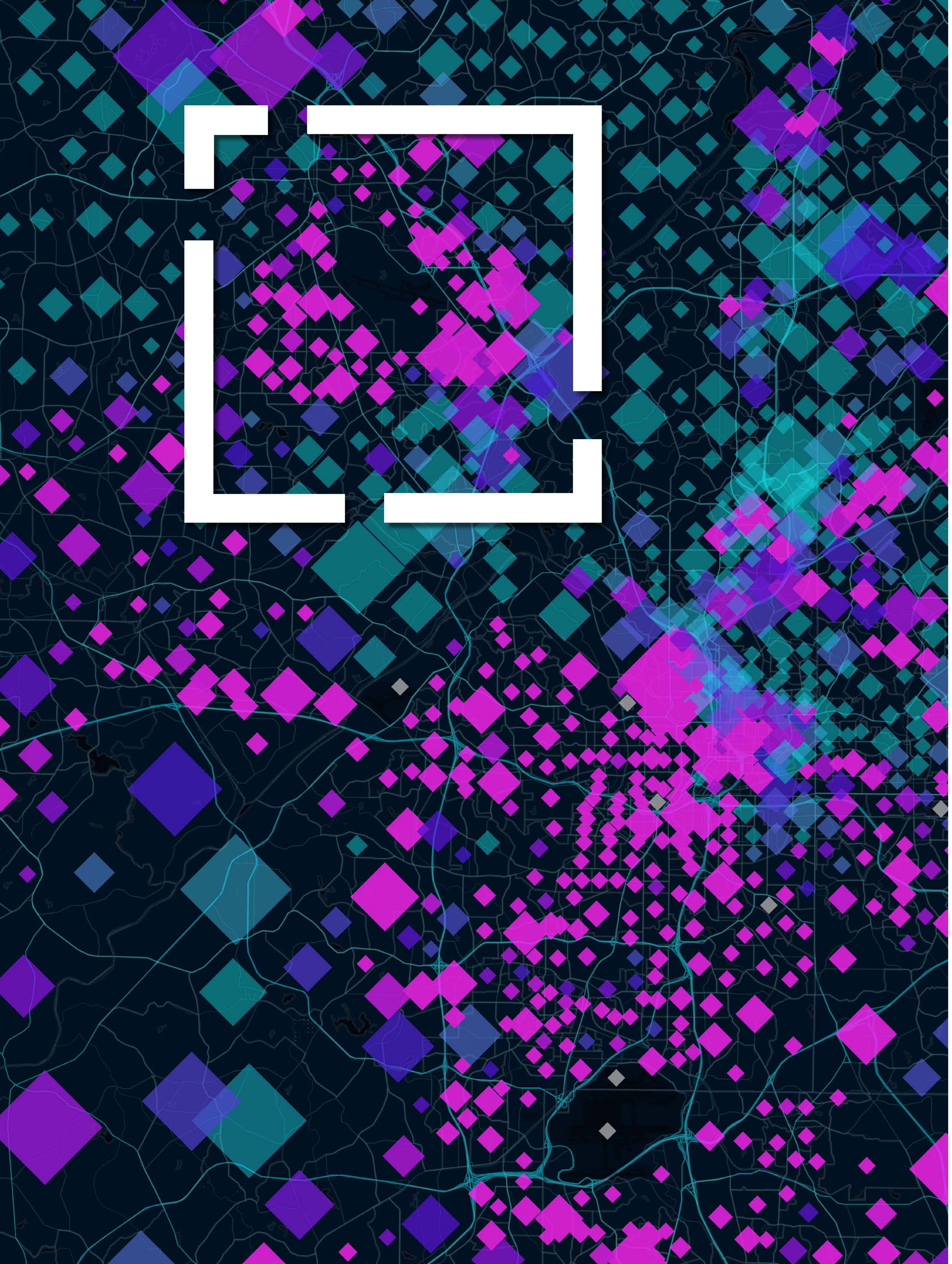
# The Rise of Geospatial AI

How organizations combine AI and GIS to automate analysis, predict trends, and optimize at scale


esri®


# WHAT'S INSIDE



"The previous generation of GIS technology was built for people, and now we have a GIS built for machines. Automation doesn't mean we're replacing humans; it means humans don't need to do the tedious work that causes a state of boredom. People can focus on what they're good at, which is innovation, and machines can take those innovations to scale—focusing on accuracy and outcomes."

—Jay Theodore, CTO, ArcGIS Enterprise Development Lead, Esri

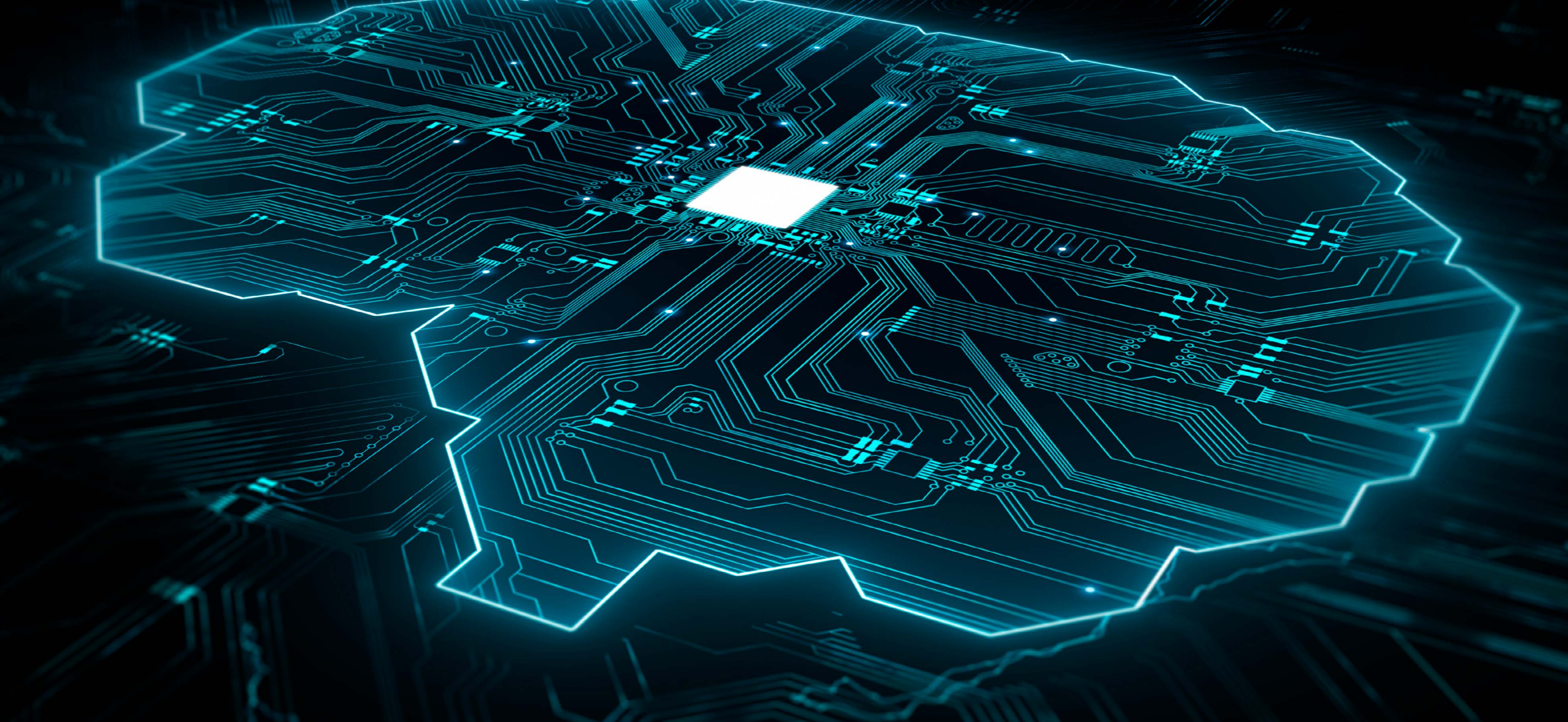
# INTRODUCTION

Leaders in government and industry have long relied on a geographic information system (GIS) to navigate and solve some of their most pressing challenges. They use this technology to analyze data through the powerful lens of location. Critical information is presented geographically, referenced on a familiar medium like a map or a dashboard.

Now, GIS, enriched with AI—what's known as geospatial AI—empowers leaders to tackle even the most complex questions and find better, faster answers.

Take for example the US Army Corps of Engineers, one of the world's largest and most diverse engineering organizations. They are tasked with keeping commerce moving on the Mississippi River—a thoroughfare for 40 percent of goods produced in the US. It's a huge job that involves monitoring depths along 25,000 miles of waterways and 400 ports. They orchestrate vessels that clear away sediment, so cargo-carrying barges don't run aground.

The corps created a system with geospatial AI that predicts areas on a map where water levels are reaching critically low points. It is a simulation of the river system that takes into account hundreds of data points to predict where sediment will need clearing. As a result, they have saved more than $100 million in operating costs.



Transformative changes like these are happening across sectors. Leaders and their GIS teams are coming together to drive innovation. A transportation commissioner asks where to prioritize corridor improvements based on traffic congestion patterns. An energy CEO asks where grid modernization will meet population growth projections. A logistics VP asks where to locate hubs to significantly reduce delivery times. GIS teams can present the answers on a shared map or dashboard.

It's the power of *where*—and it's driving smart, sound decisions. ArcGIS®, the world's leading GIS technology, equips organizations with AI-powered spatial analysis. The smart maps and dashboards that users create catalyze a new way of thinking.

Designed as an enterprise platform, ArcGIS integrates with other business systems in the technology stack to enable AI-powered spatial analysis across the full scope of enterprise data.

As challenges grow more complex, geospatial AI arrives just in time. It empowers business units to analyze complex datasets at unprecedented speed and scale, revealing insights that would be difficult or impossible to find manually. Geospatial AI doesn't cut through or minimize complexity in addressing problems—it lets users take complexity into account in designing solutions.

# THE BIG IDEA

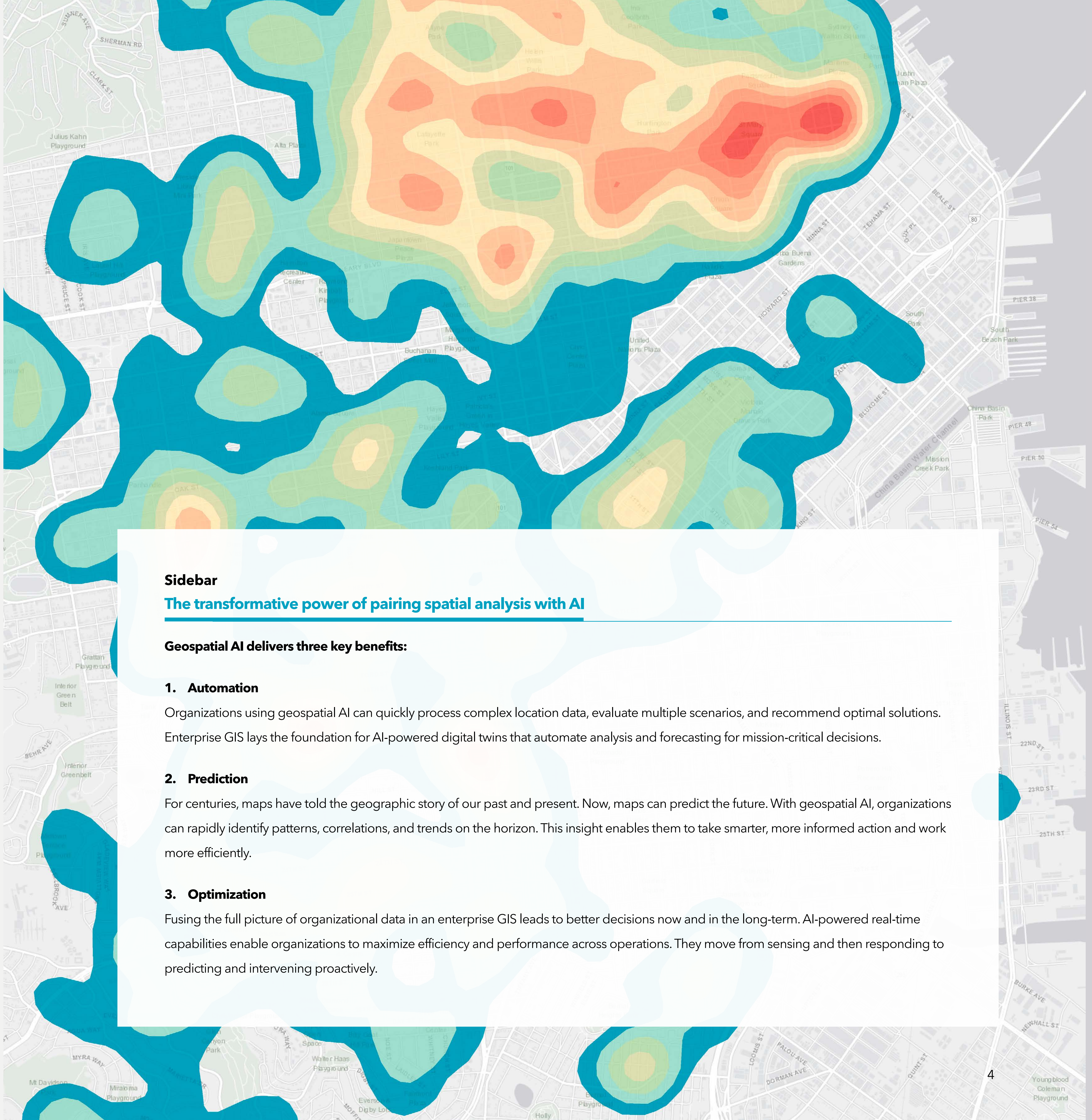
GIS technology has long helped leaders solve problems by analyzing data through the powerful lens of location. Geography allows us to integrate and organize all relevant information in terms of *where*.

Leaders in business and government use this geographic approach—the power of where—to reveal patterns and trends, model scenarios and solutions, and make sound, smart decisions. GIS technology is what makes this possible at an enterprise scale. Artificial intelligence makes GIS easier to use and even more powerful.

## Geospatial AI transforms spatial analysis in fundamental ways:

**Simplified User Experience**—AI makes GIS easier to use and productive for everyone. Users can interact through natural language rather than technical commands. Automated workflows and intelligent assistants help both experts and newcomers accomplish more in less time.

**Enhanced Power and Capability**—AI enables GIS to automatically discover patterns, predict trends, and generate deeper insights from data. It can analyze complex datasets at unprecedented speed and scale, revealing insights that would be difficult or impossible to find manually. ■



**Sidebar**

### The transformative power of pairing spatial analysis with AI

**Geospatial AI delivers three key benefits:**

1. **Automation**
Organizations using geospatial AI can quickly process complex location data, evaluate multiple scenarios, and recommend optimal solutions. Enterprise GIS lays the foundation for AI-powered digital twins that automate analysis and forecasting for mission-critical decisions.

2. **Prediction**
For centuries, maps have told the geographic story of our past and present. Now, maps can predict the future. With geospatial AI, organizations can rapidly identify patterns, correlations, and trends on the horizon. This insight enables them to take smarter, more informed action and work more efficiently.

3. **Optimization**
Fusing the full picture of organizational data in an enterprise GIS leads to better decisions now and in the long-term. AI-powered real-time capabilities enable organizations to maximize efficiency and performance across operations. They move from sensing and then responding to predicting and intervening proactively.

# Key Geospatial AI Use Cases

Geospatial AI is a dynamic opportunity already making a significant impact across the globe. It is helping leaders drive value from vast amounts of data, make smarter decisions faster, and predict future outcomes. The impact of making GIS easier to use and more intelligent? Transformation across numerous industries.

## Infrastructure development

- **Transportation planning**. Officials model and determine the most effective ways to improve roads, bridges, and highways in the context of economic development projections, traffic congestion patterns, and regulatory constraints—now and 20 years in the future.
- **Predictive maintenance**. Adding images from drones and sensors along with real-time traffic data to GIS maps, agencies understand the state of their roads and predict maintenance needs without expensive, time-consuming ground surveys. Stakeholders prioritize work based on usage and risk factors.
- **Construction project planning and management**. Geospatial digital twins enriched with AI enable teams to visualize progress against schedules, reveal issues, and simulate design impacts. Firms optimize collaboration and resource allocation and proactively address potential delays before they impact timelines or budgets.

## Energy

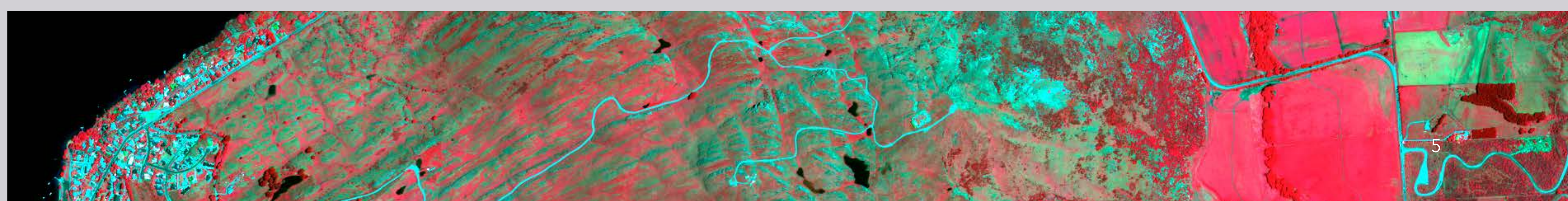
- **Grid modernization**. Planners identify where distributed energy resources, storage, and grid upgrades will have the greatest impact on reliability and resilience. Coordination across multiple organizations and agencies minimizes disruption while maximizing efficiency of repairs and upgrades.
- **Dynamic monitoring**. In emerging energy sources like nuclear, project managers track regulatory changes, economic shifts, and community dynamics. Developers accelerate considerations for co-location of power plants and data centers.
- **Site selection**. Project managers consider subsurface conditions in greater detail to assess dense sources for potential risks and compliance considerations. Renewables projects layer sophisticated solar radiation projections and wind-speed analysis.

## Resilient cities and states

- **Emergency preparation**. Officials pinpoint exactly where mitigation infrastructure can make the most significant difference by simulating the spread of floods and fires. They identify the safest evacuation routes and where to stage response units.
- **Disaster response**. Teams accelerate rapid damage assessments with AI-powered analysis of drone and satellite images. Leadership quickly communicates the extent of the impact and orchestrates relief with real-time smart maps.
- **Urban design**. Planners visualize how green infrastructure proposals would lower extreme temperatures in places with vulnerable populations. Officials optimize service delivery by analyzing demographic shifts, service utilization patterns, and accessibility needs across multiple departments.

## Mission-driven organizations

- **Targeted service delivery**. Environmental organizations track deforestation, wildlife movements, and climate system dynamics using AI-powered pattern detection, even with limited technical staff.
- **Rapid needs assessment**. Humanitarian organizations quickly assess needs and coordinate aid during crises, taking into consideration population displacement, resource distribution, and access to services. ■



## CHAPTER 1:

# AUTOMATION—

## AI-powered digital twins automate analysis and forecasting for mission-critical decisions

Digital twin is a modest name for a technology that, in practice, can feel like something from science fiction. It's a way of merging the physical world—a supply chain, the New York City bus network, an international port—with the digital world. Combined in GIS, hundreds of datasets come to life. They are updated in real time through human input or sensor feeds and pinned to a precise location.

For the organizations that create them, a digital twin streamlines the process of assessing problems, mitigating their impact, and crafting effective solutions. Using geospatial AI techniques, GIS teams can synthesize information to model and test alternative approaches. In a simulation, organizations can then better understand how individual problems cascade through systems.

A Fortune 500 company specializing in enterprise networking equipment for mission-critical applications supports customers at 130,000 locations across the globe. If there is an outage at one of those locations, replacement parts and a skilled technician arrive inside a two-hour window—anywhere in the world. How? The company combines inventory data, customer locations, and routing and logistics information in an AI-powered GIS digital twin.

Previously, these datasets were scattered across various applications and spreadsheets. Now, with all the data in GIS, geospatial AI can analyze the fastest mode of service delivery. Additionally, managers can track the work as it happens on real-time interactive dashboards, and leadership can investigate trends over time.

It's not magic—it's automation. This is geospatial analysis happening at an unprecedented speed, fueled by a wealth of data that was once unimaginable. Rather than requiring large teams for manual analysis, automation quickly processes complex data, evaluates multiple scenarios, and recommends optimal solutions.

Powerful forecasting capabilities are unlocked. Infrastructure improvement projects can prioritize maintenance based on usage and risk factors like land changes and future weather patterns. Governments can optimize services considering shifts in demographics and usage patterns. Retail site selection can account for warehouse locations, inventory patterns, and transportation networks.

Already, digital twins powered by geospatial AI are helping major cities redefine how they design and build mass transit systems. And even bigger things are on the horizon. With dynamic urban digital twins, geospatial AI enables digital twins of cities that not only mirror current conditions but predict cascading effects across multiple systems.

The result is a new kind of immersive foundation for advancing automation, where organizations can simulate and explore scenarios to uncover new possibilities. ■

US Army Corps of Engineers—Case Study

# Predicting Where to Dredge to Save $100 Million per Year

**Situation:** Dredging US waterways is the largest item in the US Army Corps of Engineers (USACE) civil works budget. The need to keep ports and channels at a specific depth for ships and barges requires constant attention. USACE spends around $1.5 billion each year on dredging for hundreds of navigation projects across the country. A typical dredging project goes through several phases, including project planning, bidding, contract award, placement, inspection, and project completion. At each point, there's room for more input to improve awareness of conditions of the country's 12,000 miles of inland and intracoastal waterways, 13,000 miles of deep-draft coastal channels, 400 ports, and more.

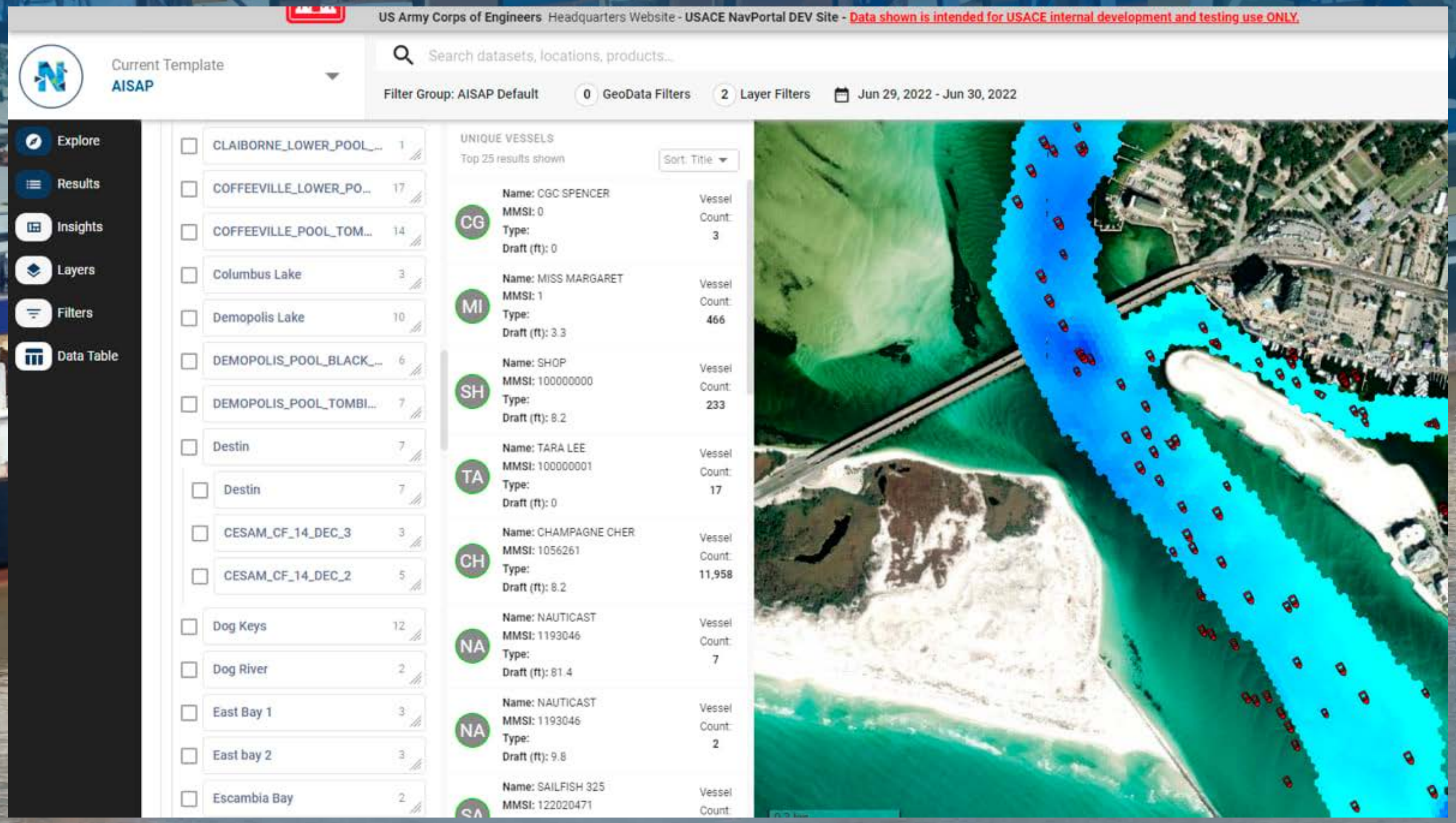
**Challenge:** Surveyors have greatly improved techniques to assess depth and understand dredging requirements, but the complexity and scale of the work sometimes make it difficult to distinguish between needs and practices that have simply become routine. USACE required a way to rigorously and repeatably determine the most efficient and effective way to conduct maintenance dredging. And the solution needed to scale across hundreds of projects nationwide.

**Solution:** The US Army Corps of Engineers combines inputs from three systems that deliver a real-time understanding of the conditions of America's waterways into one Nav Portal view to see vessel traffic and channel constraints, ensuring that commerce keeps moving through ports. This data fusion site is made possible in part by the capacity of geospatial AI to crunch the millions of Automatic Identification System (AIS) vessel tracking pings to show clearly where barges and container ships are slowing down due to building sediment.

**Result:** The new system pinpoints exactly where dredging should happen, eliminating significant reactive costs while fueling proactive workflows. It also addresses project sequencing, with attention paid to coordinating the next project nearby to reduce travel time and costs. With increased ship sizes and growth in shipping, the number and scope of dredging projects will continue to rise. With geospatial AI assistance on where and how to dredge, USACE estimates it can save as much as $100 million per year. ■

"We're able to do more with the same amount of money and reduce the long-standing maintenance backlog. They also give us the ability to adjust and adapt to the unexpected through more efficient use of the industry dredging fleet."

—Dr. Ned Mitchell, Research Civil Engineer, US Army Engineer Research and Development Center



## Microsoft—Case Study

# Impact Observatory, and Esri— Seeing Near Real-Time Changes on Earth

**Situation:** Land-cover and land-use maps have been a necessary tool for scientists and governments since the inception of remote sensing and GIS technology. More recently, the objective has expanded beyond merely collecting inventories. They have started documenting land-cover trends to assess natural capital and economic development, leading to a more informed approach to resource management. However, the lack of global imagery and the computing power to calculate change has hindered a consistent record of change at the worldwide scale.

**Challenge:** The data and processing challenge meant that environmental assessments and land-cover analysis happened at smaller scales, with infrequent updates. Landscape-scale assessments have happened more frequently for forests and watersheds, but a high-resolution view of land-cover change has been elusive and has taken a great deal of time to model, analyze, and produce a record of change.

**Solution:** Open data and a partnership between Esri, Impact Observatory, and Microsoft have yielded a repeatable global snapshot of land-cover change. With help from deep learning, the map makes it possible to closely monitor in near real time where development is happening and how to define it. Geospatial AI underpins the ability to see change and complications clearly. Ten distinct categories of land cover, the physical type of land, show just what's where—such as trees, grass, crops, built areas, wetlands, scrub/shrub, and snow/ice.

**Result:** Each pixel in the land-cover map represents a 10-by-10-meter block, bringing even the slightest detail into view. A repeatable global snapshot of land-cover change helps organizations react even at the far reaches of their operations. Thanks to geospatial AI, the ability to monitor development can be repeated at a scale and frequency that could only be dreamed of before. The capability will assist with land-use planning, hydrologic modeling, and resource management planning for years to come. Government resource agencies can use land cover as a basis to take a balanced approach to development. ■

"Data gathered from spaceborne sensors has long been used to calculate the degradation of natural landscapes, such as the deforestation of the Amazon rainforest; but now, powerful machine learning techniques combined with data gathered from spaceborne sensors are forging a path to more robust and resilient data collection and interpretation for monitoring positive interventions."

—David Merren, Assistant Director,
Analysis & Geospatial, Deloitte Middle East

## CHAPTER 2:

# PREDICTION–

## Rapidly identify patterns, correlations, and trends to reduce uncertainty in planning

Maps are the original data visualization tool. Going back 25 centuries, maps have shown what the seacoast looks like, where fortifications are, and where taxable property is. Today, asking, "What can a map do?" is like asking, "What can a satellite do?" or "What can a computer do?"

Geospatial AI takes mapping even further. Now maps can predict the future. This enables decision-makers to predict and prioritize what needs to happen where.

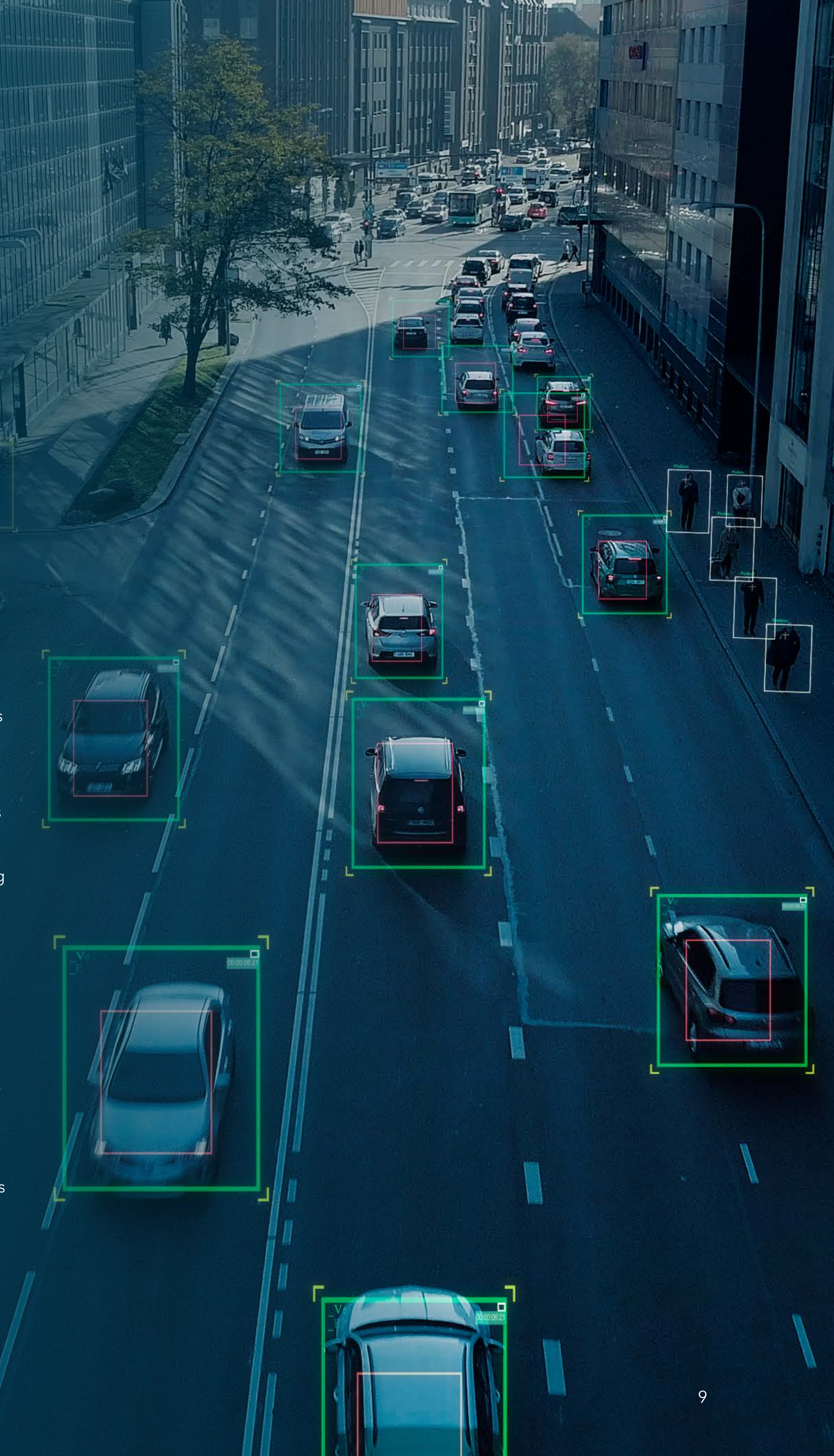
A transportation organization in Europe uses geospatial AI to process indicators of road conditions on critical highways. Using the data and analysis, decision-makers can determine when specific road sections will need repairs. The task of combing through reams of data, which would take analysts hundreds of hours, can now be done swiftly and automatically as part of ongoing workflows.

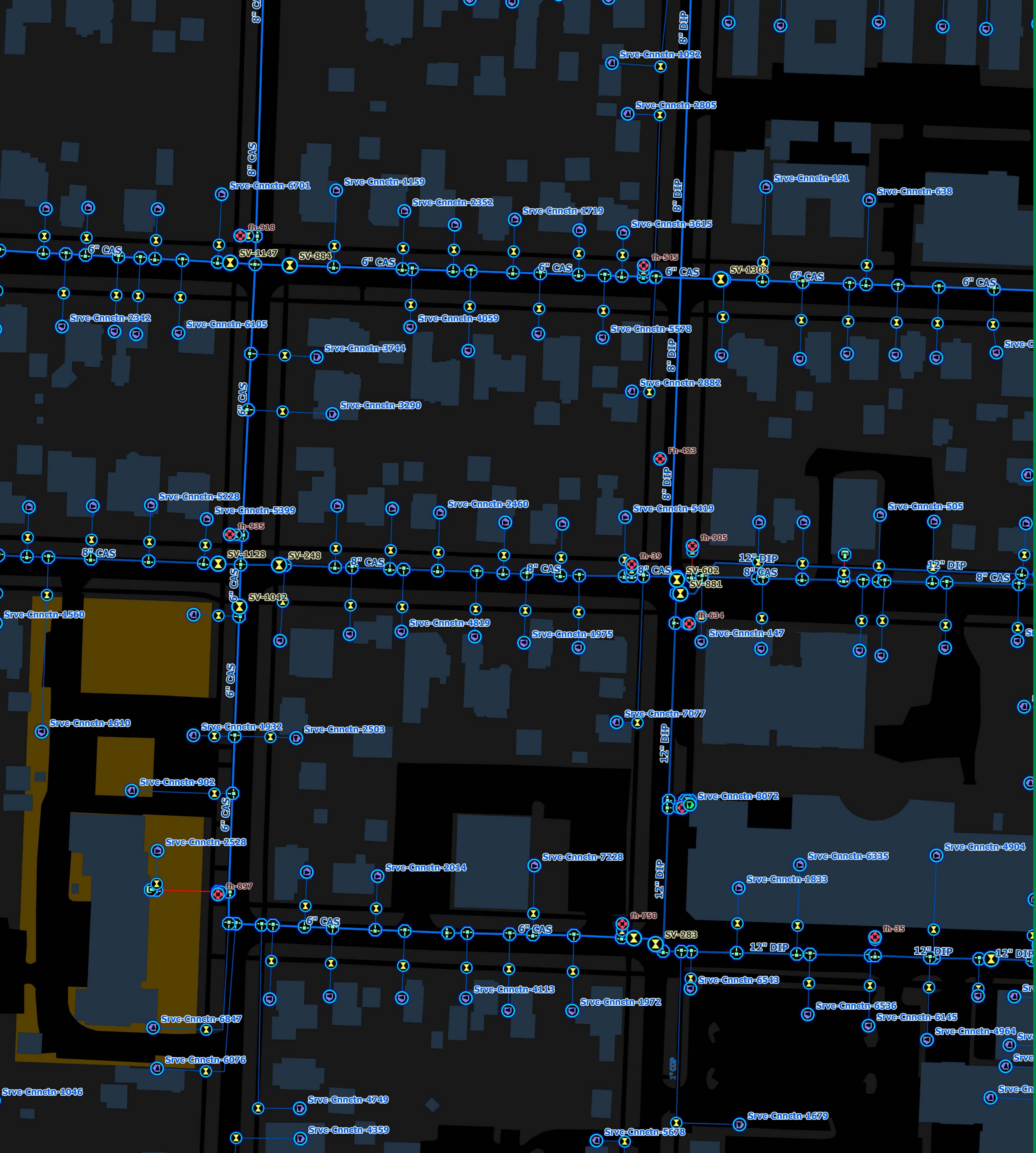
Leaders at a well-known global logistics company wanted to explore ways to wring more efficiency out of their operations. The decision-makers who oversee their flights wondered if there was a way to predict when a plane would need parts or maintenance. Geospatial AI has helped the company achieve this efficiency. The company's VP of airline technology called it "almost the holy grail for a maintenance operation."

A forward-looking US utility company used geospatial AI to conduct a conditions assessment that helped pinpoint the water mains most in need of replacement. Their AI-powered model ranked each water main segment by the likelihood of failure, as well as the consequences of that failure. The system analyzes factors such as pipe data, weather, soil type, seismic activity, and traffic to reveal the assets most at risk. The utility could also identify the assets that had remaining useful life to avoid replacing healthy assets prematurely. With knowledge of the likelihood of failure and the potential for consequences, the utility made the most of its asset maintenance budget.

Collaborating with GIS teams, leaders gain access to near real-time analysis for the many decisions that hinge on where, when, and why. They can build technology solutions that quantify how events in one area impact the supply chain or prioritize maintenance in ways that avoid costly delays and shutdowns. Or show how to reduce exposure to natural disasters before they affect balance sheets. Or forecast customer behavior across different regions to guide decisions on spending and investment.

All of it leads to a deeper, real-time understanding of opportunities and operational risks. ▶





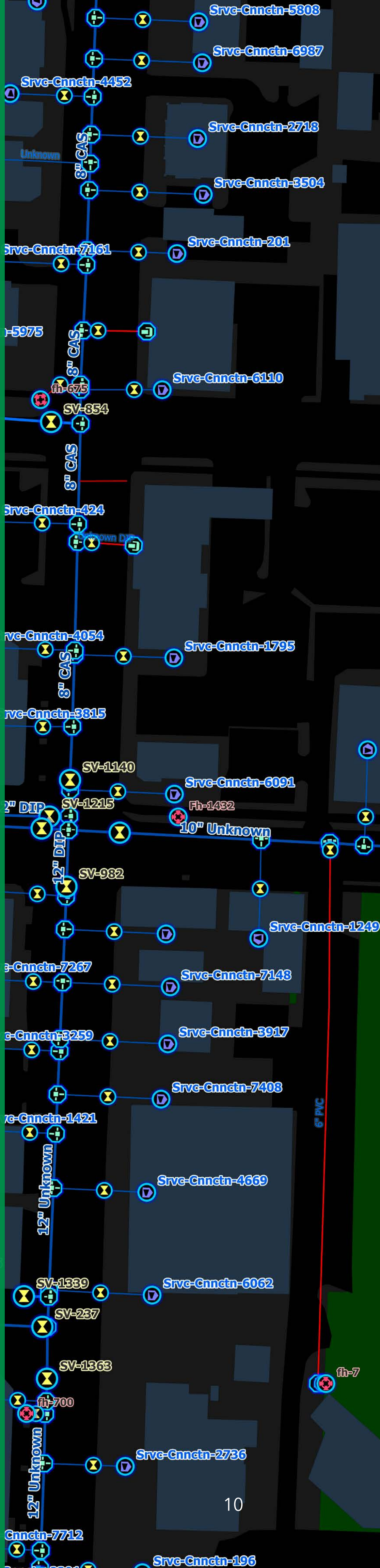
## The Importance of Trustworthy AI for GIS

GIS informs some of the most impactful decisions that shape our world. It is, therefore, imperative that the data involved be accurate and up to date.

Data accuracy is a fundamental GIS concept. AI raises the stakes—especially where decisions from geospatial AI affect people and communities.

The AI capabilities in ArcGIS, a platform relied upon by highly regulated industries, have been implemented with careful intentionality. ArcGIS clearly explains AI predictions and decisions, gives users control to align models with project needs, and includes guardrails to ensure fairness and prevent bias. Organizational data stays private and protected.

ArcGIS is designed with strong governance and organizational control, emphasizing security, privacy, transparency, fairness, reliability, and accountability. ■



**Finnish Forest Centre–Case Study**

# Robots for Better Forest Management

**Situation:** Finland's forests cover three-quarters of the country's landscape, and its trees account for 30 percent of Finnish export income—much of it from pulp and paper production. Monitoring the maintenance of this vast space falls on the Finnish Forest Centre. Recently, the center's forestry experts developed an ambitious plan to use robots to perform the majority of forest maintenance tasks autonomously.

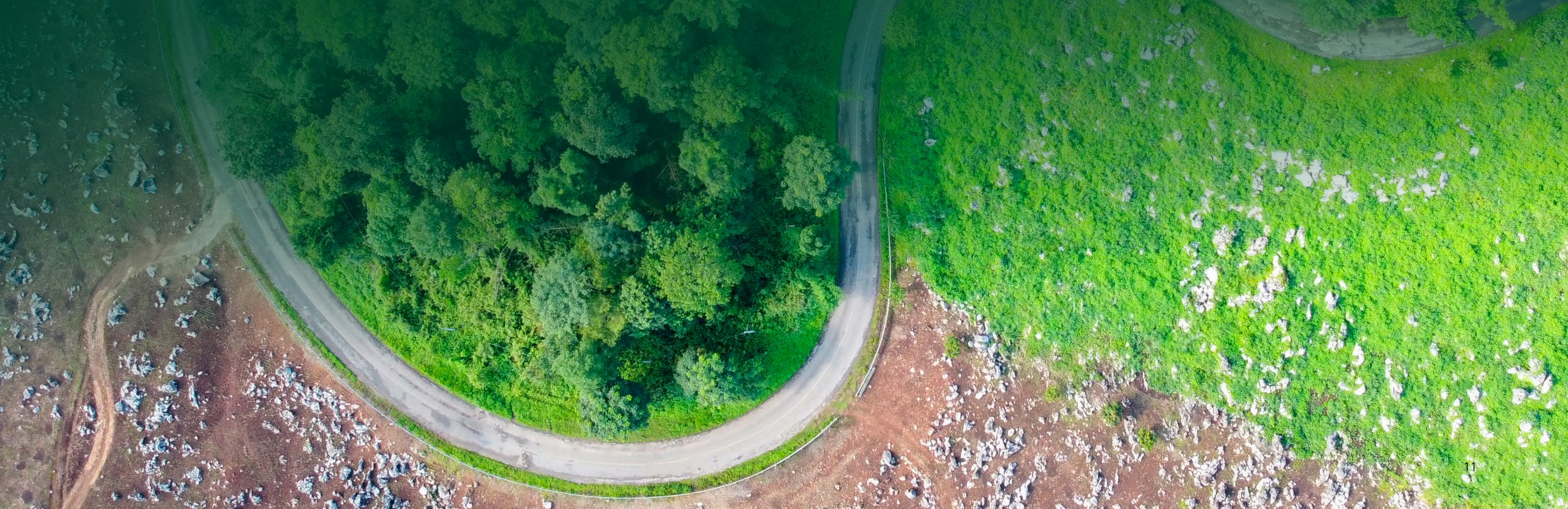
**Challenge:** More than 65 percent of the forests are owned by private owners who live in other cities and rarely visit. Using robots would allow proactive management of forests, a move that would maximize the carbon sequestration of trees. Robots could also fill an employment gap due to a lack of interest in forestry jobs.

**Solution:** The Finnish Forest Centre staff have created a marketplace for forest owners to connect with forest professionals to undertake maintenance work. The site contains forest inventory data based on surveys and a sophisticated AI-driven algorithm that takes imagery and weather and climate data to better predict forest inventory and maintenance needs. The data must be accurate and accessible, with all the data the robots will need.

**Result:** For foresters and landowners, the work of AI will give them knowledge about the volumes and species of wood without driving to the land to do a costly, time-consuming inspection. Automation has greatly streamlined the management of Finnish forests. Geospatial AI fuels the proactive management of forests, focused on optimizing growth and harvest cycles. And robots are filling an employment gap, working in the cold and the dark to maintain and sustain a whole new level of forest benefits. ■

"Going to the forest for 12 hours a day to drive a harvesting machine is lonely work in a dark forest. Some people like that, but there's no queue of people who want to be trained for these jobs. It's a real problem that can't be solved without automation."

—Tapani Hämäläinen, Development Director, Finnish Forest Centre



### Autobahn—Case Study

# Bavaria Gains Insights into Roadways with Predictive Maintenance

**Situation:** Bavaria's centralized location in the European Union makes the German state a crossroads to reach several towns in Germany, a common destination for travelers passing through on their way to other countries, and an important transit route for goods transport across Europe. The state's 23,000 kilometers of roads (motorways, federal roads, and state roads) represent €40 billion in fixed assets. Due to a reform initiated by the federal government, the previous responsibility for motorways (including planning, building, and operating) was transferred from states like Bavaria to the newly founded Autobahn GmbH at the beginning of 2021.

**Challenge:** One of the important routes in Bavaria is the motorway Bundesautobahn 70 (A 70). The heavy car volume and the high percentage of truck transport take a toll on road conditions. The Bavarian State Ministry of Housing, Building, and Transport launched a pilot project to make road maintenance on the A 70 motorway efficient by predicting when and where it will soon be needed.

**Solution:** The ministry used a deep learning program trained to notice and process indicators of road conditions. Working with a team of data scientists, the ministry provided data on road conditions from different measurement campaigns and traffic history. The A 70 motorway was divided into 4,800 segments, each 100 meters long. A GIS program served two functions: It provided a way to visualize the data and perform preprocessing functions. Using the data, a deep learning model was developed that could detect when road sections would need repairs by analyzing features such as thickness and road conditions.

**Result:** The pilot project has proven that these approaches are capable of realistically forecasting changing road conditions. With the application of AI deep learning, several road condition variables can be meaningfully connected, and thus, interdependencies of different parameters can be included in the forecast. With geospatial AI, the task of combing through reams of data, which would've taken analysts hundreds of hours to pore over, could now be done swiftly and automatically as part of ongoing workflows. ■

A visualization of the input dataset containing features for 4,800 road sections (each 100 meters long) describing road conditions and traffic density on the A 70.

## Nob Hill Water Association—Case Study

# Replacing Old Water Mains After AI Analysis

**Situation:** Utilities around the world struggle to deal with water loss due to broken pipes. Deteriorating water infrastructure not only impacts customers but can also erode roads and damage property. Nob Hill Water Association in Yakima, Washington, faced the familiar challenge of aging infrastructure. Frustrated customers were experiencing more service disruptions and higher water bills, while Nob Hill was dealing with higher repair costs and increased water loss from broken pipes.

**Challenge:** Preventing loss by proactively replacing water pipes is not an easy task. The utility needed a system to select the right pipes to replace at the right time that would factor in such considerations as the age of the pipe, its failure history, and the material it is made of. The utility needed a system to inform it of the required work while maintaining service to its customers. It needed a way to avoid water loss and stay on budget.

**Solution:** Nob Hill Water used a geospatial AI deep learning model from Esri startup partner VODA.ai to conduct a conditions assessment that helped to pinpoint the water mains most in need of replacement. The machine learning model ranks each water main segment by the likelihood of failure, as well as the consequences of that failure. The system analyzes factors such as pipe data, weather, soil type, seismic activity, and traffic—all of which reveal the water mains most likely to fail next. The model also establishes the pipes that have remaining useful life, which helps the utility avoid replacing healthy pipes prematurely.

**Result:** With knowledge of the likelihood of failure and the potential for property consequences, Nob Hill Water makes the most of its maintenance budget. The utility's engineers credit geospatial AI with efficiency gains and making smarter decisions. The map view of priorities also makes it easier to find and test nearby valves and other assets to validate what valves serve each customer—creating a better map for all future work. ■

"Every utility has more miles of main line that should be replaced than there is money in the budget. We are using this program to direct our valve exercising program to the mains that are predicted to fail so that if they do fail, the damage can be kept to a minimum."

—Zella West, Manager, Nob Hill Water

**Sidebar**

### Rethinking Utility Vegetation Management with Geospatial AI

Power lines require regular vegetation management to eliminate encroachments that can lead to power outages and, in the worst cases, wildfires. Using a geospatial AI deep learning approach, vegetation encroachment analysis can be conducted at scale. The workflows not only help identify encroachment sites but also help prioritize them based on whether vegetation growth is above, below, or intertwined with distribution wires.

Inspecting and identifying places that need work take a great deal of time, money, and resources—costs that are compounded when tackling tree trimming work. Geospatial AI workflows automate the analysis of satellite and drone imagery and lidar data—classifying the condition of distribution wires and poles in relation to trees.

Geospatial AI workflows reduce costs and optimize the process of vegetation management for utility companies—ensuring a more thorough assessment. Automation ensures these processes can be repeated regularly with pinpoint precision.

***"This era of mapping is a whole new world: a world of spatial problem-solving. We can put our problems on maps. And then we can use maps to solve them."***
—Jack Dangermond, Cofounder and President, Esri

**CHAPTER 3:**

# OPTIMIZATION–

## Maximize efficiency and performance at granular and massive scales

Data analysis has a way of sparking new ideas and uncovering a more effective way to work. Today, the big challenge for decision-makers is to squeeze impactful insights from the sheer volume, velocity, and variety of data streaming into the enterprise. This is where geospatial AI shines. It helps unravel problems that involve massive datasets to reveal patterns beyond human detection.

Layered on a map or dashboard, the patterns clue organizations in to how they can improve outcomes. They spark a new way to think about how to allocate resources, anticipate risks, or identify opportunities. And decision-makers move from sensing and then responding to predicting and intervening proactively.

A city, for instance, uses geospatial AI to analyze energy usage patterns in buildings and identify opportunities to reduce energy consumption. Another city department might use it to analyze population shifts, utilization patterns, and accessibility needs to optimize service delivery.

A crop grower can analyze vast streams of images from satellites, aircraft, and drones at unprecedented speed and scale. AI sifts through the pixels to detect minute changes in vegetation conditions invisible to human perception. Data layered on a map gives insight into timing the harvest and refining processes—now, and in the coming weeks and months.

A company determining where to locate retail stores or other physical assets can search and cross-reference data related to customer demographics and geography. They can visualize transportation patterns and determine how far a potential customer is likely to travel. Their supply chain decisions can account for efficiency goals, warehouse locations, inventory patterns, and disruption risks.

Fusing data from across the enterprise for AI-powered spatial analysis leads to better decisions now and in the long term. Infrastructure projects can minimize disruption by carefully considering transit data in the planning and design phases. Construction managers can monitor real-time maps and dashboards to make swift adjustments. Maintenance can be forecasted, planned, and tracked to completion.

The whole mentality of operations is changing. Smart maps enriched with geospatial AI can quickly communicate where action is needed. Entire industries can adapt swiftly to changing conditions and market dynamics.

**Clearwater Seafoods—Case Study**

# Executing a Data-Driven Marine Harvest Strategy

**Situation:** The Nova Scotia-based brand Clearwater Seafoods specializes in luxury seafood, including scallops, clams, crab, shrimp, and lobster, which it gathers mostly from the seafloor in coastal Canada. Some of Clearwater's catch, such as clams, live on the seafloor, creating homes in the silt and mud known as the substrate. Catching these seafloor dwellers is labor-intensive and expensive. But a company like Clearwater also needs to know when and where to harvest—and where not to harvest—to protect the long-term viability of these habitats.

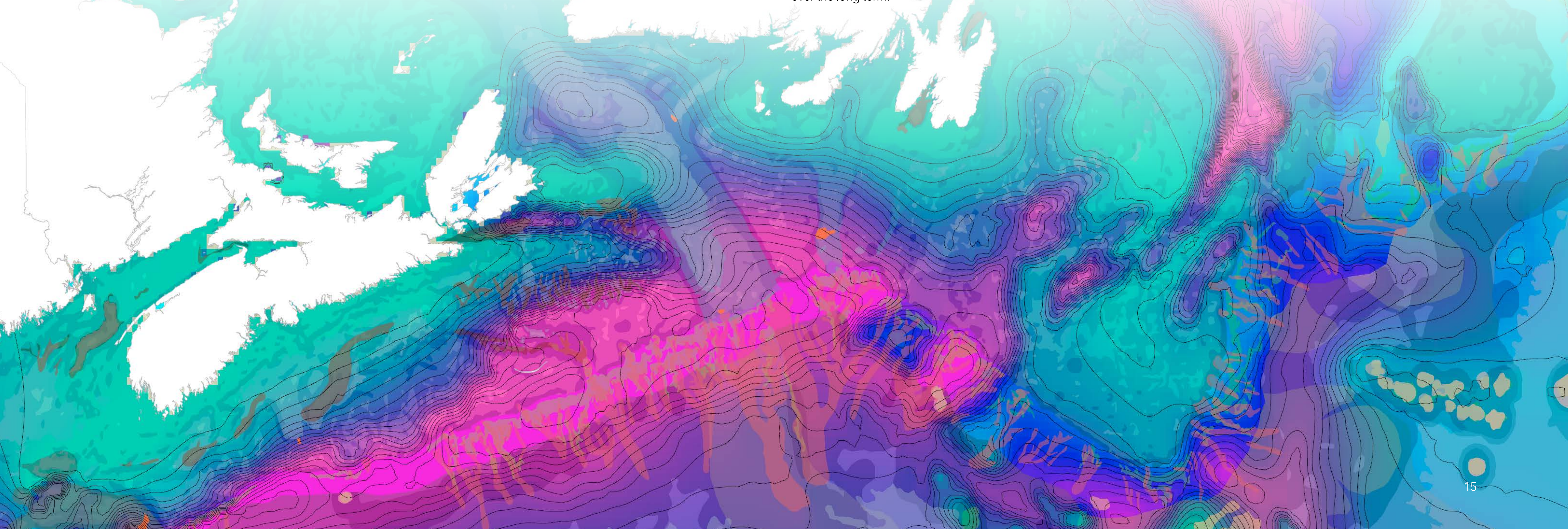
**Challenge:** Clearwater needed a precision approach to fishery management. In Canada, companies are granted rights to a specific fishery to hunt specific species. Harvest planning that considers the broader ecosystem can prevent the collapse of fish stocks and other marine life, which could otherwise lead to a decline in the fishery's productivity.

**Solution:** Clearwater uses sophisticated assessment models to determine stages of growth and log fishing activities to avoid returning to the same fishing grounds until the appropriate time has passed. This allows Clearwater to execute its harvest strategy, and meet traceability requirements for food safety, and to convey the origin of each catch. In this way, GIS, coupled with advanced analytics, becomes a four-dimensional tool, cataloging the space and time for the present catch and all past catches.

**Result:** This new awareness allows Clearwater to factor in weather influences, species biology, and other relevant details to determine the most effective methods of harvesting. With increasing amounts of high-quality data, Clearwater has moved from fishing to harvesting. Rather than going out into the ocean with the thought of catching a certain quota, the company now has data that every ship captain uses to plan their harvest. Each foray captures more fish and more data that AI and location intelligence workflows use to forecast and predict profitable harvests over the long term. ■

"We're really moving the operation to being one of culturing and nurturing. To be able to look at the seafloor and understand population characteristics—these are the tools we need to support our objectives."

—Jim Mosher, Director of Havest Science, Clearwater Seafoods



**The Mozambique National Institute for Disaster Management and Risk Reduction—Case Study**

# Aiding Flood Victims Before and During Disasters with Drone Imagery

**Situation:** In 2019, two cyclones destroyed more than 800,000 hectares of farmland in Mozambique during the harvest season, leaving two million people facing acute food insecurity. The United Nations World Food Programme (WFP) responded quickly, using two helicopters to ferry supplies and rescue stranded people.

**Challenge:** The flooded roads made the air support crucial, but it was not nearly enough to both distribute food and find stranded people. The dimensions of the flooded areas were in constant flux, further complicating efforts by pilots to understand where help was most needed. And the people could only tread water or cling to trees for so long.

**Solution:** Drones were put to the task of searching for survivors, freeing up helicopter pilots to conduct rescue and supply missions. And now, that workflow involves advanced geospatial AI algorithms to search through drone imagery to identify flood victims. The human eye has trouble with this task, and there's not enough time to both collect and review each image. Geospatial AI can quickly identify people surrounded by flood waters and quantify damage to buildings and infrastructure to help responders know what resources are needed and where.

**Result:** Coupling drones with geospatial AI workflows has greatly improved disaster assessments and reduced the time it takes to instruct the population to leave flood zones for safe zones. That used to take 72 hours, and now, the alerts happen well in advance of floodwaters. That leap has come in part from using drone imagery to construct intricate hazard maps for watersheds, using geospatial AI to process imagery with a focus on preparedness. WFP is now applying these techniques from Mozambique in geographic focus areas worldwide. ■

"We combine science, technology, and local knowledge to prepare the communities and local governments in a participatory manner. Every year we are seeing more frequent flooding, and that has motivated us to innovate."

—Antonio Jose Beleza, Deputy Director,
Mozambique National Emergency Operations Center

**Organic Valley—Case Study**

# Improving Pasture Vigor with Insights Derived from Daily Satellite Imagery


**Situation:** Organic Valley, a national organic brand and family farm cooperative, prioritizes smart grazing practices, determining optimal methods for rotating cows across pastures. For the more than 40 percent of Amish or Mennonite farmers in the cooperative, a high-tech solution would need to be hands-off because they don't use computers.

**Challenge:** As many as 200 different types of plants can grow on an Organic Valley farm. A careful rotation results in the maintenance of a critical balance of grasses and legumes. Farmers were accustomed to painstaking measures for determining grazing rotation. To determine the amount of biomass on a pasture, a farmer would walk through the paddocks with a plate meter to measure the height of grass, recording figures in a notebook.

**Solution:** Organic Valley now uses custom mapping products to create pasture condition reports. Geospatial AI algorithms are applied to daily satellite imagery passes to produce insights regarding which paddocks should be grazed, cut, or left to grow by measuring such variables as the amount of chlorophyll in an area. AI-powered GIS automates the process, generating reports sent to farmers. A critical component of these reports is the "grazing wedge" that shows the estimated biomass availability for each paddock.

**Result:** The system produces better analysis with less effort on the part of individual farmers. There are also important ancillary benefits. The geospatial AI capability behind the imagery analysis is sophisticated, but the reports themselves are simple. The data generated by the program, combined with GIS-based routing systems, helps determine what farms to visit to fill each truck. The same data workflow also measures carbon sequestration, an important potential revenue stream due to growing interest in carbon farming. ■

## CHAPTER 4:

# Maximizing the value of enterprise data with AI in ArcGIS

The examples in this book illustrate how geospatial AI helps organizations advance their missions. Utilities and logistics companies can orchestrate maintenance to work ahead of disruptions. Government agencies can better understand how to allocate resources by monitoring population and land use changes. Critical infrastructure and energy providers can modernize their assets and networks for resilience.

These outcomes are shaped by better, more informed executive decisions. A more collaborative cross-team environment aids in the execution. Both are tangible impacts of integrating data from across the organization for AI-powered geospatial analysis.

It all starts by joining enterprise data in GIS. ArcGIS is purpose-built to integrate smoothly into the tech stack. By connecting the capabilities of ERP, CRM, EAM, and BI systems, ArcGIS empowers organizations to unify, visualize, and analyze their data through the lens of geography. This holistic approach not only enhances decision-making but also drives innovative solutions to complex challenges.

This alone makes ArcGIS an incredibly powerful tool. Geospatial AI—a multidimensional toolset embedded throughout the ArcGIS user experience—unlocks even more possibilities.

Organizations are equipped to extract deeper insights from their existing data by adding location context to traditional analytics. It means geospatial AI can find useful patterns in data to automate, predict, and improve processes in every part of an organization. This maximizes the value generated from current data investments without requiring extensive new data collection.

Machine learning capabilities were first introduced in ArcGIS as early as 2009, with software developers leading the charge. Today, geospatial AI is a robust toolset, designed to empower organizations to rapidly unlock value through AI-powered spatial analysis.

ArcGIS users are never starting from scratch implementing geospatial AI. ArcGIS comes equipped with more than 75 pretrained AI models, battle-tested for common workflows like object identification in imagery and extracting insights from text and maps. These are designed to address common business needs. Models can be customized for specific use cases via the built-in geospatial analysis tool, Deep Learning Studio, ensuring they meet evolving user needs.

The latest advancements in generative AI assistants are making ArcGIS more accessible than ever, empowering users across the enterprise, even those without formal GIS training. These are ushering in an era where a powerful spatial analytics platform is democratized by natural language capabilities.

ArcGIS is used by most of the world's largest public and private organizations: 70 percent of the largest global companies, 95 percent of the largest national governments, and 80 percent of the largest cities. ArcGIS is the flagship technology from Esri, the recognized leader in GIS and location intelligence with a 55-year record of success and high performance. ■

# Conclusion

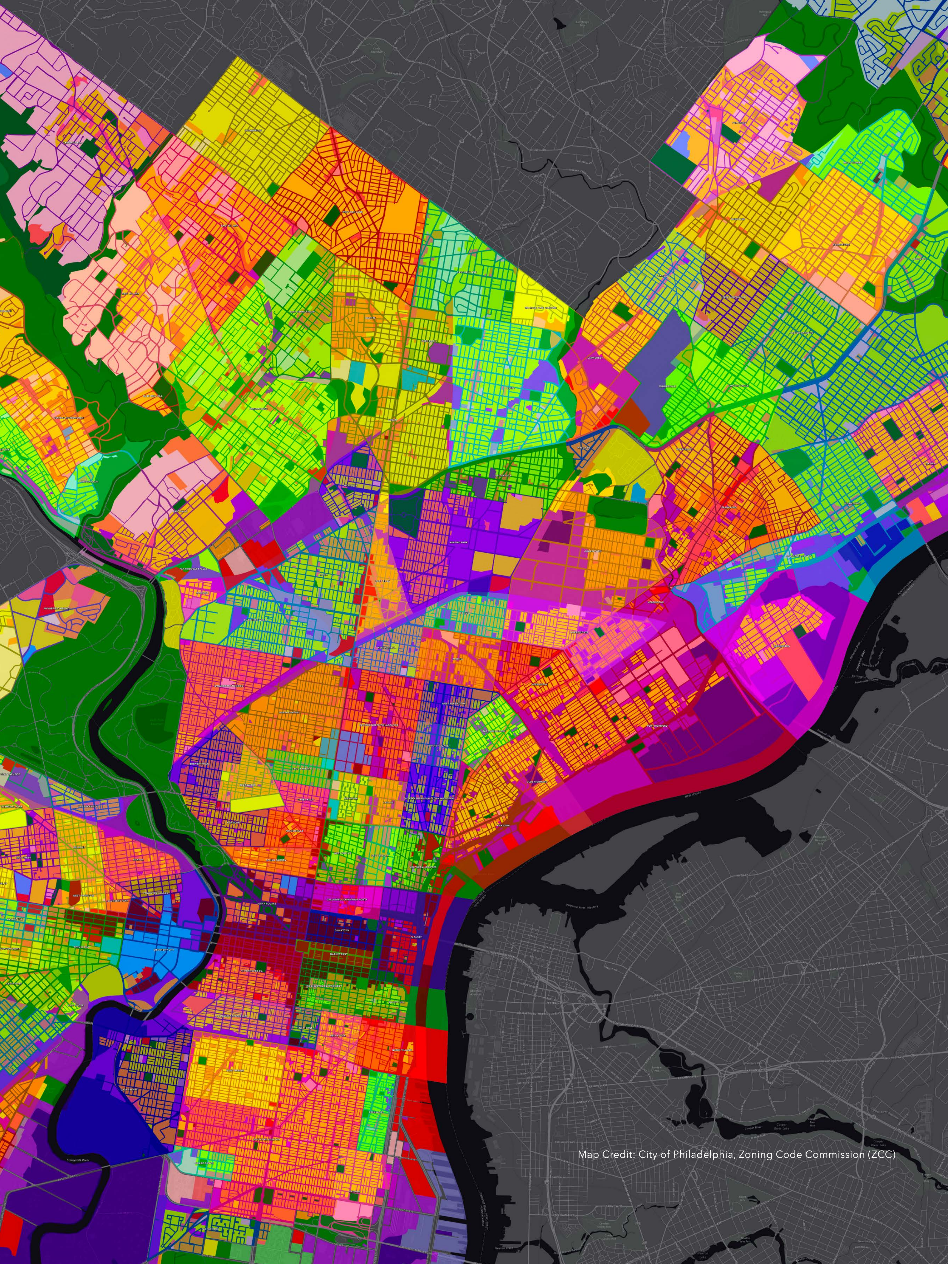
AI is becoming so advanced, so sophisticated, that it can be made easier to use as a routine analytical tool. That changes not just the power of computing and geographic information systems. It changes the power of organizations and their people.

AI amplifies the power of what GIS brings to bear. Viewed through a lens of location, complex challenges inspire new ways of thinking among those dedicated to solving them. Geography provides a framework for organizing information in a way that anyone can grasp. Patterns on a map tell a story. The story guides the viewer. Now, not only can they see those stories in real time or look back in time—they can also anticipate what lies ahead.

It follows that leaders in business and government should use a geographic approach—the power of where—as a mechanism for making sound, smart decisions. Data becomes truly transformative when the entire landscape is considered. This is the power of GIS in the enterprise, the vital conduit for integrating and harnessing the full picture of organizational data.

In an era of streaming satellite images and uninterrupted sensor feeds, geospatial AI meets the moment with enhanced power and capability. Analysis is now automated at an unprecedented speed and scale. We can synthesize data in new ways to predict future conditions and simulate outcomes without having to live through the consequences.

These advancements in analytical output mark significant strides forward. But it is always human intelligence that interprets the analysis and meets it with creativity. Geospatial AI, by streamlining the repetitive tasks in GIS analysis, promises more time for higher-level thinking. The kind of thinking that leads to better decisions and meaningful real-world optimization. The kind that is uniquely human. ■



Map Credit: City of Philadelphia, Zoning Code Commission (ZCC)

# About Esri

Esri, the global market leader in geographic information system (GIS) software, location intelligence, and mapping, helps customers unlock the full potential of data to improve operational and business results. Founded in 1969 in Redlands, California, USA, Esri® software is deployed in hundreds of thousands of organizations globally, including Fortune 500 companies, government agencies, nonprofit institutions, and universities. Esri has regional offices, international distributors, and partners providing local support in over 100 countries on six continents. With its pioneering commitment to geospatial technology and analytics, Esri engineers the most innovative solutions that leverage a geographic approach to solving some of the world's most complex problems by placing them in the crucial context of location.

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