Volume 2

Enterprise GIS in National Security

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The following stories demonstrate how military, intelligence, public safety, and government organizations use Esri® technology to solve problems by using a common platform: ArcGIS. The ArcGIS® platform enables spatial thinking and reasoning using today's technology, whether in the cloud or via web, server, desktop, or mobile devices. These technologies take the power of geospatial information from large organizations, such as an army, and bring it to small municipal public works and to the community at large.

Enjoy reading about how organizations move geospatial technology from the back room to the field, across an organization, and into the hands of the public.

Warm regards,

Jack Dangermond
President

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ROOK: A Digital Oasis in a Challenging Environment

Stationed in southern Afghanistan since the US-led coalition engagement in 2001, the US Marines have learned many lessons about the value of geographic information system (GIS) mapping support in remote and sometimes hostile environments.

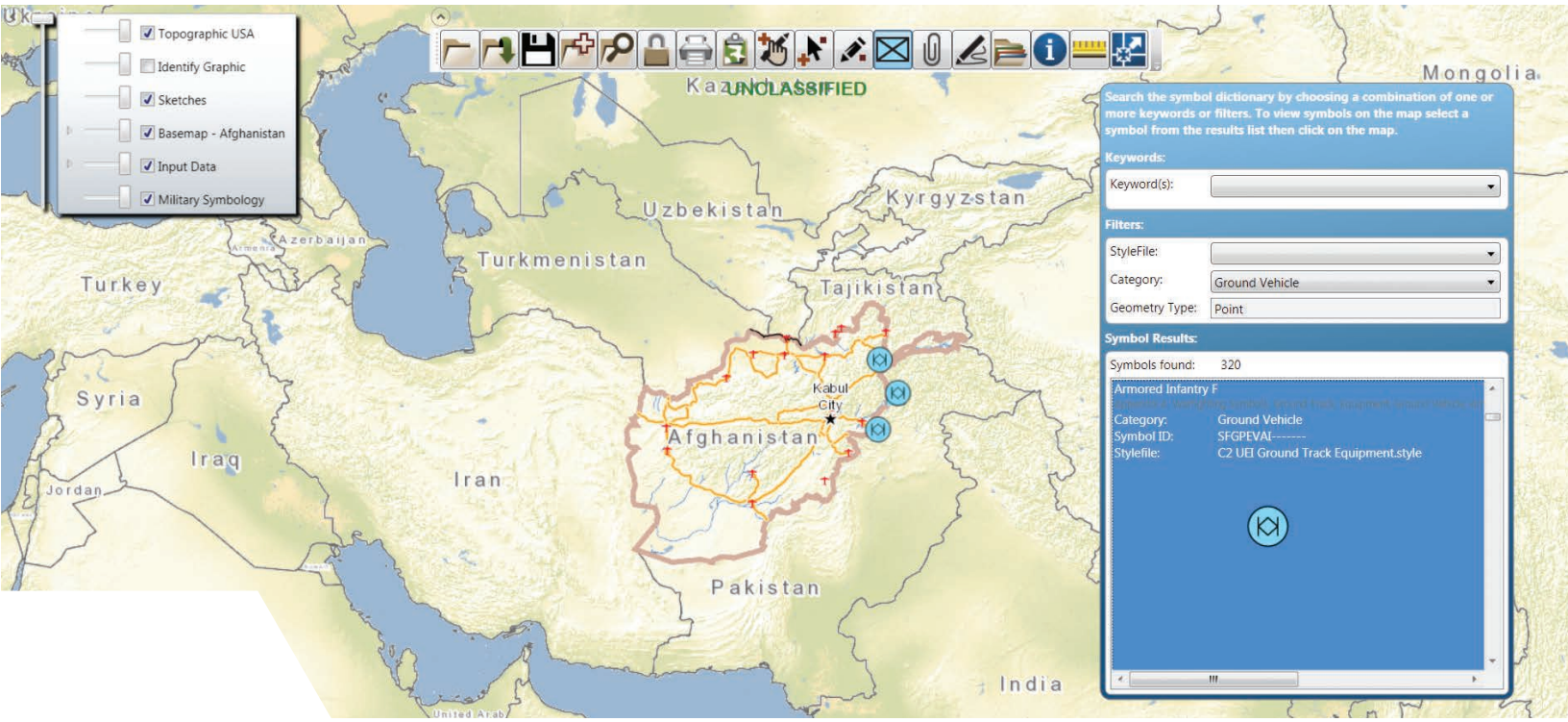
Initially, they performed tactical mapping intelligence with a customized software solution from Esri called the Regional Expeditionary Intelligence Portable Resource (REIPR). While effective, this portable geospatial viewer required too much hard-drive space in the high-security environment of Afghanistan and was further complicated with limited bandwidth and hardware restrictions.

The Marines soon realized they needed something more agile with greater capabilities to meet their battlefield mapping needs. They wanted a geospatial viewer that allowed them to quickly sketch nearby battles for situational awareness, as well as capture screen shots for time-sensitive reports and PowerPoint briefings.

Esri developed the Regional Open-Source Operations Kit (ROOK) based on ArcGIS Runtime software, a new technology that gave the Marines the smaller software footprint and greater capabilities they required.

The Challenge

REIPR provided the US Marine Corps (USMC) in Afghanistan with a geospatial viewer that supported its intelligence efforts. However, because of the viewer's limitations, it didn't completely meet the Marines' needs or objectives.



This ROOK image displays MIL-STD-2525B symbology in Afghanistan.

While using REIPR, the Marines developed four criteria that were essential to the successful implementation of a geospatial viewer for military use:

- Small digital footprint for installation
- The ability to operate in a disconnected environment
- Being preloaded with the data and images needed in deployment areas
- Having no administration privileges required to begin the installation process

The Solution

With the release of Esri's ArcGIS Runtime, new possibilities became available to develop a geospatial viewer for military use. ROOK, the resultant viewer, requires less than 300 MB of hard-drive space and can function with or without network connectivity. The application can be loaded onto a single DVD.

In a disconnected environment, ROOK gives users the ability to load their laptops with unclassified GIS resources, such as maps, data, and geoprocessing tools. This is important for US Marine intelligence analysts, whether they are deployed for battlefield assessment or emergency relief efforts.

Publicly available geospatial data and maps can be preloaded on ROOK before deployment. This means Marines are not forced to rely on classified government systems that may have limited resources and cumbersome administrative procedures.

New users can easily learn ROOK in a single session. The interface is intuitive and includes 19 buttons and one toolbar, making formal training unnecessary.

The Results

The US Marine Corps pioneered ROOK and plans to extend its use throughout the USMC Intelligence, Surveillance, and Reconnaissance (ISR) Enterprise as a portable dissemination solution.

While ROOK was not deployed in Afghanistan because of America's reduction in troop numbers and involvement, Typhoon Haiyan, one of the most powerful storms ever recorded, gave the Marines a chance to field-test its capabilities.

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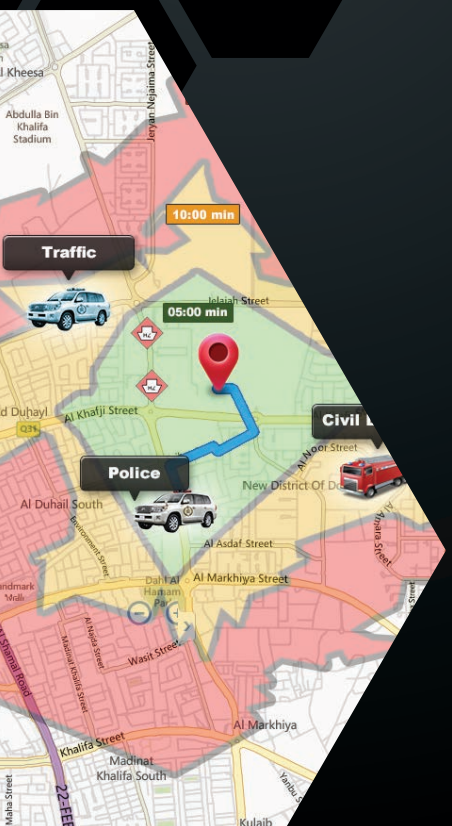
Qatar Enters a New Era of Emergency Response and Proactive Security

A Unified Geospatial Infrastructure Boosts the Country's Response Capabilities with Actionable Information

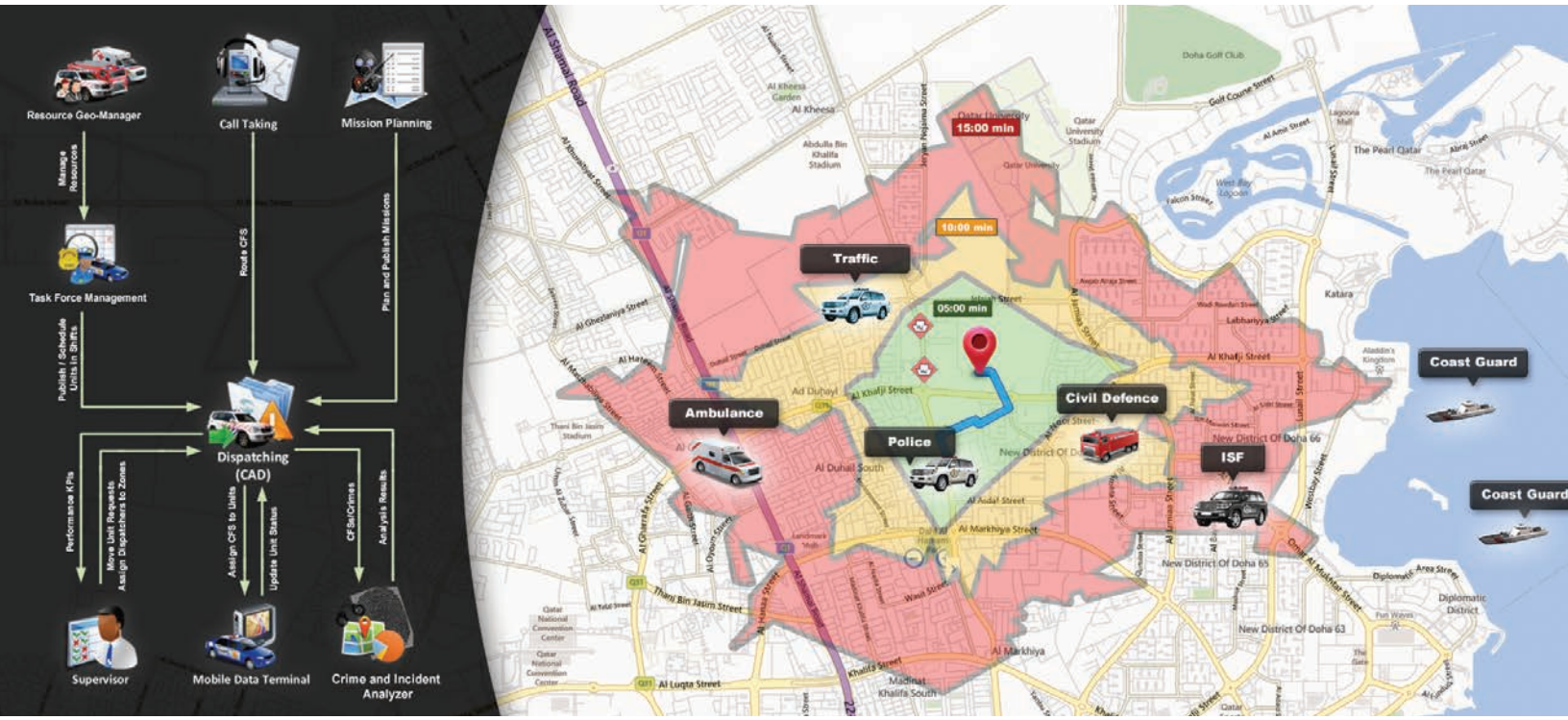


Whenever an urgent situation poses a risk to life or property, an immediate, organized, and collaborative response from those stakeholders responsible for emergency operations is required. The success of emergency response depends on real-time dissemination of incident information and continuous status updates.

The State of Qatar, a country on the Arabian Gulf, has created the National Command Center (NCC) to manage a coordinated response to both local and national emergencies. The NCC works with different national agencies to evaluate emergency situations and implement the appropriate response. These agencies include the country's Emergency Service Center; the Ministry of Interior; Internal Security Forces; and the Hamad Medical Corporation, operator of Qatar's national ambulance services.

The Challenge

Because the emergency response workflows of the NCC have procedures in common with related agencies, strategic and operational decision making is dependent on information retrieval and communication between them. Therefore, the NCC needed an extensible, unified system that centralized data located in those agencies to streamline workflows, connect all responsible agencies to facilitate knowledge sharing, and enhance performance. In addition, because of the extensive use of GIS in the country, the new system had to provide an inclusive, GIS-based common operational picture capable of geospatial analysis from a myriad of data sources.



Integration between NJM Dispatching application, other NJM applications, and external applications empowers dispatch officers with the actionable information needed for efficient emergency response. Based on service area analysis, NJM Dispatching application recommends units in the proximity of the incident and draws the route to the incident on the map.

The Solution

Qatar-based Mannai Corporation and Esri Northeast Africa in Egypt, in consultation with Esri's national security team, developed a solution that fulfilled the extensive requirements of the NCC. NJM (the Arabic acronym for Unified Geospatial Infrastructure) is a web-based, bilingual (Arabic/English) geographic security system built on the ArcGIS platform. It includes a number of interactive applications and a unified geodatabase that hosts all geographic and tabular data in a single repository. NJM integrates all NCC functions into a single system and seamlessly interfaces with other systems when needed.

NJM supports the NCC's emergency response workflow, starting with incident reporting, when NJM Call Taking application receives a call for service. Through computer telephony integration, the caller's telephone number is identified with an automatic number identification system. The location and related information are then retrieved and displayed on a map through integration with the automatic location identification services provided by mobile operators. Based on that location, the application provides the emergency call operator with locational information, including the records of nearby incidents, hazardous materials, and critical infrastructures. Predefined instructions and inquiries (or ProQA directions for medical cases), per incident classification, guide the operator through the information collecting procedure. For certain situations, the NCC requested that senior officials be notified about specific incidents that require special attention. This need is addressed through the integration of the application with the short message service (SMS). An SMS is automatically sent by NJM system to notify predetermined senior officials when a special incident is recorded.

NJM Dispatching application provides incident details and its location, as well as the location of responding vehicles and their availability status. The application then uses the ArcGIS Network Analyst extension with an integrated automatic vehicle location (AVL) service to determine the nearest

NJM Crime and Incident Analyzer provides a number of temporal and spatial analysis capabilities and reports that can be shared with different stakeholders.

available units and match the response needs with predefined unit capabilities and their current location. Accordingly, it recommends the best units that could be assigned to the incident as first responders. Furthermore, with the updates of incident details, recommendations can be repeated for second responder units and any additional units needed.

NJM Mobile Data Terminal application automatically receives the dispatched incident and pushes it to the in-field officer, along with all relevant information. Using the system's route analysis capabilities, route mapping and driving directions facilitate the unit's response to the incident. Building diagrams are also provided to speed up the responders' access to the incident location. Nearby priority areas and hazards are highlighted for dispatch and unit officers so that they can avoid further risks and limit incident impact. An open channel of communication between NJM Dispatching and NJM Mobile Data Terminal enables the continuous exchange of the latest incident and unit status updates. The dispatch officer can continuously monitor the movement of all in-field units on an interactive map through the integration of NJM Dispatching application with the AVL service. Also, any updates to incident details or status are shared with respective stakeholders through audio and visual alerts as well as through a live news feed.

Solid integration with government services through an enterprise service bus enables operators, dispatch officers, and unit officers to retrieve information from civil records, traffic authority, visa systems, and mobile operator systems. The follow-up on overall emergency response performance is addressed through NJM Supervisor application, which provides a complete, generic map-based image of work progress, key performance indicators, incident frequency, residential and commercial zone classifications, and daily staff performance reports. The system also supports proactive emergency management activities through NJM Mission Planning application, which uses ArcGIS Spatial Analyst to enable geospatial modeling and visualization of 2D preresponse plans for priority areas, supported with 3D area visibility analysis and line-of-sight analysis. The plans define the required resources from different agencies to properly respond to potential risks. These plans are shared with dispatch and field officers for implementation.

Another powerful capability of the system is NJM Crime and Incident Analyzer, which analyzes existing data using ArcGIS Network Analyst and Spatial Analyst extensions to provide a comprehensive view of incident and crime density, geographic distribution, and temporal and spatial recurrence patterns to help emergency response authorities address the root causes behind incidents and crimes. Analytical results generated by NJM Crime and Incident Analyzer can be shared with related agencies through generated reports.

The management of emergency resources and their daily operations is handled through two different applications. NJM Resource Geo-Manager enables resource managers to add and manage emergency response resources—personnel, animals, equipment, and vehicles—and design templates defining the required resources for the different units. NJM Task Force Management manages duty rosters, shift patterns, geographic zones, and resource assignments. It also monitors shift performance and provides different reports on work groups and shift schedules and duties.

In addition, the NCC needed to manage the business rules governing the entire emergency response workflow, future changes in the organizational structure of emergency response agencies and departments, roles and privileges, the availability of GIS data, notification rules, dispatching policy, and the relations between different applications. All these needs, along with many other administration services, are addressed through NJM Enterprise Manager application.

Finally, to guarantee continuous availability of the system, the entire NJM environment is replicated in a disaster recovery (DR) center remotely connected to the main NJM system at the NCC data center through a fiber-optics infrastructure. All tiers of the DR environment are automatically synchronized with the main data center environment to guarantee minimum recovery efforts and downtime in the worst-case scenario of physical damage to the data center and the main system.

The Result

Emergency response time per incident has been significantly reduced, and the process itself is more efficient. All stakeholders now benefit from the GIS-based common operational picture, which allows an immediate connection between incidents, units, critical infrastructures, priority assets, and other critical information. In addition, the continuous accumulation of data, along with the rich analytical capabilities of the system, supports future response and the reduction of potential risk. The situational awareness provided by pushing the right information to the right place at the right time enhances the overall capabilities of Qatar's emergency response efforts. The flexibility of NJM system paves the way to accommodating new security needs and a safer future for Qatar's residents and visitors.

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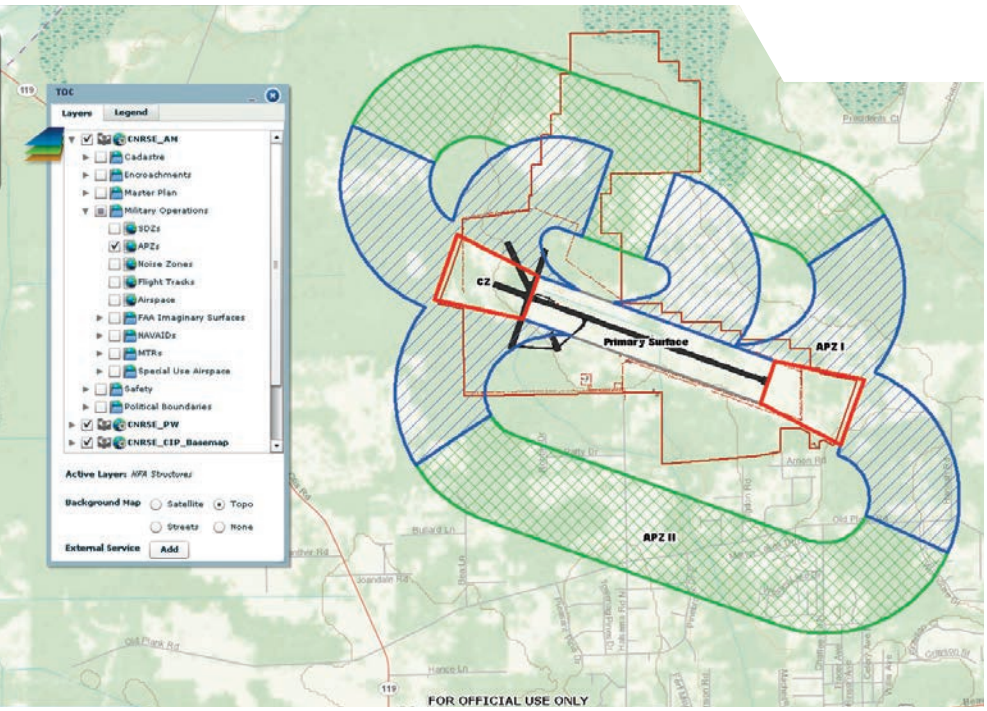
US Navy Uses GIS to Minimize Its Impact on Local Communities

Compatible land use is a critical consideration whenever military installations are close to local communities, whether from urban sprawl, population growth, or mission expansion. To address this issue, the US Department of the Navy created the Navy Community Planning and Liaison Officer (CPLO) position to better understand the interaction between military and civilian activities. CPLOs work directly with community officials to minimize operational impacts and ensure the health, safety, and welfare of the public. The GeoReadiness Center (GRC) at the Commander, Navy Region Southeast in Jacksonville, Florida, provides tailored Esri GIS support to CPLOs and navy departments from Texas to Puerto Rico. Analyzing both inside and outside the navy fence line using parcel, land-use, and zoning data, the GRC creates custom maps that help CPLOs perform spatial analysis, identify potential impacts, and develop mitigation recommendations for the local community.

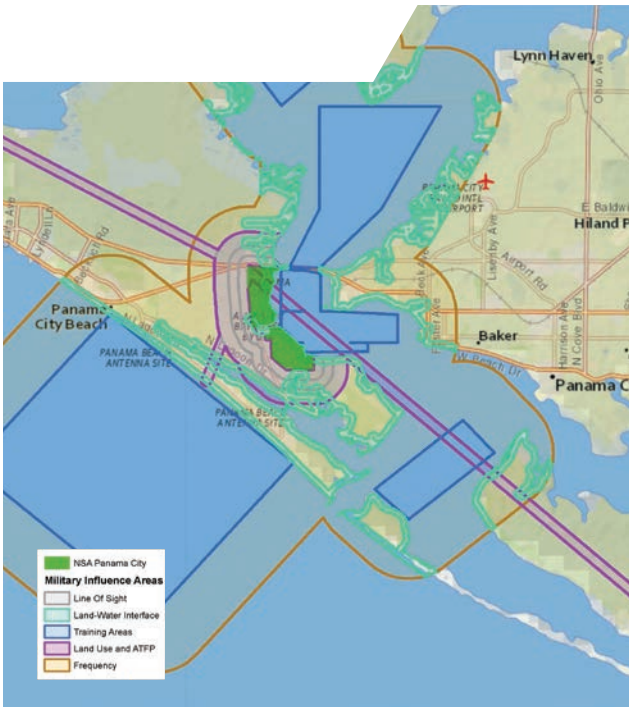
The Challenge

Due to the specialized mission of each military installation, there are unique challenges between the installation and the adjacent community—aircraft noise, accident potential zones (APZ), marine training encroachment, radar or frequency interference, security concerns, airfield obstructions, and more.

Most land-use conflicts are minor, but some underscore the gravity of the CPLO mission. In April 2012, an F-18 from Naval Air Station Oceana crashed into an apartment complex in Virginia Beach, Virginia, that was located in an APZ where the construction of residential property was not recommended. Fortunately, there was no loss of life, but this accident highlights the importance of appropriate land-use development near military installations.



Accident Potential Zones Developed for OLF Whitehouse



Military Influence Areas Developed in 2009 for NSA Panama City

The Solution

By overlaying GIS-based military aircraft noise contours and aircraft APZs onto residential development data, CPLOs can provide the local community with zoning recommendations to protect adjacent residential areas near landing fields. The same process can be applied to bomb ranges, airspace, sea space, and submarine operating areas and for endangered species protection. Staff use Esri® software to visualize and analyze both the installation's mission and the community's development plans to protect both public and military interests.

The recently released GeoReadiness Explorer (GRX), using Esri ArcGIS for Server, provides a powerful tool that allows navy and community data usage in a web viewer environment. Online maps created for nontechnical GIS users allow rapid analysis of installation/community compatible-use layers.

The Result

The GRC staff continually updates its data, providing CPLOs with a current, accurate picture of activities both on and near local military installations. Using GRX, CPLOs can rapidly develop informed analyses to resolve compatibility issues and engage community leaders with informative land-use depictions. Although restricted to navy use, GRX products and analysis can be shared with the community on an as-needed basis.

GIS analysis helps CPLOs evaluate military and civilian land-use compatibility and identify potential conflicts between the public, environment, and military operations requirements.

Rapidly Responding to Colorado's Historic Floods

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In September 2013, Colorado's Front Range was drenched with record rainfall. Rivers, streams, and reservoirs in the region surged with the influx of precipitation, leading to widespread flooding across nearly 2,000 square miles of the state. The storms and flooding claimed the lives of 10 people, drove more than 18,000 residents from their homes, and completely isolated mountain communities such as Lyons, Colorado. Countless buildings, roadways, bridges, and critical infrastructure were damaged or destroyed, causing hundreds of millions of dollars in damage.

Government agencies, from local towns all the way up to the state and federal levels, activated their emergency procedures as part of the response. Efforts ranged from protecting lives and property and communicating with the public to documenting damage and developing and executing recovery plans.

The Colorado Department of Public Safety Division of Homeland Security Emergency Management (DHSEM) and Longmont Power & Communications (LPC), a department of the City of Longmont, were two of the hundreds of organizations that were impacted by the floods. For both groups, geospatial technology provided a key mechanism for understanding the evolving nature of the floods and making informed decisions to safeguard citizens and drive recovery.

Streams and rivers surged, overrunning banks and affecting bridges and pathways.

Widespread flooding left residential communities and commercial properties completely inaccessible.

The Challenge

As the primary state response agency, Colorado DHSEM was tasked with understanding where flooding occurred and determining where to deploy response assets. The department needed a platform to share information and perform analysis in real time to coordinate activities across multiple agencies.

With a service territory of 49 square miles covering the towns of Longmont and Hygiene and parts of Lyons, LPC was hit particularly hard by the storm. Significant portions of its infrastructure were damaged, and approximately 1,300 customers were without power for several days. LPC staff needed a way to efficiently manage inspections and repair infrastructure.

The Solution

Both Colorado DHSEM and LPC used ArcGIS℠ Online to visualize information related to the floods and impacted areas. ArcGIS Online enabled Colorado DHSEM and LPC to share continuously updated live maps with staff located in the field and in offices throughout the state.

Colorado DHSEM worked with local, state, federal, and private partners to collect imagery and geospatial information to create maps related to everything from road closures and traffic control points to evacuation areas and damaged facilities. The myriad maps and data created a common operating platform that decision makers were able to access in support of response and recovery efforts. Regional field managers and other personnel used the maps to maintain situational awareness and make informed decisions that supported their local counterparts.

In addition to ArcGIS Online, LPC also used Collector for ArcGIS, a configurable app for smartphones and tablets that enables field data collection and syncs with online maps. Field crews used Collector for ArcGIS to inspect high-voltage equipment in the field. Their reports were fed into an online map that was instantly updated on all the crews' devices. This let field personnel see what had already been inspected and allowed them to perform their work in smaller groups.

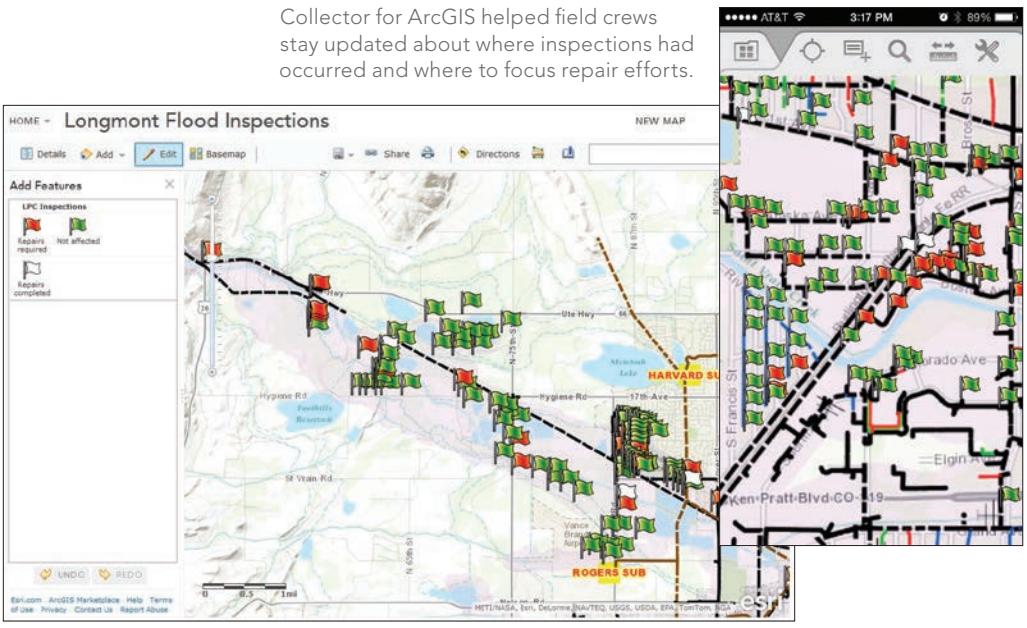
Floodwaters caused severe damage to roadways and other infrastructure throughout the state.

The Results

The online maps created by Colorado DHSEM were accessed by hundreds of users to visualize impacted areas and orchestrate response efforts. Other online maps, such as those identifying disaster recovery centers, were also shared with the public. The common operating platform offered by ArcGIS helped leaders understand the size, scope, and proximity of the crisis.

Collector for ArcGIS empowered LPC to complete inspections of all damaged assets in just three days. By replacing paper maps and dispatch lists, LPC was able to operate more efficiently and quickly perform critical tasks. In all, the ArcGIS platform helped LPC gain a better understanding of the impact of the floods and lowered costs by optimizing the efforts of its field crews.

Collector for ArcGIS helped field crews stay updated about where inspections had occurred and where to focus repair efforts.



As inspections were completed in the field, they were immediately recorded on an ArcGIS Online map that field-workers and office staff monitored.

GIS-Based Web Services Provide Rapid Analysis and Dissemination of Maritime Data

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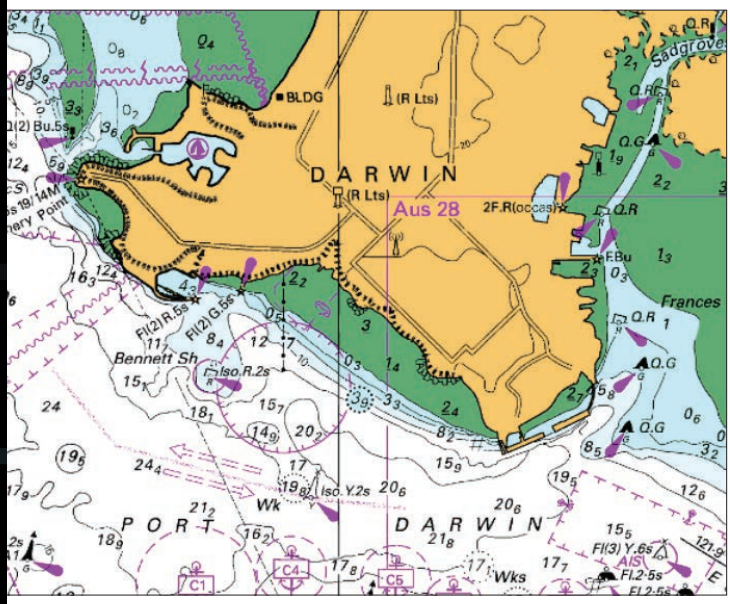
The Royal Australian Navy's (RAN's) Hydrography, Meteorology and Oceanography (HM) Branch is responsible to the Australian Department of Defence for the collection, management, analyses, and dissemination of meteorological and oceanographic data. Through this process, the HM Branch provides information on the maritime environment. This enables defense users at the strategic (through climatology), operational (through forecasts), and tactical (through observations) levels to properly consider the environmental impacts on planning and conducting maritime activities.

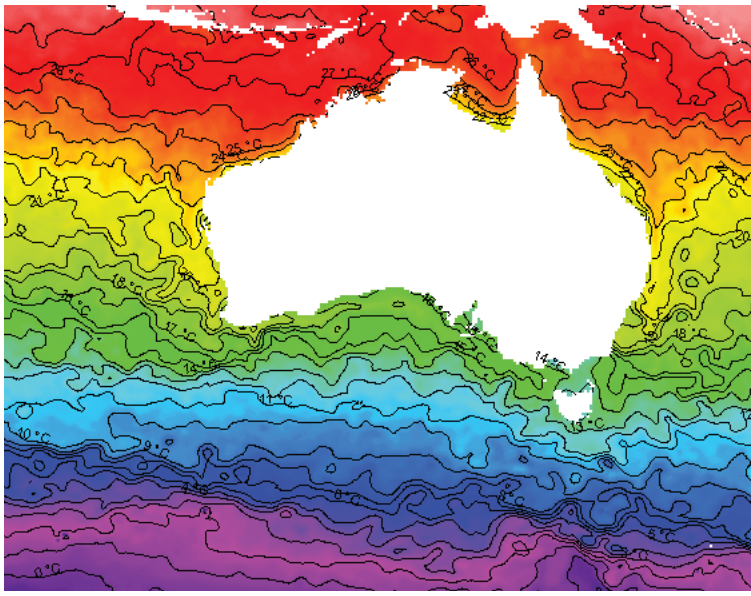
The Challenge

The ocean can be a harsh and unrelenting environment, providing no shelter for vessels and their crews caught in open waters. Extreme winds, rogue waves, untracked icebergs, and freezing ship superstructures are only a few of the conditions that can disrupt maritime activities. In extreme cases, they can lead to disasters.

The ability to rapidly assess change for safe navigation is crucial for the mariner and the defense planner. The volume of data collected for parameters, such as ocean temperature and salinity, ocean currents, winds, and waves, is enormous, significantly increased with the added dimensions of depth and time. To provide context, data must be geolocated relative to foundation maritime features such as coastlines, bathymetric survey data, and nautical charts. It must also be considered in relation to vector datasets such as Automatic Identification System (AIS) shipping traffic, piracy incidents, and fishing activity.



Nautical chart data, such as the approach to Darwin, can be viewed in ArcGIS. (Maps © Commonwealth of Australia 2014.)



Group for High-Resolution Sea Surface Temperature (GHRSST) data can be served as a time-aware service. The time slider can be used to view the data over a period of time.

In addition to the volume of data, its analysis and dissemination is further complicated by the number of formats that are required by the agencies using it. These formats include Network Common Data Form (NetCDF), General Regularly-distributed Information in Binary (GRIB), and Tagged Image File Format (TIFF). All these data formats must be easily accessible.

The Solution

Using a combination of custom scripts and ArcGIS for Server, the HM Branch is able to satisfy a variety of requirements to quickly serve meteorological and oceanographic (METOC), bathymetric, and geospatial foundation data.

- Foundation data is served as Open Geospatial Consortium, Inc. (OGC), web services.
- Nautical charts and bathymetric data are served as OGC Web Map Service (WMS) with a REST endpoint and also as native GeoTIFF.
- The NetCDF weather data is published as WMS and Web Coverage Service (WCS) and served as NetCDF.
- The use of WMS and WCS also allows the use of OGC web processing services (WPS).

These make the data readily available for use in ArcGIS for Desktop and a variety of systems that use OGC web services.

The Result

The ability to load data, quickly develop products, and serve the resultant information in a variety of formats and web services are significant advantages when analyzing rapidly changing environmental conditions. These processes enable commanders and analysts to gain superior knowledge of their battlespace and environment, leading to the best course of action at both operational and tactical levels.

An Effective Tool for Drinking Water Protection

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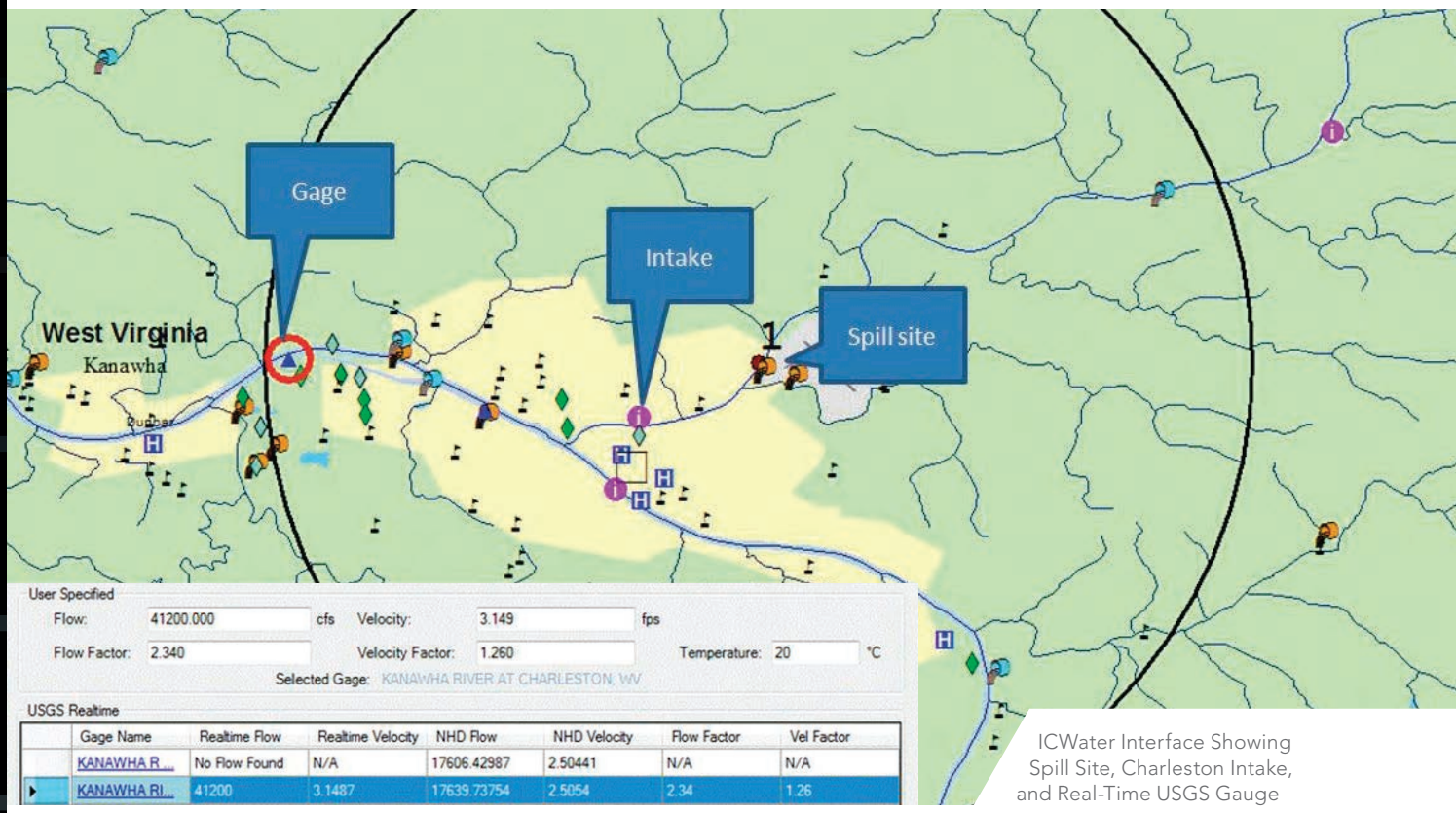
After a release of hazardous materials into a river or stream environment, drinking water protection and contamination risk mitigation require that information on the fate of waterborne contaminants be made available quickly to decision makers. The Defense Threat Reduction Agency (DTRA) has identified the Incident Command Tool for Drinking Water Protection (ICWater) as a forecasting tool that can be used to predict the consequences of a chemical, biological, or radiological (CBR) materials release within river or stream systems.

ICWater was designed to answer four critical questions:

1. Where is the contaminant going?
2. Is there a drinking water intake in its path?
3. When will it reach drinking water?
4. Is its level high enough to be a human threat?

The tool interfaces with the US Geological Survey (USGS) real-time stream gauging network. Contaminant travel time and concentration can be estimated at locations downstream based on conditions at the time of the spill. Several other relevant geographic databases are combined within the tool to provide information that incident commanders require. Information includes the location and contact information for all public drinking water intakes, dams, hazardous material sites, pipelines, bridges, and locations of critical infrastructure such as hospitals and fire and police stations. ICWater also contains a reference database that identifies the concentrations of CBR contaminants, which are a concern for human health if consumed in drinking water. River networks have also been developed for basins outside the contiguous United States, in Asia, Africa, and Europe. Upstream tracing of the river network can be used to identify sources of contaminants.



ICWater Interface Showing Spill Site, Charleston Intake, and Real-Time USGS Gauge

In addition to ICWater, models of water distribution (PipelineNet) and wastewater collection systems (SewerNet) have been developed for emergency management of CBR events. The tools have demonstrated usefulness for spill response and homeland security through their application in national and international events such as the West Virginia chemical spill and the Fukushima Daiichi Nuclear Power Plant incident. ICWater was developed by Leidos, Inc. (carrying on the legacy of Science Applications International Corporation[SAIC]), with funding from several government agencies, most notably the US Forest Service and DTRA. DTRA currently maintains, trains, and distributes the software to federal, state, and local users.

The Challenge

On January 9, 2014, an estimated 10,000 gallons of 4-methylcyclohexanemethanol (MCHM), an organic solvent used in coal processing, leaked from a ruptured container into the Elk River near Charleston, West Virginia. The spill, just one mile upstream from a water treatment plant, forced officials to ban residents and businesses in nine West Virginia counties from using the water for anything other than flushing toilets or fighting fires. An estimated 300,000 West Virginia residents were affected by the spill. ICWater model runs were initiated by DTRA, Leidos, and Greater Cincinnati Water Works (GCWW) to estimate the travel time and concentration of the spill.

ICWater Downstream Trace (120 hours' travel time) Showing Drinking Water Intakes

The Solution

ICWater, an Esri ArcGIS extension, uses the National Hydrography Dataset Plus (NHDPlus) river network for downstream and upstream tracing of contaminants. NHDPlus contains more than three million stream and river reaches, all hydrologically connected. Mean flow volume and velocity are attributes of each reach in the network.

USGS real-time stream flow gauges are linked to the network to update the mean flows and velocities to reflect actual conditions. The difference between the updated mean velocity in ICWater and the measured velocity on the Kanawha River (just downstream of the spill and the Charleston, West Virginia, intake) was less than 3 percent. The system also contains locations of industrial and municipal dischargers such as the spill site on the Elk River. It is also linked to the Environmental Protection Agency Safe Drinking Water Information System to provide data on populations served by each water utility downstream of the spill.

Tracing was initiated at the spill site to forecast the location of the leading edge, peak concentration, and trailing edge of the plume for drinking water intakes as far downstream as 200 miles. Model runs were updated based on MCHM measurements at downstream locations on the Ohio River to provide accurate forecasts to nearby water intakes.

The Results

GCWW, a large water utility on the Ohio River, used ICWater and National Oceanic and Atmospheric Administration velocity estimations, along with river grab samples, to determine when to close its intake to allow the spill to pass by. Data for Cincinnati showed good agreement (within several hours) between the observed peak time of arrival and the model's estimated peak time. The leading-edge predictions were also close to the observations.

According to GCWW, "The model was very useful in preparing for the arrival of the spill. It assisted in narrowing down an expected time of arrival and was especially useful in predicting the peak concentration. In spills such as the Elk River spill, GCWW normally closes the raw water intakes to allow the spill to pass."

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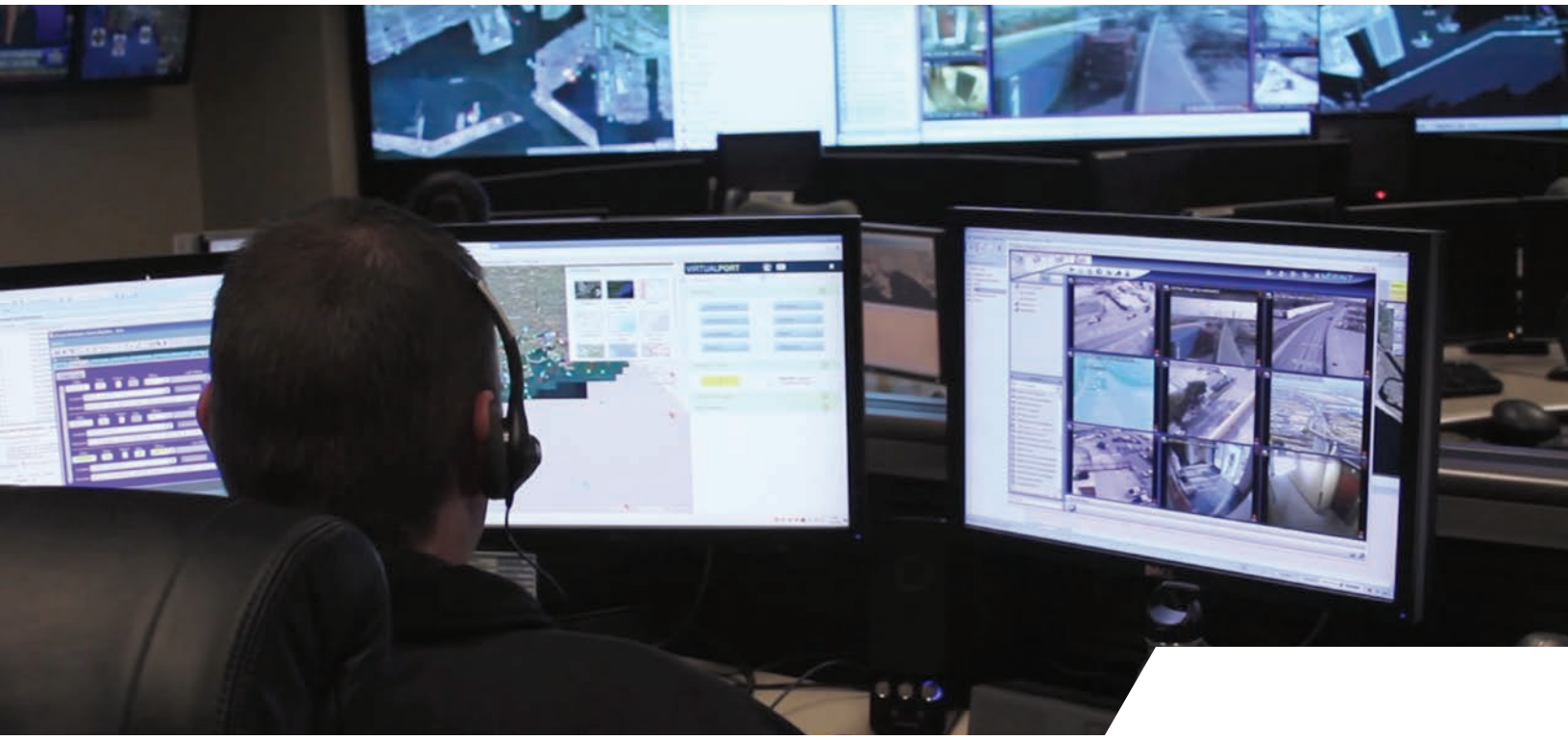
Keeping an Eye on the Port of Long Beach

Together with the Port of Los Angeles, the Port of Long Beach accounts for more than 40 percent of the containerized cargo and materials that enter the United States. The port supports more than a million jobs throughout the country and generates billions of dollars in economic activity each year.

With 3,200 acres of land and 80 berths, keeping track of everything that's occurring throughout the port is a difficult but critical task. Port officials must be aware of a variety of potential problems, from security concerns and environmental hazards to logistics and staff safety.

The Challenge

Given the size and complexity of port operations, the Port of Long Beach needed a way to prioritize the allocation of limited resources throughout the port complex. With literally hundreds of vessels, trucks, and containers moving at any given moment, port officials needed a way to easily identify irregular situations, such as people gathering near a gate, and ensure smooth operations. The port also coordinates with many other jurisdictions and agencies, ranging from the US Department of Homeland Security and the US Coast Guard at the federal level to local fire and law enforcement agencies in Los Angeles and Long Beach. When incidents occur, the port must be able to rapidly coordinate and share information with these various entities.



The Solution

The Port of Long Beach contracted with Esri Professional Services to develop a comprehensive geospatial technology-based security and business resiliency system called Virtual Port. Built with the entire ArcGIS platform, this open, configurable solution provides a common operating platform for port operations that pulls in open-source data from a variety of sources. With Virtual Port, leadership can view live feeds from hundreds of cameras in the port complex, get information about traffic conditions in and around the port, monitor social media, explore utility and communication networks, and track live weather conditions. The system also allows port officials to identify and monitor any vessels of interest within its sphere of influence and get an alert when suspicious or abnormal behavior is observed. All this information is presented in a map-based view that lets personnel see at a glance what's happening across the complex.

Because of security requirements, Virtual Port leverages Portal for ArcGIS, which is deployed behind the organization's firewall and restricts access to authenticated users. When information needs to be shared with the public, the port uses ArcGIS Online to create public-facing web applications. Mobile apps ensure that staff throughout the complex can stay connected to the system and maintain situational awareness at all times.

The Results

Virtual Port provides decision makers with instantaneous information from multiple response agencies that helps them identify which resources and assets are available and where they are at any time. As a shared system, Virtual Port helps leadership orchestrate resiliency and efficiency in the movement of cargo, which is the primary mission of the port.

When incidents—such as fire or the release of volatile chemicals—occur, the Virtual Port system used for daily operations becomes a platform for coordinating response. Rule-based alerts built with ArcGIS GeoEvent™ Extension

for Server provide instant notifications to port personnel when certain conditions occur, such as a vessel coming within the designated radius of a restricted area. This helps staff immediately identify unusual incidents. Multiple agencies can connect to Virtual Port and access its common operational picture to collaborate and share information, ensuring better business recovery and resiliency. Port officials can also run what-if scenarios that model chemical plumes and other potential hazards to help agencies prepare for and better understand the impact of possibly dangerous situations.

Virtual Port has been in place for several years and continues to evolve as new capabilities and technologies emerge.

Esri Training for National Security

Effective training is essential to build and sustain enterprise geospatial capabilities. Esri training options are designed to help geospatial professionals and other knowledge workers maximize their productivity with the ArcGIS platform.

Instructor-led courses take an immersive, experiential approach to learning. Their design incorporates proven adult learning principles and focuses on interaction and hands-on skills application. Self-paced e-learning courses cover focused geospatial topics and are a convenient option to provide on-demand access to training throughout your organization.

Esri domain experts have created a specialized curriculum to support the unique missions of national security organizations. Using a mix of instructor-led and e-learning courses, the curriculum addresses core concepts and best practices to visualize, analyze, and manage geospatial content. Courses use relevant operational scenarios to enhance learning and skills application.

To learn more, please visit esri.com/geospatial-skills.

Esri Technical Certification Program

The Esri Technical Certification Program is designed to create a community of qualified individuals who are proficient in best practices using Esri software. The program helps organizations maximize their investment in Esri technology by employing a work force certified in using best practices and assists with creating progressive professional development plans. Exams recognize expertise in desktop, enterprise, and developer domains.

To learn more, please visit esri.com/certification.

For more information, e-mail **GIStraining@esri.com**.

Understanding our world.

Esri inspires and enables people to positively impact their future through a deeper, geographic understanding of the changing world around them.

Governments, industry leaders, academics, and nongovernmental organizations trust us to connect them with the analytic knowledge they need to make the critical decisions that shape the planet. For more than 40 years, Esri has cultivated collaborative relationships with partners who share our commitment to solving earth's most pressing challenges with geographic expertise and rational resolve. Today, we believe that geography is at the heart of a more resilient and sustainable future. Creating responsible products and solutions drives our passion for improving quality of life everywhere.

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