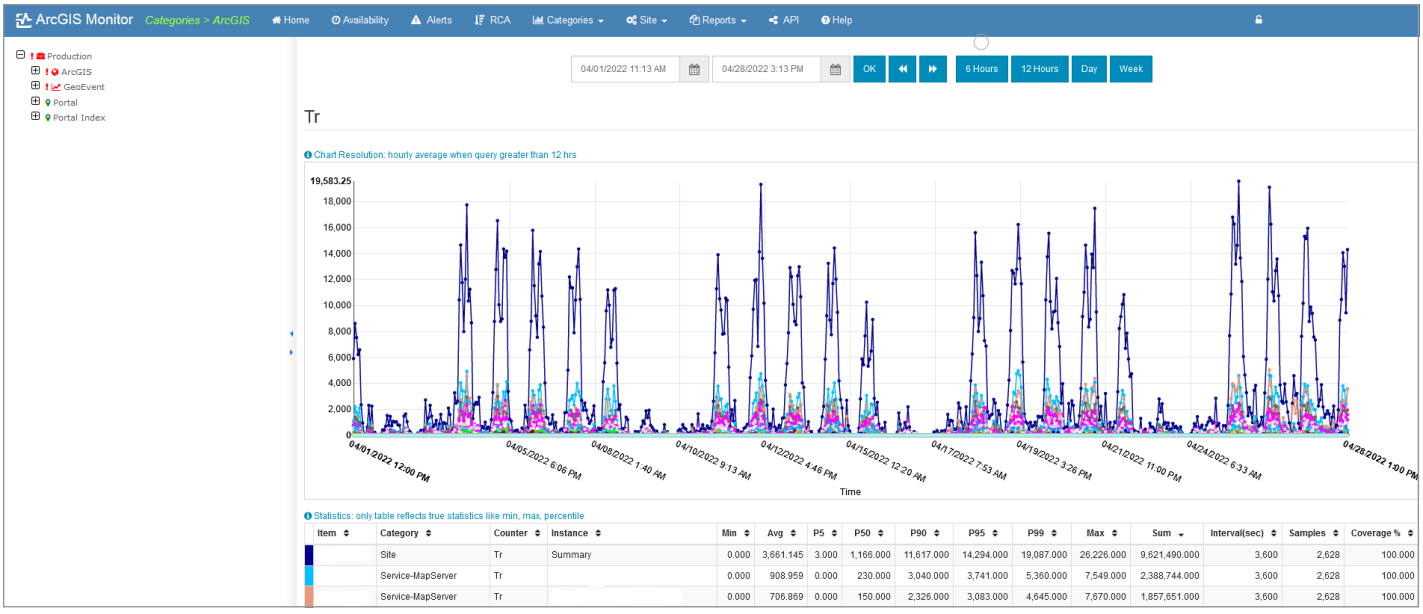
In addition, Dymaptic's support role was expanded across Houston Public Works with everything from application development to server management and database administration.

Dymaptic team members, who frequently use Monitor with their own clients, like the fact that this solution is part of the Esri portfolio. Mara Stoica, CEO of Dymaptic, says that because the solution is made by Esri, it's assured that it will keep up with Esri technology.

"If Esri comes up with a new product, the Monitor team will make sure that the new product is being monitored also. Other third-party applications have a harder time keeping up with Esri's invention of new technology," says Stoica.

Kevin Sadrak, a senior GIS developer at Dymaptic, adds, "Monitor has got the support and the usability that makes it easy for us to help a customer to get it [set up and] working."

After the initial setup, Powell says Monitor was connected to a few of the department's emergency operation solutions for monitoring, but the GIS team had some challenges with implementation and later brought in Dympaptic to



↑ ArcGIS Monitor displays of transaction rates.

> "Before, I didn't have anything to gauge what system usage looked like. ArcGIS Monitor has been able to provide us that picture of how many hits and what the performance [metrics] look like so that we can make the appropriate adjustments immediately."
>
> Anthony Powell,
> Houston Public Works

help. The Dymaptic team began by talking with Powell and Chen about the state of their databases and how they were running and what they'd like to improve. Sadrak said it was important to get a holistic view of the enterprise GIS.

"When Kevin came on board, he was able to . . . identify where the disconnects possibly were and to get things configured to where we could then start fully taking advantage of [Monitor]," says Powell. "He got some readings on performance that have helped [Chen] tweak and make adjustments to her processes."

Monitoring capabilities were established for the enterprise public works environment, including reports to observe performance. Sadrak says they got the reports running immediately with only slight adjustments to refine them. He used the Monitor to customize the alerts, so Powell and the team received only the critical alerts they wanted to see. In addition to email notifications, alerts are added directly to a Microsoft Teams channel.

Result

The deployment of ArcGIS Monitor has resulted in improvements in performance and the overall user experience, enhanced troubleshooting, and a fourfold increase in usage of the system. Sadrak says the user experience has improved because ticket requests have decreased, and users now benefit from a generally improved system with faster performance and fewer hiccups.

Chen echoes this sentiment and says after Monitor was fully operational, it provided a wealth of data. At the beginning of the day, Chen checks how many transaction counts and failed data counts there are. She also checks to see which server has services that may have stopped.

"I really like Monitor, so I start to use it frequently. It's a mirror for me each morning [when I check it]," says Chen. "I don't want to sound like ArcGIS Monitor is just for our database. It's not. It's for our whole GIS system. Now, we can see the whole database server, performance, status, activities, and have very detailed information."

Powell believes Monitor has enabled geospatial services team members to be proactive because they are leveraging it to inform them of critical issues ahead of time. Sadrak agrees and notes that the team can look at past reports to identify trends such as when usage is going up or disk space usage is starting to climb.

"To me, having that historical record is what's most important because that's where you can start establishing, 'Okay, we've got X usage, but that's normal.' We're able to see what is really happening easily," says Sadrak.

He adds that they can do maintenance tasks more proficiently because they can spend less time troubleshooting with reports.

"It's helping us work more efficiently, and we're able to discover these things so that our response time to issues actually shortens, which is a good thing overall for ourselves and for the customers that are having a problem," says Sadrak.

The improved troubleshooting has helped the team better determine the source of performance issues. Sadrak says the challenge before was diagnosing the more than 100 services at Houston Public Works, but with ArcGIS Monitor, the team can get information and more easily determine what the problems are. Now, when Monitor issues a performance report, there is enough information to make decisions quickly.

"When you're just hunting for a solution because someone said it was slow, you're kind of feeling around in the dark. Is it the database? Is it the RAM? Some tools can help you with that, but what Monitor does is kind of put it in one place," says Christopher Moravec, CTO for Dymaptic.

For example, with the rollout of new services recently, the system was low on resources, but with the reports from Monitor, the data was displayed in visuals like charts. These visuals helped justify the requests for additional resources to support the GIS team's activities.

"The data was authoritative, it was right out of the system, and we had that factual information. So it helped support the cause," says Sadrak. "We were able to make that chart and say, 'Look at where we were. This was our usage. And we need you to give us some resources.' It made that conversation with IT and management easy."

The ability to customize components for Monitor and add extensions allowed Dymaptic to provide more capabilities to the Houston Public Works team. Sadrak says he was able to add an extension to watch scheduled tasks such as database loading.

The Houston Public Works geospatial services team has started migrating the utilities, water, wastewater, and stormwater networks into the new utility network model environment, which will require the use of Monitor. Powell says it will be a big shift from the department's traditional way of managing the software development environment, but with Monitor, he says team members can easily plug it in and apply it to this new environment.

"I feel ArcGIS Monitor can help us [go] from being reactive . . . to [being] proactive. That's a big benefit. We don't want to wait until users are [reporting an issue] to try to find it," says Chen. "We monitor with Monitor frequently, and we find the issues and fix the problem, hopefully before users find it. That's great."

380 New York Street
Redlands, California 92373-8100 USA

Presorted
Standard
US Postage
Paid
Esri

Don't miss out on news, insights, resources, and alerts.
Sign up for updates at **go.esri.com/subscribe**.

184356 G3327732

Create Lasting Change in Your Community

Apply for Esri's Small Nonprofit Organization Grant Initiative and secure GIS software.

Scan this QR code to apply for one year of GIS software.
Deadline: February 28, 2023

esri.com/nonprofitgrant