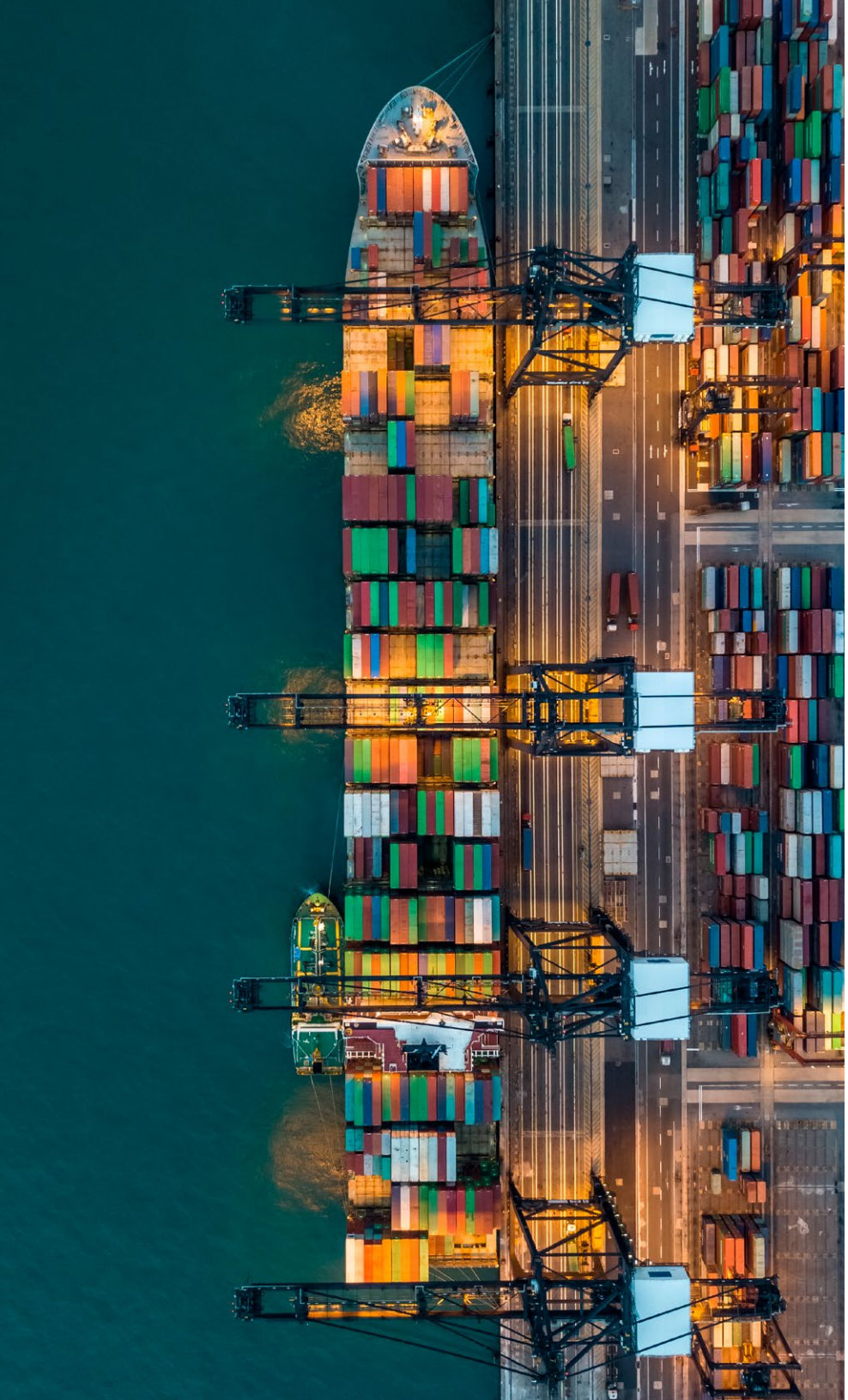
GEOSPATIAL TECHNOLOGY: THE KEY TO SUCCESSFUL DRONE OPERATIONS

A Geographic Approach to Drone Data Collection, Management, and Analysis



WHAT'S INSIDE

EXECUTIVE SUMMARY

Executives and operations managers are eager to capitalize on drone operations. They see great potential, especially in making site planning and operations more efficient, speeding up inspection and monitoring, and reducing risks to safety and security.

So, what's standing in the way of successful drone operations? For many organizations, it's the challenge of managing massive volumes of drone data. Greater precision in drone data is essential, as is integration with existing business systems. Point solutions and legacy systems often fall short. Analysis tools must be sophisticated enough to deliver the insights organizations truly need.

Yet the demand for drone-enhanced workflows is growing—especially across AEC (architecture, engineering, and construction), infrastructure, natural resources, transportation, and state and local government. Leaders are calling for a more integrated approach, one that ties imagery collections more tightly to business intelligence needs and enables scalability in data capture, analysis, and precision.

Esri meets this demand with ArcGIS® software. It's a comprehensive geographic information system (GIS) technology platform that empowers organizations to better manage and scale their drone operations. *Comprehensive* means end-to-end capabilities for flight planning, data capture, imagery processing, management, analysis, visualization and mapping, and sharing.

Organizations that use ArcGIS for their drone operations also gain a distinct advantage: the power of location. Nearly all data has a location component, and nearly all business decisions involve critical questions of where. As the world-leading GIS technology, ArcGIS integrates all drone-collected imagery and data with other proprietary and authoritative data across an enterprise, connecting everything through the crucial context of location. Location intelligence gathered from this geographic approach to data collection and analysis has emerged as one of the smartest, most sophisticated ways to gain valuable insights. GIS maps, rich with data and imagery, tell dynamic stories that support thorough analysis and clear decision-making.

Drones help organizations see what's going on. GIS adds context. By pairing these technologies, organizations can:

- Perform reality capture of locations and sites
- Gain near real-time awareness of what's happening where
- Apply historical analysis and predictive modeling
- Layer high-quality imagery on GIS maps for a realistic, holistic picture
- Analyze landscapes, natural systems, built environments, and human activities
- Leverage artificial intelligence (AI)-enabled machine learning for fast, automated pattern recognition and object identification
- Streamline and expand drone operations to make the most of the investment

Many AEC, infrastructure, natural resources, and state and local government organizations have relied on ArcGIS for decades. The geographic approach to data collection, management, and analysis has improved efficiency and safety, and kept teams updated in real time. Bringing drone operations into this fold is a natural next step.

Organizations can look to ArcGIS for the scalability, precision, integration, and analytics capabilities they need to manage drone operations—and to achieve a competitive advantage.

CHAPTER 1
BUILT-IN DATA MANAGEMENT

Imagine a frictionless drone workflow. The piles of imagery and other data get collected, then organized in near real time. From there, it can be searched and shared via any related workflows or with anyone in the organization who needs it.

This is possible when you manage drone data within a geospatial platform like ArcGIS. Imagery can be ready for enterprise-wide spatial analysis quickly because it's immediately accessible to any GIS application—from an on-site worker's incident map to an executive's progress report.

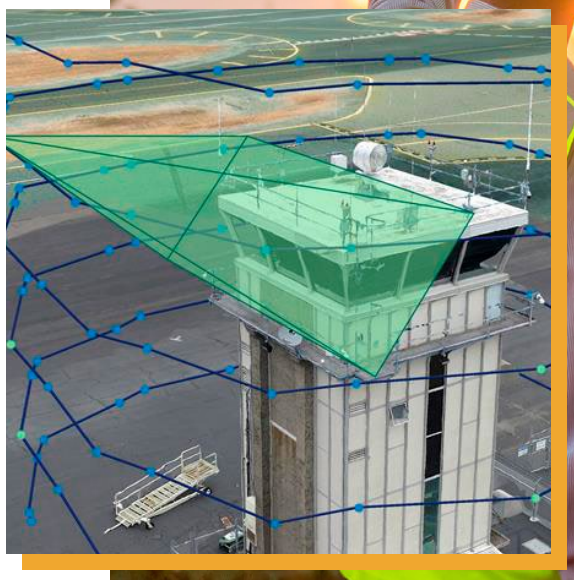
Construction companies, for instance, that perform continuous drone surveys during ongoing projects amass large amounts of data. They can efficiently process and catalog that data for use in analysis, 3D modeling, and future referencing. Their teams can set up automatic drone flights to gather consistent data. In areas without connectivity, they can easily process big datasets offline. All the imagery can then be analyzed and displayed.

Of course, the imagery is all shared securely—even with external stakeholders and the public—based on an organization's requirements and regulations.

Organizations can use ArcGIS to enhance data management efficiency through centralized search and discovery capabilities. As a unified drone data system, it eliminates the friction of working with siloed, unstructured data. And it allows organizations to scale their drone programs while prioritizing privacy, security, and data ownership.

Key business benefits:

- **Extend the value of your drone data.** Enable drone data as an organizational asset that can be used beyond its original purpose.
- **Efficiently manage all your imagery.** Automated tools quickly process and analyze large volumes of imagery, delivering rapid insights while conserving resources.
- **Enhance your drone data usage.** Create a single, easy-to-search catalog to store, organize, and share drone imagery across your organization and projects.
- **Make your drone data accessible at scale.** Use best-in-class imagery management tools to easily access and securely share large amounts of data within your organization and with outside parties, tailored to your specific requirements.
- **Ensure your operations are secure and compliant as they grow.** Use Esri's drone solutions, either on-site or in the cloud, to meet industry regulations and organizational policies.



CASE STUDY

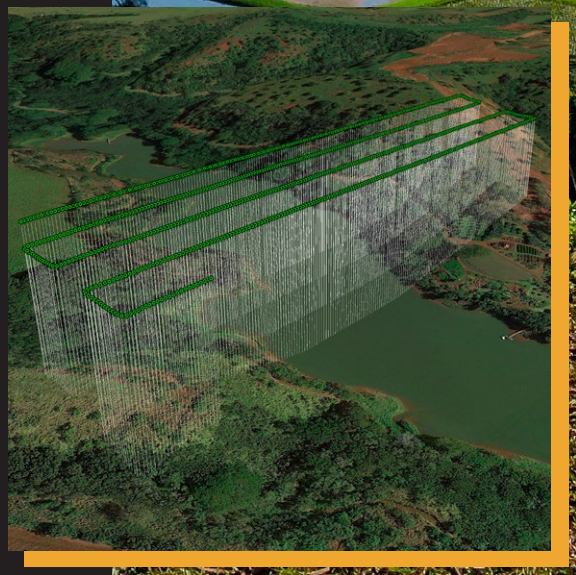
Dudek

Speeding Land Surveys with Drones and GIS

Dudek, an environmental and engineering consulting firm, uses GIS to complete projects for clients in a variety of industries like water utilities, retail, conservation, education, health care, and energy. Renewable-energy projects, in particular, have been well-suited to the firm's newest approach of combining GIS and drones. To determine if a site is viable for development, Dudek conducts site planning, engineering, and evaluation. Staff at Dudek recognized the need to streamline their operations to eliminate unnecessary steps and costs, to get data to their customers faster.

Challenge

Dudek had been using multiple systems to plan flights and collect imagery data in the field. The data collected by the drones was stored on laptops and transferred to cloud storage before being moved to servers. Then, imagery processing was handled by a separate program for photogrammetry. This disjointed process was inefficient and expensive.



DUDEK CASE STUDY (continued)

Solution

Dudek staff saw Site Scan for ArcGIS—end-to-end, cloud-based drone mapping software—as an opportunity to fix their fragmented workflow and get data to their customers faster.

Now, with Site Scan fully integrated into their workflow, staff use it for flight planning, data collection, and processing. Additionally, Dudek's GIS team utilizes Site Scan for mapping and integrating GIS and CAD data to share with other staff and customers in the custom-built Dudek Land Surveying Portal. The portal supports faster, more informed decision-making, as well as real-time mapping of a project's status.

Results

Dudek saved over $80,000 in one year by transitioning from disconnected systems to Site Scan. Flying a small site in the morning means the data will be available to clients later that afternoon.

Once Dudek's surveyors gather all the data they need with Site Scan, they can create a digital twin and share it in a single view on ArcGIS GeoBIM℠. Combining the spatial analysis capabilities of GIS with detailed 3D design and construction data, these digital twins are dynamic virtual representations of reality that provide contextual understanding of built environments. Now with geospatial artificial intelligence (GeoAI) and digital twins, the drone data and GIS workflows are easily integrated within the utility network schema.

CASE STUDY

OCMI, Inc.

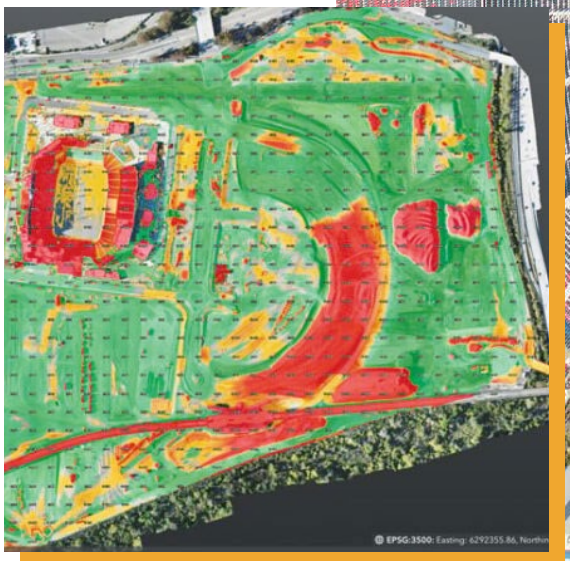
Building a Sustainable Snapdragon Stadium

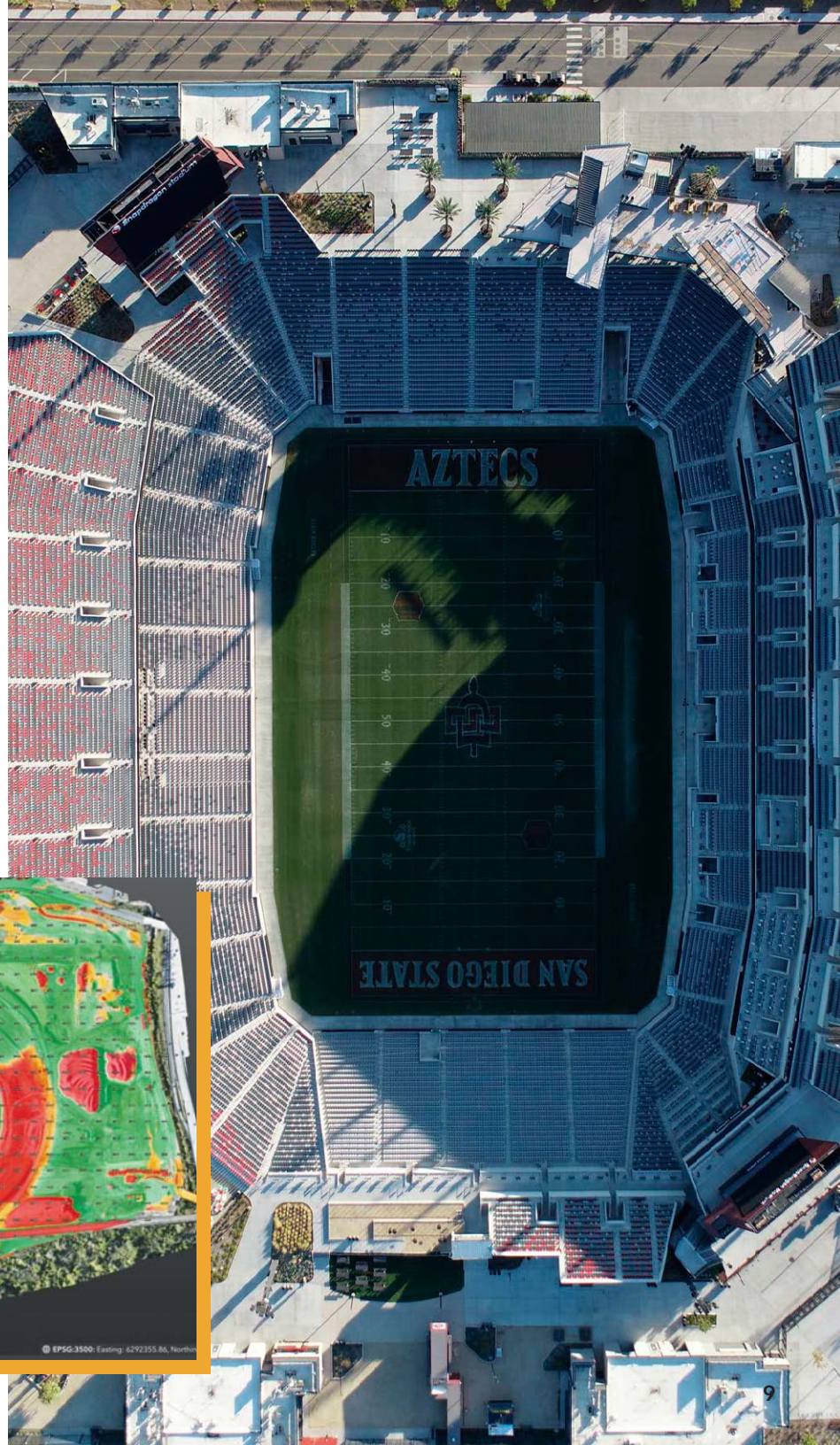
For decades, San Diego's pro sports teams played inside a stadium of concrete sitting in a sea of 18,870 paved parking spaces in Southern California. When it came time to demolish the stadium and build the new Snapdragon Stadium on the 166-acre site, that same concrete became the foundation for a new home for San Diego State University's football team.

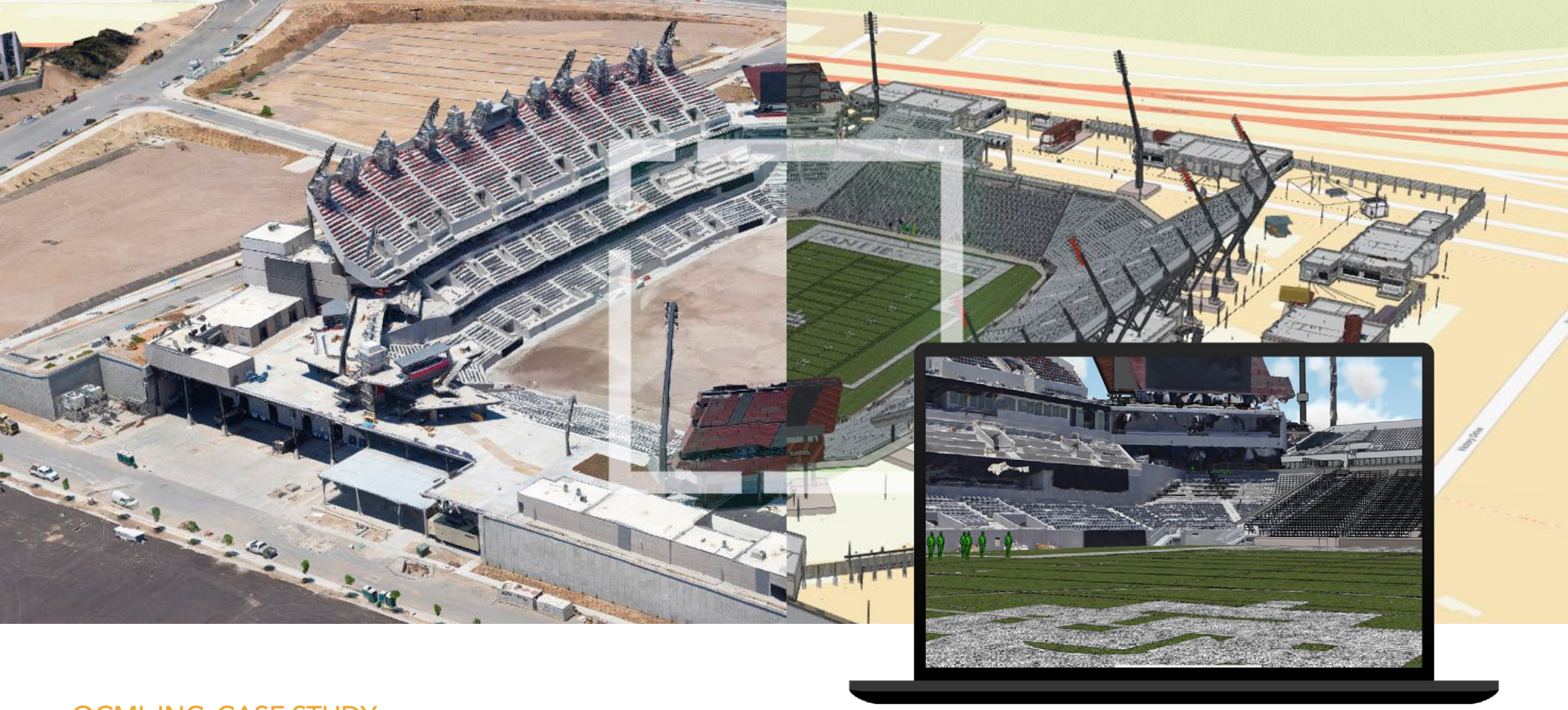
Reusing materials for the new site would ultimately involve recycling all the concrete from the former stadium, requiring one million cubic yards of materials to be moved.

Challenge

OCMI, Inc., a project and construction management consultant, needed to better understand how materials were being moved and when, and to validate the quantities. OCMI also needed a way to monitor the progress of ongoing construction. The company knew it would use drones to do both, but staff needed a solution with the right tools and the ability to scale up—and one that wouldn't require the purchase of proprietary hardware or specific drone vehicles.







OCMI, INC. CASE STUDY (continued)

Solution

OCMI chose Site Scan for ArcGIS, cloud-based drone mapping software designed for imagery data collection, processing, and analysis.

Part of the ArcGIS geospatial platform, Site Scan provides the right tools, scalability, and flexibility for use with any drone.

Collecting several hundred images per flight mission, OCMI could share a weekly distribution report. This allowed stakeholders to see the site plan along with a link to a 2D orthomosaic and a 3D mesh model that let users remotely walk around the site.

Results

Site Scan gives OCMI up-to-date images for increased visibility, even remotely.

When the original stadium was being demolished, construction personnel created large stockpiles of materials. They started to reprocess the concrete at an on-site batch plant, using GIS tools and drone images to estimate the size and quantity of materials on-site at a given time.

Construction teams could run accurate volume calculations with the drone-captured imagery. When a grading subcontractor requested a change order, claiming there wasn't enough material to build the base of the stadium, the information from Site Scan proved otherwise.

CASE STUDY

Short Elliott Hendrickson Inc.

Relocating an Airport Runway

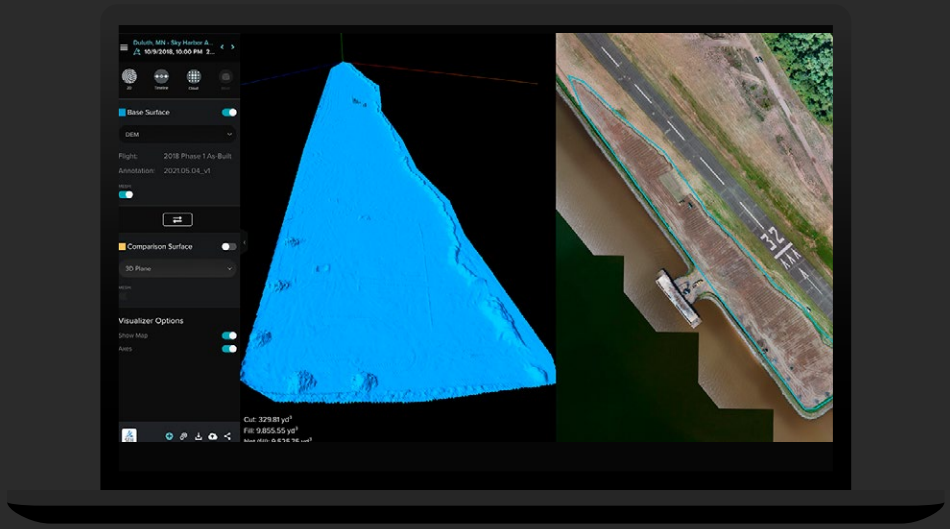
Situated at the end of a freshwater sand spit, Sky Harbor Airport in Duluth, Minnesota, needed to relocate its runway. The task would involve filling in seven acres of open water and ensuring protection of the surrounding environment.

Consulting firm Short Elliott Hendrickson Inc. (SEH) led the construction project and worked with the Federal Aviation Administration (FAA) and the Minnesota Department of Natural Resources. The company needed a solution that would allow staff to track the quantities and volume of incoming fill shipments, as well as inspect a floating silt curtain that prevents contaminants from entering the clean water of the bay.

Challenge

Because raw materials were loaded directly onto floating barges, it was difficult to weigh the entire barge to determine how much contractors should be paid for the deliveries. In addition, the project's leaders had to position the silt curtain in the water and assure the US Army Corps of Engineers and the Minnesota Pollution Control Agency that it was preventing contaminants from spreading into the open water.

SEH knew that an aerial view from drones would help in both situations, but the company was working with a single tower computer for site monitoring and processing data locally. It didn't have the resources to maintain the additional IT infrastructure needed to manage and process drone data.



SHORT ELLIOTT HENDRICKSON INC. CASE STUDY (continued)

Solution

SEH turned to Site Scan for ArcGIS because of its end-to-end, GIS-based workflow for acquiring and processing drone imagery in the cloud.

Airport construction was to be conducted in three phases. The solution would allow a consistent flight plan throughout each phase, ensuring accuracy in tracking costs and the quantity of materials. GIS tools such as maps, dashboards, and 3D models would facilitate collaboration among all stakeholders.

Results

Site Scan supported the Sky Harbor runway relocation project in several respects, including using drone-captured imagery for silt curtain inspection to view contaminants in the water and to make volumetric calculations of materials.

Teams could more quickly and accurately take measurements of things like land, buildings, and pavement. During construction, the drone imagery also helped keep stakeholders better informed. At weekly construction meetings, stakeholders would discuss the progress of the project and any challenges, and the SEH team could show updated 2D aerial shots to the group. Those same images could be sent as the project progressed to government agencies to view developments on the site.

CHAPTER 2
ACCURATE DATA AND PRECISE ANALYTICS

There's little room for error when it comes to building and maintaining the places where we live, work, and play, or managing the resources we depend on. Errors in drone-collected data can lead to problems in site planning, inspection and monitoring, and security and safety.

That's why organizations prioritize precision and accuracy in their drone operations. And it's why Esri designs its drone solutions to enhance the accuracy and precision of drone data, with capabilities for standardizing flights, automating analyses, and scaling data management. This foundational data becomes the basis for deeper analysis and visualization, so accuracy is paramount.

Architects, engineers, and builders, for example, need precise data and accurate measurements for effective site planning, cost estimation, and competitive proposals.

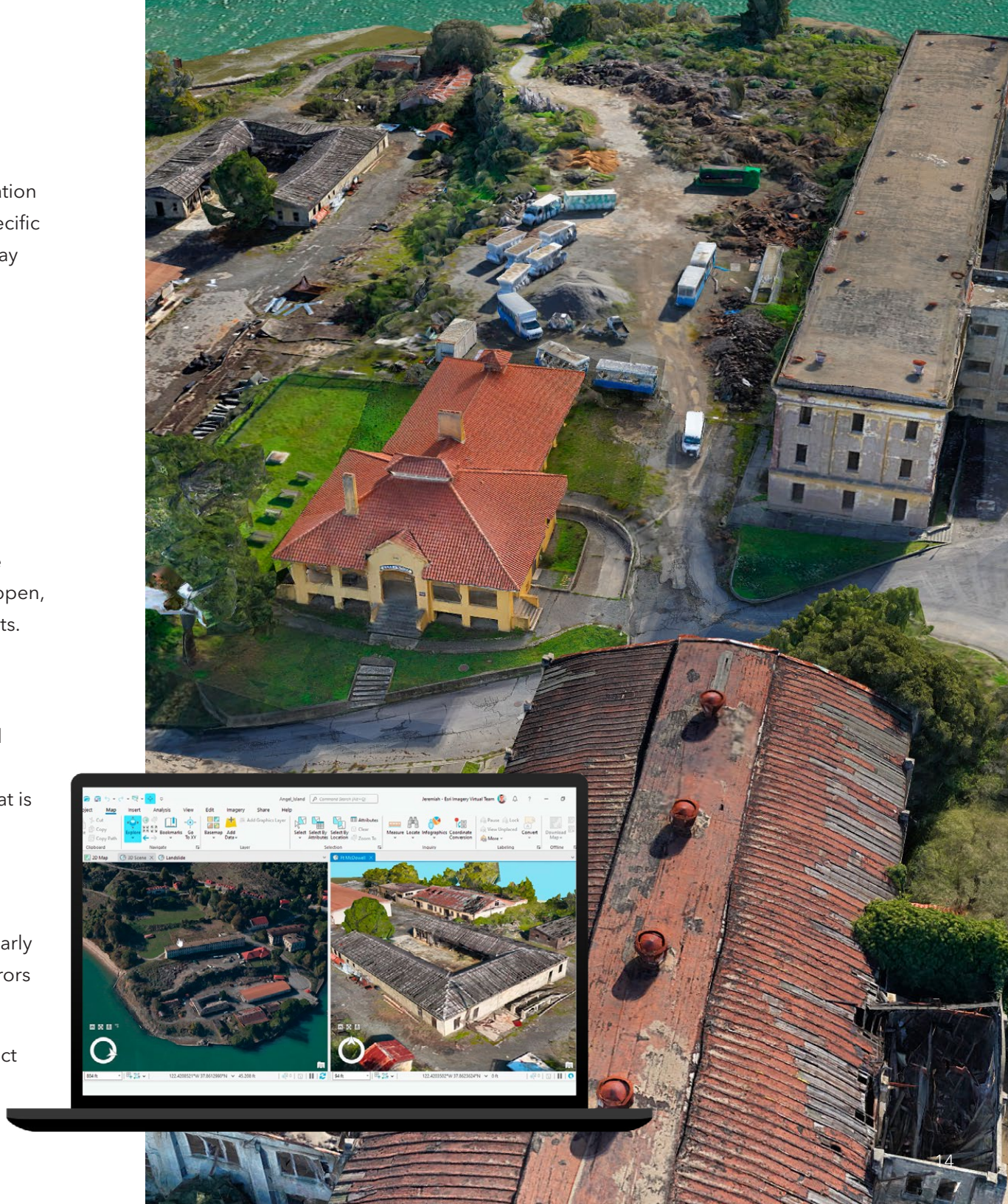
Once a project is in the construction phase, drone monitoring can detect whether the work aligns with design plans. Accurate data is crucial, as it helps prevent costly and potentially irreversible mistakes—for example, consistent flight paths deliver more precise views of on-site assets to move equipment efficiently, minimize wasted materials, and reduce safety incidents. Additionally, drone data continues to deliver value well beyond completion of construction. Imagery collected during a build can form the basis for a digital twin, which drives more efficiency in operations. Pilots can use Esri's flight planning capabilities to guide drones over various terrains and conditions. These GIS-powered tools are equipped to navigate even complex landscapes like mountains and work sites, ensuring repeatable and standardized data capture every time.

The best-in-class photogrammetry engine obtains accurate, georeferenced imagery that can be used in detailed maps, models, and orthomosaics.

With trust built into the foundational data, an organization can then trust AI to detect changes over time for a specific location. Analyzing changes can help forecast what may happen—and where—in the future.

Key business benefits:

- **Trust that your data is accurate across workflows.** Use high-quality images to gain detailed views of important sites and locations, which improve the precision of evaluations and maintenance planning.
- **Know where preventive maintenance is needed.** Leverage accurate pattern recognition and machine learning to identify possible failures before they happen, which reduces downtime and cuts maintenance costs.
- **Track and manage how your assets change.** Use deep learning models to assess damage and accurately track shifts in land use, infrastructure, and environmental conditions—changes as minuscule as cracks in an airport runway, or vegetation growth that is too close to power lines.
- **Get your projects done right—the first time.** Use drones to monitor construction sites in detail, ensuring the project aligns with design plans. This early detection helps avoid expensive and irreversible errors
- **Anticipate impacts and outcomes.** Use AI to analyze both old and new images to predict future trends.



CASE STUDY

City of Denver

Revolutionizing Red Rocks Amphitheatre Safety

The Red Rocks Amphitheatre, situated just outside Denver in Colorado, has been a renowned outdoor destination for world-class concerts and events, hiking, and recreation. It is also part of the vast Red Rocks Park, spanning more than 700 acres of complicated topography.

Challenge

The City of Denver, Denver Fire Department, and West Metro Fire Department wanted an innovative way to enhance situational awareness for public safety at Red Rocks.

Solution

Collaborating with Esri, the agencies captured a digital twin of the amphitheater in unprecedented detail using advanced drone technology by ArcGIS. Work began with meticulous planning and the deployment of a mapping drone, operated using the ArcGIS Flight app.

CITY OF DENVER CASE STUDY (continued)

Because of the sprawling acreage, the team divided the area into five overlapping flight polygons, ensuring comprehensive coverage without sacrificing detail. To guarantee that the digital twin aligned with real-world coordinates, crucial for any emergency response scenario, the team used a Trimble DA2 high-precision global navigation satellite system (GNSS), paired with ArcGIS Field Maps, to collect and document 63 ground control points. The imagery and ground control points were processed in the cloud using Site Scan for ArcGIS. The critical data gained from each flight was then used to create a highly accurate 3D digital twin of the venue.

Results

The digital twin has become a vital tool in public safety and the venue's management. Site Scan for ArcGIS captured detailed views of venue features with precision, from hiking trails to the locations of fire hydrants, as well as textures of the rocks themselves. Venue managers can now use this accurate digital replica to simulate and prepare for various scenarios, from evacuations to emergency responses, including modeling water runoff from a heavy rainstorm. In the event of an emergency, first responders can access detailed, actionable information on tablets while en route to an incident at the venue. The result has been enhanced safety and operational efficiency with a level of accuracy that was previously impossible.

CASE STUDY

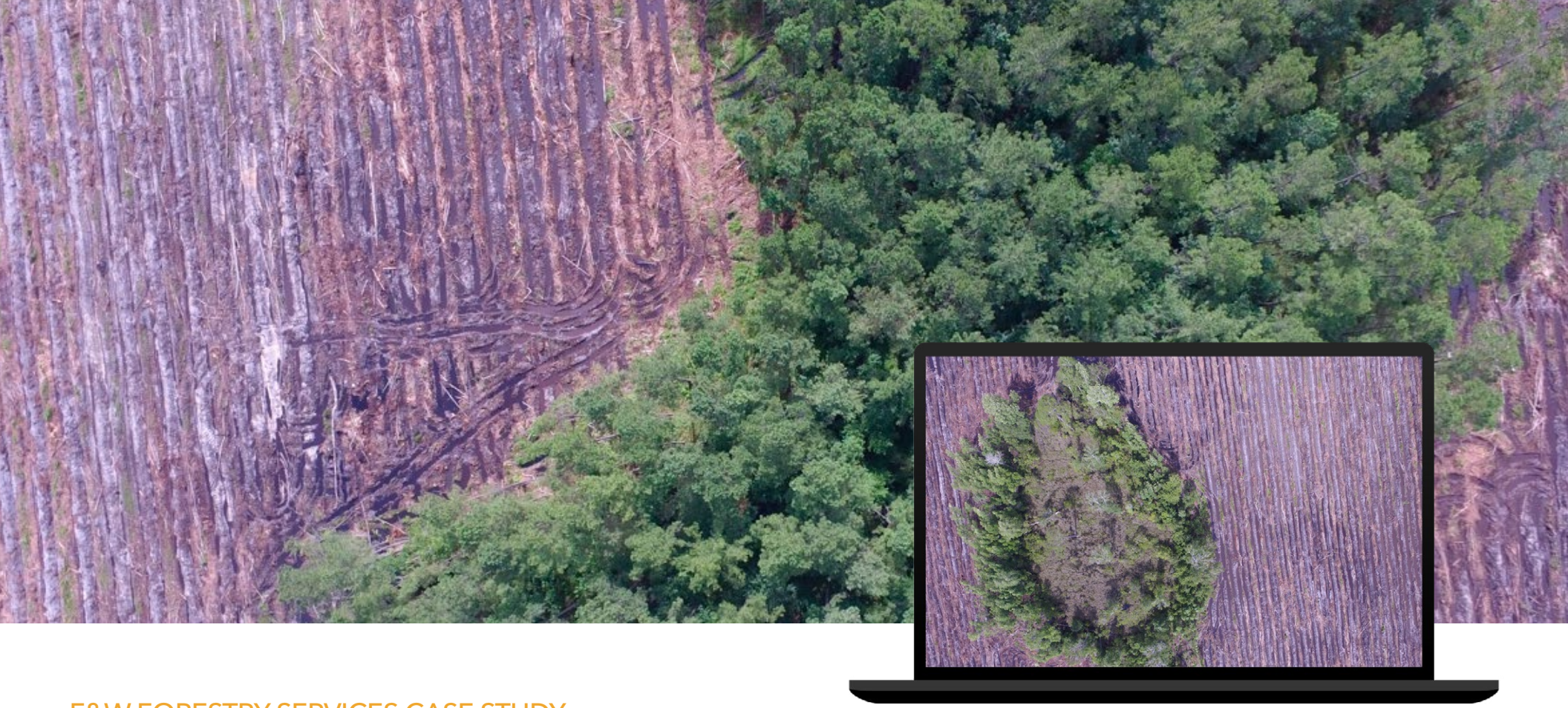
F&W Forestry Services

Mapping Forests with Precision

F&W Forestry Services manages hundreds of thousands of acres of privately owned yellow pine plantations in southeast Georgia and northern Florida. Maximizing the health and yield of each tree is critical in producing timber to meet demand. The company's forest consultants are increasingly using drones to capture details to guide forest management plans and provide a top-down view of the forest.

Challenge

Pine plantation forests are planted with precision using special tractors that evenly space seedlings. Some are even hand planted for greater control and consistency. This precision work is guided by maps that F&W creates, containing details about soil type, vegetation health, and topography. The company also uses GIS to record all the services it applies to each forest tract. However, F&W needed a way to provide clients with additional assurance that the precision work that was contracted had been applied. A previous drone management solution was inefficient, requiring too much of a manager's time to act as an intermediary between all the pilots. The manager also had to process imagery and then upload and share it themself.



F&W FORESTRY SERVICES CASE STUDY (continued)

Solution

Using Site Scan for ArcGIS, F&W can share access with pilots and enable them to quickly process what their drones captured and upload it into the cloud. Site Scan then converts the imagery into high-resolution maps and 3D models. This comes in handy to ensure they captured what they came to collect. Because it's a cloud-based tool, Site Scan allows everyone to see each other's work immediately on any device. The manager can also review the work of the pilots, manage their battery use, and keep track of their licenses and FAA registration. Ultimately, it means F&W can provide quick feedback to owners that otherwise would have taken days or even a week.

Results

The number of F&W flights has grown, with the company flying above more than 50,000 acres within the first few years after the drone program began in earnest. Drones have been able to safely monitor terrain that may have otherwise required workers to walk hazardous routes to inventory the forest. In addition to documenting site work for clients, F&W's drones provide imagery and mapping for site prep work, maintenance, and preparation for planting season. They also help plan for harvest, which occurs year-round, depending on the market and the interest of the owner. The flexibility and low cost of launching a drone, as well as the data drones can gather, are why they've become essential to field operations at F&W and elsewhere.

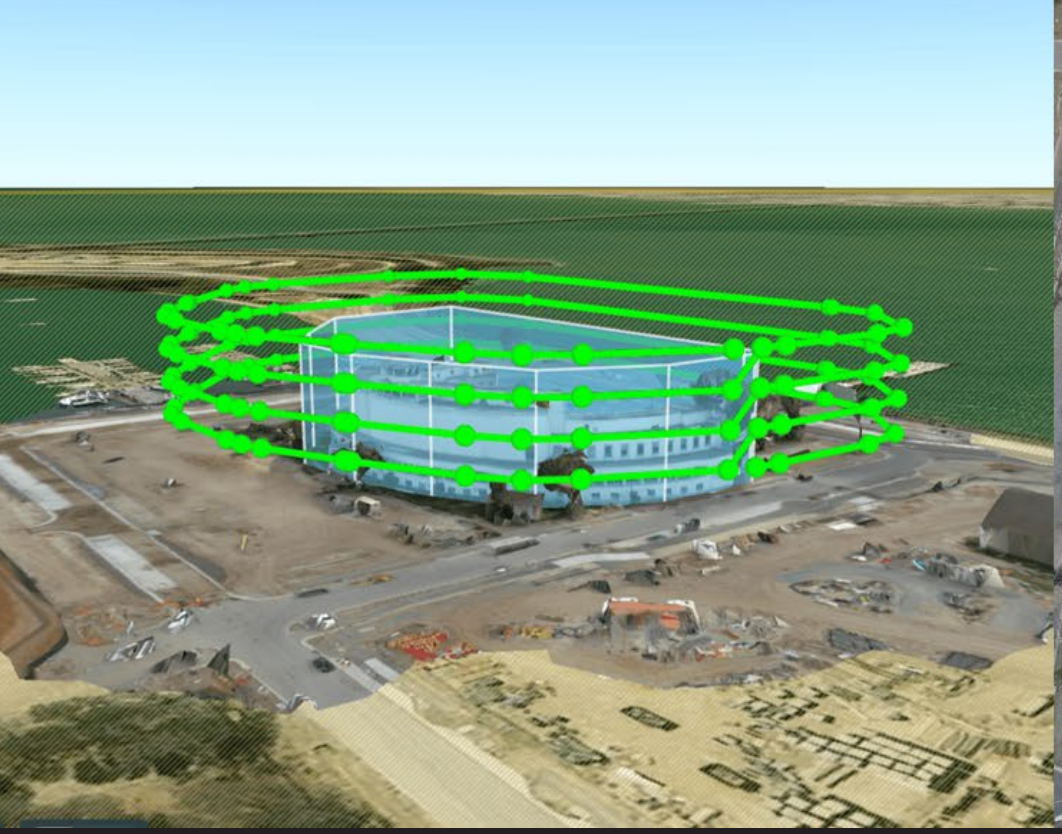
CHAPTER 3
SEAMLESS INTEGRATION WITH EXISTING TOOLS

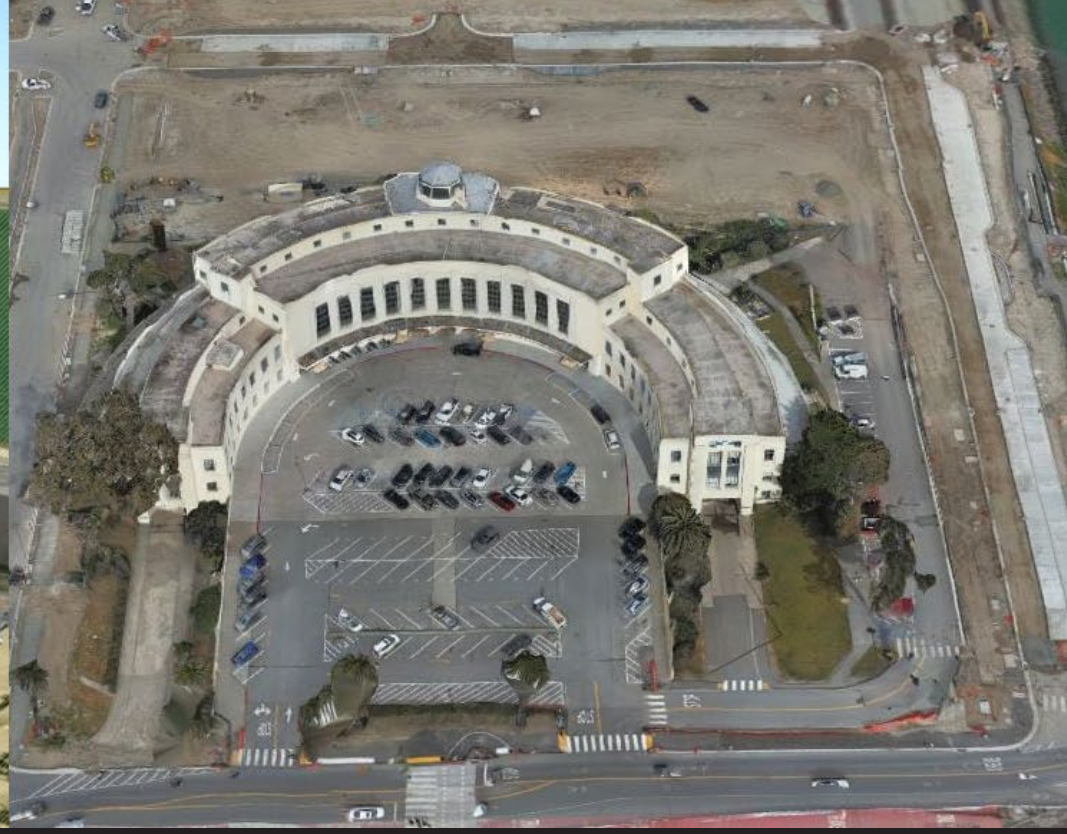
Just as drones need a clear view to capture high-quality imagery, organizations need a clear view into their data and operations. That unobstructed view comes from seamlessly integrating drone imagery into existing systems and tools.

Operational teams collaborate better, too, when they can readily access the data and technology they need in a unified system. This approach makes analysis more effective—compounding the value of a drone operations system.

Esri's drone solutions integrate seamlessly because they are combined with GIS. Location technology is a unifier. Most business data has a location component, so GIS can bring more information together—including imagery—in analyses and visualizations, accelerating time to insights and better strategic decisions. Drone data can be easily incorporated into current workflows and systems and adapted for different scales of use, from individual projects to enterprise-wide operations.

Drone imagery can integrate with existing GIS applications, enhancing maps with high-quality images or creating detailed basemaps for enriched data products.





Imagery products created with Esri® technology integrate with information models, CAD drawings, real-time data, and open data. This enables the creation of realistic 3D maps and models, plus digital twins and dashboards for monitoring sites and engaging stakeholders.

Consider the work of infrastructure and natural resources agencies. Drone images can be seamlessly added to GIS-powered 3D models for a detailed operational view of sites and assets. Planners and designers can use imagery to propose new pipeline routes and understand a project's environmental impacts. By adding sensor data, these models can also monitor and analyze asset changes. Additionally, they can add other data like elevation, population, and infrastructure to find the best spots for new energy projects.

Key business benefits

- **Work in a connected system that improves your business intelligence.** Combine data from multiple sources, such as maintenance reports and Internet of Things (IoT) sensors, into one clear view. Analyze operations more effectively and gain valuable insights.
- **Build shared understanding with your stakeholders and colleagues.** A unified system simplifies processes. Quickly manage and access data, analyze large amounts of imagery, and visualize results together with more clarity and insight.
- **Enhance your digital capabilities.** Integrate the growing volume of drone data with advanced geospatial tools and current business systems. Stay competitive in a changing technology landscape.

CASE STUDY

Brasfield & Gorrie

Improving Site Operations from Planning to Construction

Brasfield & Gorrie of Birmingham, Alabama, is one of the largest privately held construction firms in the US. Operating 13 offices in the Southeast and Texas, the firm specializes in general contracting and design-build delivery for markets like aerospace, health care, mission-critical industries, water utilities, and civil infrastructure.

Challenge

In construction, project managers and virtual design coordinators traditionally collected data by maintaining a schedule via email or whiteboards. However, not all project managers operate on-site, which could lead to delays in communicating important project planning and status information, especially to busy construction sites. Brasfield & Gorrie staff were integrating drone data collection with their geospatial technology as early as 2015.

The data their drones collected, though, was stored and processed on a single, albeit powerful, desktop computer, making the data less useful to team members in the field.

BRASFIELD & GORRIE CASE STUDY (continued)

Solution

Brasfield & Gorrie had already been using ArcGIS Online. Collecting imagery via drones and using that imagery for mapping and analysis seemed like a logical next step. In 2021, the company switched to Site Scan for ArcGIS, allowing it to collect, manage, store, and process data in the cloud. By implementing Site Scan, an end-to-end, cloud-based drone mapping program, the firm could now use QR codes with links to easily track and manage site construction progress in scenes populated with the latest drone imagery. Site Scan feeds the latest data directly into ArcGIS Online. Site Scan also enabled the company to scale up its fleet. By the end of 2023, the firm was using as many as 50 drones in its operations, compared to just two in 2015.

Results

Now, everyone involved in a Brasfield & Gorrie project can access the most current site maps and information on their mobile devices if they need it. That situational awareness has minimized costly mistakes at the jobsite—including disrupting existing gas, water, or electrical lines—and improved task management. Staff can also use the imagery to plan for adverse events such as safety incidents related to severe weather. In one case, Brasfield & Gorrie's project manager used Site Scan to measure the amount of composite materials delivered. This helped the company determine that it had been overbilled for the materials by $20,000.

CASE STUDY

Tahoe Environmental Research Center

Tracking Algae for Ecosystem Conservation

Observing Lake Tahoe's complex ecosystem requires a combination of sensors and systems, including a network of sensors providing real-time reads on water quality. The Tahoe Environmental Research Center (TERC) monitors environmental conditions in Lake Tahoe, including algal growth and the invasive Asian clam. Brandon Berry, an ecological researcher at TERC, has used a combination of drones, water sampling, and GIS technology to record conditions and address Lake Tahoe's problem with metaphyton—free-floating, nuisance algae that forms mats above the bottom of the lake before it washes onshore and rots.

Challenge

TERC wanted to capture imagery to record the clarity of the lake and the presence of algae around its 72-mile shoreline. The organization had previously tracked the growth of algae based on small subsamples. At first, there was doubt that the water was clear enough for drones to be able to analyze the presence of algae.

TAHOE ENVIRONMENTAL RESEARCH CENTER CASE STUDY (continued)

Solution

Berry discovered that drone technology can capture hundreds of meters of Lake Tahoe shoreline, making it easier to track algae growth. He learned that early-morning hours, when winds are calm, make for ideal conditions to fly the drones and see through the water. To process and aggregate drone images, TERC uses Site Scan for ArcGIS. After completing each flight, Berry uploads images to the cloud while driving to the next site. By lunchtime, the photos are ready to share with the rest of the team. After the drone flights, he dives into the lake to scoop and sample sand to count the number of Asian clams. Data is processed and analyzed with GIS to communicate conditions and support collaboration with other scientists to gain an overall understanding of the lake and test out techniques to manage the problem.

Results

With the success of tracking metaphyton, the drone program expanded to monitor attached algae known as periphyton, which grow on rocks and other objects near the shore. The comprehensive near-shore monitoring program includes drone flights that monitor specific sites with high-resolution imagery to track the rate of growth for both types of algae, providing data that informs mitigation and management practices.

CHAPTER 4
INTUITIVE DECISION SUPPORT

From start to finish, location forms the foundation for much of the data captured by drones. It only makes sense, then, that combining drones and GIS produces insights that help leaders make better, quicker decisions.

After all, spatial analysis is the most effective way to make sense of spatial data—which includes drone imagery. Drone solutions from Esri deliver that spatial analysis to improve decision-making and collaboration for better business results.

Analysts can use the AI and machine learning capabilities in ArcGIS to quickly analyze volumes of images, recognize shapes and patterns automatically, and gather insights from multiple aspects. Images move swiftly into precise, easy-to-share maps and models, and can be further analyzed or visualized within GIS.

Consider the work of emergency response teams. They can use drones to take pictures of current conditions during an event, analyze the data online, and quickly share updates with first responders to help rescue people faster. After the event, they can use these images with their GIS tools to assess damages, identify areas needing urgent help and cleanup, and create visual reports for the public and stakeholders to keep everyone informed.

Analysis can also take historic and current conditions into consideration, enabling the prediction of future outcomes and allowing decision-makers to contemplate what-if scenarios for proactive planning.

Key business benefits:

- **Get new—and better—insights from your drone data.** Advanced analytics tools help you identify objects, compare imagery over time, spot trends and patterns, and predict potential risks.
- **Make smarter decisions.** Using drones that are more aware of their location provides more reliable and useful information, helping leaders make confident choices that save time and money while keeping track of all steps in their operations.
- **Speed up time to insights.** Rapidly analyze large datasets with AI and machine learning. Then, display the results on 2D and 3D maps and dashboards to provide clear, actionable insights to key stakeholders.
- **Know what's happening, where.** Use drone-captured data to quickly assess important locations and better coordinate with field personnel using up-to-date insights.
- **Collaborate in real time.** Develop a clear overview that includes site conditions, possible risks, and current actions, and make sure it's easy to share with field teams and stakeholders.
- **Speed up response times and keep people safer during emergencies.** Use high-resolution and thermal imagery during crises to find and protect people and assets.

CASE STUDY

Greater Salt Lake Municipal Services District

Drone Program Enhances Civil Service and Urban Planning

The Greater Salt Lake Municipal Services District (MSD) delivers services to approximately 86,000 people living in small communities in the greater Salt Lake municipal area. MSD staff provides current and long-range planning, business licensing, building inspections, permits, plan reviews, information technology, and GIS services.

Challenge

With a small staff, the district needed a faster and more efficient way to gather and analyze imagery for the services it provides. Staff also wanted to avoid using low-resolution 2D images and relying on infrequent data releases from public and private imagery sources that could slow down the decision-making process.

GREATER SALT LAKE MUNICIPAL SERVICES DISTRICT CASE STUDY (continued)

Solution

MSD, an ArcGIS Enterprise user, started a drone program to capture its own imagery, using ArcGIS Drone2Map® first and eventually Site Scan for ArcGIS to capture and process high-resolution imagery for analysis. MSD uses the imagery data to turn 2D plans into 3D models to better compare sites before and after work and to track project progress, like it did for Sky Ranch, a housing development that includes finished and unfinished buildings and grading work. Along with capturing 3D imagery, the district also has built an interactive web page using ArcGIS Experience Builder to show—before the work is conducted—what a project will look like to gather community feedback. Another of the district's 3D modeling efforts gathered public opinion about the installation of a cell phone tower. With in ArcGIS Experience Builder, a no-code customizable solution to create web applications, MSD staff used drone imagery they captured to visualize what the tower would look like once built and analyze the shadows it might cast.

Results

MSD's drone operations and imagery collection workflows have become a valuable resource for long-range planning in the communities the district serves. MSD also supports government marketing and communications teams in producing drone images of towns, cities, and their local events. MSD staff have seen requests for their drone services increase across departments as its drone-based workflows have modernized planning processes. MSD has also begun offering cost-effective property evaluations and aerial roof and gutter inspections to residents and businesses.

CASE STUDY

Alaska Department of Transportation and Public Facilities

Rescue and Recovery After a Landslide

In Alaska, the Southcoast Region (SR) Materials Section acts as a kind of catch-all for engineering support for its larger agency, the Alaska Department of Transportation and Public Facilities (DOT&PF). Overseeing the department's engineering and geospatial technology needs can include anything from maintenance and operations to construction. The group is increasingly using GIS technology for its operations, making SR invaluable for emergency situations, as well.

Challenge

When heavy rainfall caused a deadly landslide on a highway near Wrangell, Alaska, in November 2023, several people went missing, and the damage was devastating. Responders needed to know where to look and where nearby homes may have been pushed away or covered by the landslide.

ALASKA DEPARTMENT OF TRANSPORATION AND PUBLIC FACILITIES CASE STUDY (continued)

Solution

The first and most critical technological tool employed in response to the Wrangell landslide was drone imagery. With drones in the air, SR staff could assist search and rescue teams on the ground as well as incident command. In addition, the SR team built a map with ArcGIS Pro that Alaska DOT&PF would use to inform the public. As part of its efforts, SR analyzed building footprints of homes in the direct path of the landslide, paired with drone imagery layers, using Site Scan for ArcGIS and ArcGIS Online. SR also needed to take stock of any repairs that might need to be done on roads or utilities, and whether the impact on any other infrastructure would need to be addressed.

Results

GIS mapping allowed the team to visualize the flow of debris and where homes may have ended up after the landslide. After the initial emergency phase, the team used ArcGIS Survey123 to document the amount of landslide material being disposed of, a critical step in securing FEMA reimbursement.

"The only reason we can do what we do is because there's funding available that starts with an emergency declaration," said Mitchell McDonald, SR's regional engineering geologist. "That's the critical link for us, with GIS—our data collection center ultimately gets us that funding to do what we do and to continue monitoring."

The SR team has since conducted weekly drone flights of the landslide scar to monitor any changes in stability. With drone imagery augmented by data from weather stations installed in the area, the team can monitor how the ground is reacting. Now, following any storm event, SR can conduct daily and weekly routine monitoring using drones. The gathered information will also, undoubtedly, help Alaska prepare for future adverse events.

.

CASE STUDY

South Australian State Emergency Service

Seeing the Floods from Above

When a record amount of rain fell on South Australia in January 2022, the storms submerged a key highway running north to south and severely impacted Australia's transcontinental railway running west to east. The damage in such an inopportune location cut off strategic transportation routes to Western Australia and the Northern Territory, as well as residents who were unable to get out or have essentials brought in.

Challenge

The South Australian State Emergency Service (SASES) needed to quickly communicate the damage to the public as well as to leaders who could mobilize relief and recovery efforts. The largely volunteer organization has been working with remotely piloted aircraft for years, building use cases and caches of aerial imagery while learning about the latest tools and teaching others about them.

SOUTH AUSTRALIAN STATE EMERGENCY SERVICE CASE STUDY (continued)

Solution

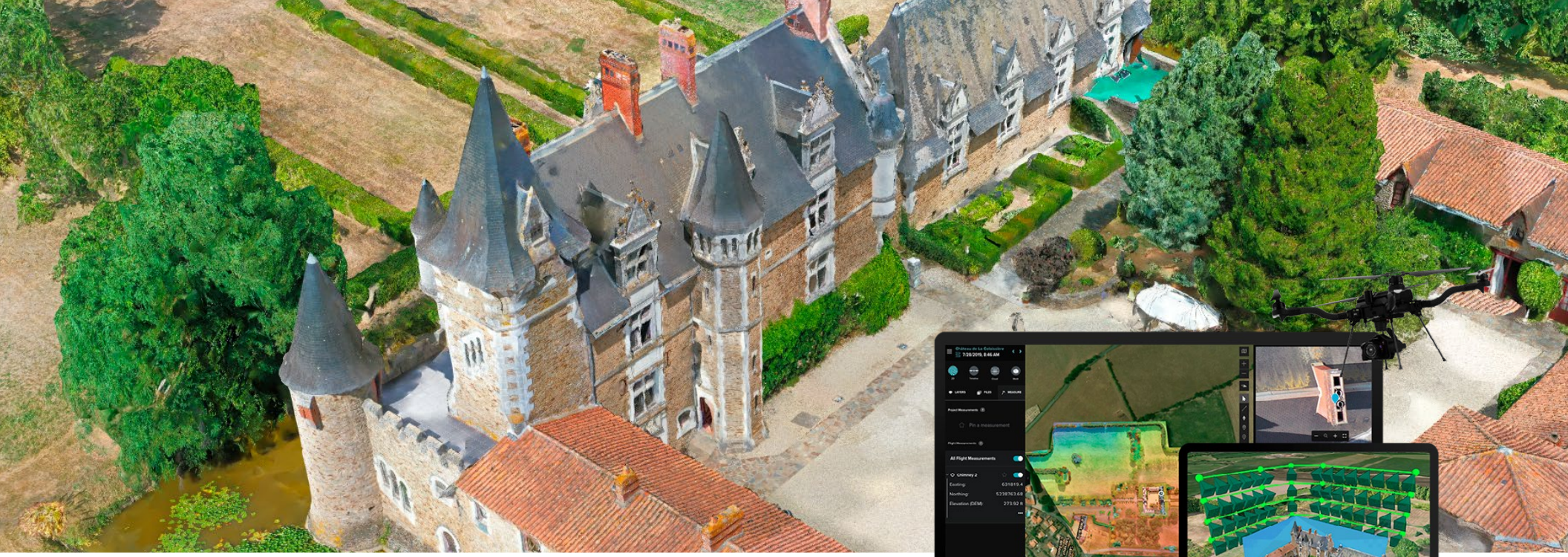
Within a few hours of the storm letting up, the agency's chief remote pilot arrived in the rural outback and sent a drone to assess the damage. Holding a smartphone aloft to capture the slightest signal, the pilot shared the images as soon as possible. Updates would inform maps to convey road conditions and closures, including the submerged railway and road. The public and stakeholders could then see exactly why this corridor was now impassable.

Traditional damage assessment imagery taken by piloted aircraft could capture images, but at far greater cost and with a less complete aerial view of the damage below. In contrast, the images captured by the remotely piloted aircraft were stitched together seamlessly using Site Scan for ArcGIS, a cloud-based tool that speeds up imagery processing and information sharing.

Results

The initial images, and those taken in the days and weeks after, helped officials and the public fully understand and assess the damage that would need to be fixed. The footage was viewed more than 750,000 times and served as a warning to motorists while the areas remained hazardous. Later, when the railway and road were repaired and reopened, follow-up footage showed the efforts that went into bringing about the welcome relief of restored mobility.

During the storm, SASES added images to a dashboard that kept track of all the damage. The imagery, maps, and charts provided everyone in the region with the context they needed to understand the impacts. The information was relayed to the Australian Government National Situation Room in Canberra, which needed evidence of damage to support relief and recovery planning.



THE TOOLS
DRONES

Drones come in many shapes and sizes, with different load capacities, battery power, and time-of-flight specifications.

The types of drones are broadly classified as the following:

Multirotor aircraft can fly close to structures and hover to make sure they capture the data that's needed at high precision. They can carry heavy payloads, and even deliver materials where they are needed. These drones are ideal for inspection workflows or small sites where accuracy is the primary objective, such as surveying and measurement workflows.

Fixed-wing drones can typically cover more ground, staying aloft longer than other drones, with a focus on capturing large areas rather than close-up details. Some fixed-wing drones look like traditional airplanes, while others can take off and land vertically for flexible use in tight spaces or difficult terrain.

THE TOOLS
SOFTWARE

Capture Images

ArcGIS Flight: Revolutionize your drone data capture for reality mapping and inspection, plus in-app LAANC confirmation gets you off the ground quickly. Plan flights with GIS context and automatically collect high-quality imagery for processing in ArcGIS.

Process, Analyze, and Visualize Your Data

Site Scan for ArcGIS: Process large volumes of drone imagery faster with cloud-based data processing. Create 2D and 3D maps and models that you can quickly share across your organization.

ArcGIS Drone2Map: Process drone imagery on your desktop while offline or in the field. Turn recently collected drone images into 2D and 3D models, even without an internet connection.

ArcGIS Reality for ArcGIS Pro: Generate large-scale true digital surface models (DSMs), True Orthos, DSM meshes, point clouds, and 3D meshes from satellite, aerial, and drone imagery with this ArcGIS Pro extension.

CONCLUSION

The drones are ready. The technology is ready. And with GIS solutions, organizations can also be ready to optimize and scale drone operations. This future looks like enterprise-ready GIS software that enables reality capture, advanced analysis, and seamless integration with other business systems and data.

It's a future with positive impacts to on-site planning, inspection and monitoring, and safety and security. One that supports faster decision-making, enhanced operational efficiency, and significant cost savings.

Organizations will be able to manage large amounts of drone imagery using powerful tools for data cataloging, centralized search and discovery, and sharing options that meet specific business needs—all while maintaining high security and compliance.

They can capture and analyze precise drone imagery, creating highly accurate 2D and 3D maps and models of real-world sites, assets, and locations.

Across the enterprise, operational teams can streamline workflows and enhance data sharing by integrating drone imagery into existing business systems.

All this is made possible by the power of location. The ArcGIS geospatial platform from Esri transforms drone imagery into actionable insights. The result? Faster, more informed decisions that drive superior outcomes and greater shared awareness, even in real time.

G5787501

esri.com