National Flood Preparedness Guideline

Produced by:

NAPSG Foundation

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Contents

Disclaimer:

In this guideline, the National Alliance for Public Safety GIS (NAPSG) Foundation refers to individual companies and/or software applications. These references are made only as examples, and they do not constitute an endorsement by NAPSG Foundation. Nor does such reference constitute a guaranty that any tools referenced will function in all instances as described. NAPSG Foundation encourages all public safety agencies to rigorously test and price compare all options before making important purchases.

Introduction

Floods are one of the most common natural disasters in the United States and are only increasing in frequency, magnitude, and cost because of ever-changing weather patterns and the built environment. When a flood occurs, first responders must make life and death decisions under considerable time constraints.

In 2016, a group of first responders across the country developed the first version of the National Flood Preparedness Guideline to help jurisdictions prepare for, respond to, and recover from flood events by better utilizing technology, modeling, and core data needs. The problems identified included how data becomes actionable information and a lack of reliable, timely, and accessible information. The resulting guide provided three key sections:

1. Key Challenges in Flood-Prone Communities
2. Priority Information Needs
3. Workshop Facilitation

To streamline the new version, sections 2 and 3 have been removed. Section 2, Priority Information Needs, has been consolidated into the NAPSG Foundation managed ArcGIS Online Group All-Hazards Core Information Needs. This section was already designed for GIS and Information Technology support staff, and it continues the concept of providing key workflows and information needs for first responders. The geospatial resources can be accessed in a single location, identified as authoritative, and includes metadata to ensure you are accessing the most up to date datasets. Section 3, Workshop Facilitation, can be accessed in the archived version of the National Flood Preparedness Guideline.

To help develop this version of the National Flood Preparedness Guideline, hereinafter referred to as the NFPG, NAPSG Foundation brought together first responders, technologists, GIS professionals, flood modeling experts, the private sector, academia, and other subject matter experts in flooding to determine what has changed since 2016 and how this guide can continue to provide value. Through three virtual workshops, the group identified key data needs for the first responder community during flood disasters, as well as challenges facing the community. Major challenges such as the overwhelming amount of reliable, timely, and accessible information, the sophistication of flood modeling, and pace of technology innovation were identified and form the basis for the rest of the NFPG.

Major challenges that were considered for the first responder community during flood disasters:

- The overwhelming amount of reliable, timely, and accessible information
- The sophistication of flood modeling
- The pace of technology innovation

Using this guideline provides a starting point for discussions on common challenges related to flooding and is a jumpstart on assembling the right information needed to support critical decision-making. Although this guideline seeks to provide a snapshot of available data sources, modeling, and technology, we understand that the pace of innovation outpaces adoption. The following sections provide best practices, use cases, and additional resources from the public safety community and show how flood preparedness and response operations continue to evolve.

Chapter 1: Alert and Warning

People will often ignore or disregard alerts that could potentially save their lives. When alerts are not targeted at a specific population, or when they lack wording that makes the case for immediate action, citizens are less likely to take protective action. In addition, people who are traveling through unfamiliar places that have a significant flood risk may not be aware of the risk or the alerts meant to protect them.

The challenges associated with targeting a specific population with actionable alert messaging highlight the need to improve geotargeting and the need to make messages understandable to the public. Geotargeting refers to the use of location to alert specific areas, preventing over-alerting and reducing alert fatigue. Alerts and warnings should contain actionable directions written in plain language and include common symbology so that recipients are more likely to understand the severity and need to act.

Geospatial technologies provide the opportunity to enrich alerts and warnings through live, continuously updated maps, providing two-way communication platforms, enabling geolocation and targeted information, and incorporating existing vulnerability and data sources to improve the accuracy and effectiveness of messaging.

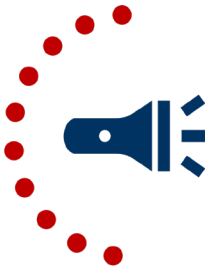
Key Takeaways

- Craft your messages in advance.
- Follow the EAS and WEA Standardization Checklists, including: message source, threat or event, location, timing, protective action to take, and expected end of event or update. If possible, indicate whether the recipient of the message has been geotargeted.
- Register with the IPAWs system and take courses from EMI to learn how to integrate it into your operations. Consider how to partner with the NWS to help distribute local alerts and warnings.
- Explore how social media can augment your alerting system and crisis communications during a disaster. Consider it a two-way communication stream and dedicate resources to manage this.
- Use geofencing to better target resources and alerts and work with your GIS staff to do so. Work with your local vendors to ensure they can support geofencing in their software.
- Use existing datasets to enrich your analysis and provide hyper-local alerts and warnings.

Challenges in Hazard Communications

Push notifications to cellular devices have become an increasingly important part of emergency alerts and warnings for all kinds of disasters. Common challenges faced by the first responder community include message fatigue, accuracy of geotargeting, and alert clarity.

A common need expressed by the first responder community is the need for alerts that more accurately target a location where the population is at risk. Rather than alerting an entire county or community (a common practice in weather events), warnings need to be more accurately aligned with the impending threat location to avoid over-alerting those who are not in harm's way. Unnecessary alerting can cause "alert fatigue" and lead to people ignoring the advice of the warning, both in the short term during the event as well as over the long term for future events. In addition to alerting the correct population, the warning language needs to be more actionable and include visual tools like symbology, maps, and other graphics to increase the rate at which recipients take protective actions.



Spotlight: Crisis Communication Catalog

Although jurisdictions have improved their alert and warning processes with their own population, they continue to struggle with visitors and those who have not signed up to receive messages. The Crisis Communication Catalog (CCC) seeks to provide a dataset of authoritative public information including social media accounts, authoritative law, fire, and emergency management websites, and other news sources. To learn more about the Crisis Communication Catalog, visit https://ccc.napsgfoundation.org/.

Targeted Alerting and Geofencing

Knowing whether a message has been geotargeted to the recipient is a critical aspect of convincing a person to act. If a recipient thinks the disaster warning applies to where they are located at that moment, they are more likely to take protective action. However, simply saying "this area" is a target of the disaster is ineffective. Recipients do not know from such a statement whether they have been singled out to receive the message. Using other descriptions of the hazard location can be too long or inaccurate, such as listing affected counties in the warning area or describing its scope using physical boundaries like roads (which non-locals are not likely to understand).[i] Using actionable language like, "If you receive this message, you are at risk," can work well to assure the recipient they have been targeted, but only if the alert was targeted to a sufficiently fine-grained location[ii]. Coupling this message with a visual cue such as their current location and hazard location will only improve the rate at which alerts and warnings are followed.

GIS can assist in this geotargeting by using a process called geofencing. To aid in the geofencing process, agencies can integrate their own sensor network (e.g., flood sensor,

cameras, etc.) with GIS to help monitor a weather event. By linking information from sensors into a GIS map, public safety officials can gain better situational awareness of the event with a more precise understanding to where the community is at risk. If a locality does not have gages or a sensor system that alerts a specific geographic area automatically, they can utilize national level sensors from the USGS, NOAA, and others.

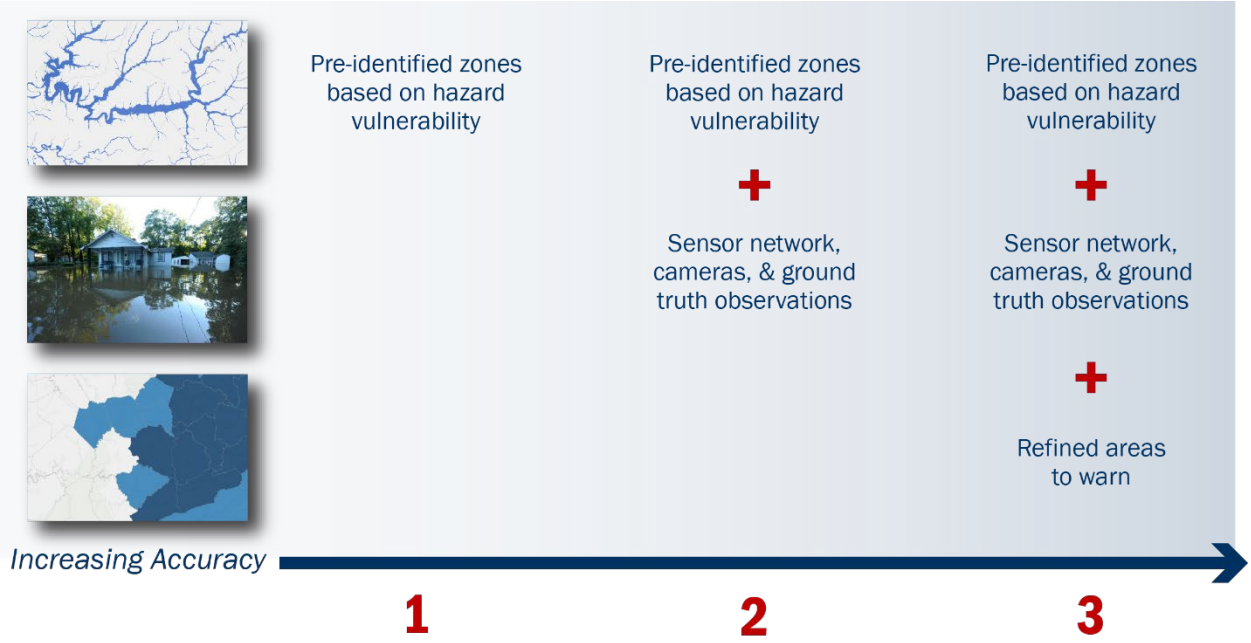


Figure 1 Increasing geofence accuracy

Agencies can still create custom geographies within GIS that reflect known at-risk areas or physical landmarks that are often impacted by flooding events by using floodplain maps, dam inundation areas and emergency action plans, or historical flood data as a starting point. These custom hazard area polygons can help first responders more accurately alert the population at risk rather than relying on traditional geographic boundaries.

Spotlight: Boulder Emergency Notification All-Hazard Polygons

Through Boulder Counties Geospatial Open Data Portal, the Emergency Notification All-Hazard Polygons map provides a set of pre-created polygons for reverse 911 notifications. Separate polygons have been created for flood and wildfire events and allows dispatchers to rapidly send notifications based on incident data.

Using Formal Systems: Integrated Public Alert Warning System (IPAWS)

The Integrated Public Alert Warning System (IPAWS) integrates several streams of alert messaging into one interface to increase coordination among alerting campaigns, reduce messaging and alert redundancy, and improve the clarity of public messages. IPAWS enables government authorities to use the Emergency Alert System (EAS), Wireless Emergency Alerts (WEA), and the National Oceanic and Atmospheric Administration (NOAA) Weather Radio alerting systems all from one interface. [iii]

Currently, 1,632 alerting authorities have adopted the IPAWS system.[iv] Alerting authorities at all levels of government are encouraged to use the IPAWS system and integrate their local systems into the IPAWS infrastructure. If a local system uses the Federal Emergency Management Agency's (FEMA's) Common Alerting Protocol (CAP) standards, it can be easily integrated into IPAWS. Training on how to participate in the program can be found through FEMA's Educational Management Institute (EMI).

The IPAWS EAS and WEA Alert Standardization Checklists provide the order in which a message should be composed, to include:

- The source of the message
- The threat or event
- The location affected
- Protective action to take
- When the threat or event will end and how new information will be received

Longer messages remain the most effective for encouraging people to take protective action during disasters when people often underestimate the risk, such as flash flooding. According to the Department of Homeland Security, 1,800-character (EAS) messages remain the most effective. This helps overcome "people's pre-alert and warning event perceptions of different hazards based on personal experience, and perceived risk and knowledge, which may or may not match the event they face."[v] Current character limits include:

- Emergency Alert System (EAS) – 1,800-character limit
- Wireless Emergency Alerts (WEA) – 360-character limit
- SMS Message – 160-character limit
- Twitter – 280-character limit

As smartphones and other technologies continue to improve and allow for more characters to be sent in an alert, links to maps and graphics generated by GIS is an effective way to communicate additional information that may otherwise exceed the character limit.

Warning Messages

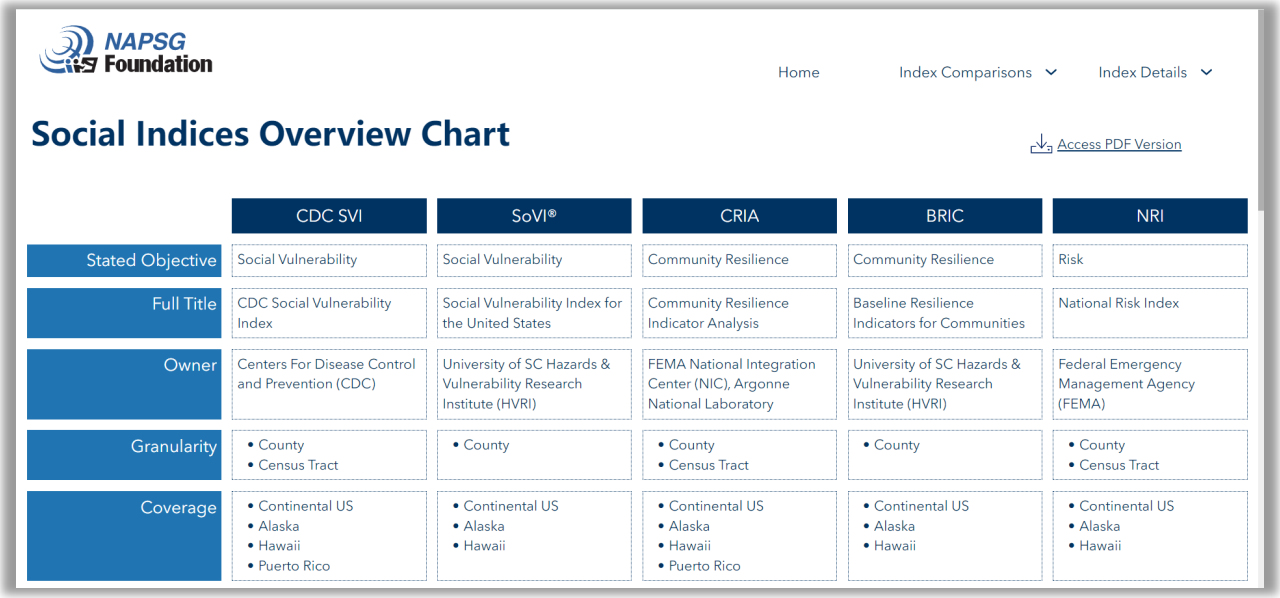
In studies, the Department of Homeland Security (DHS) found evidence that people respond differently to warning messages depending on the type of hazard. For instance, compared with tsunamis, when people received warnings about flash flood events, recipients had

"significantly lower levels of message belief and personalization." [vi] Messages about tornados and flash floods were also more likely to be misunderstood by the public, leading to the need for targeted campaigns such as the National Weather Service's, "Turn Around Don't Drown," to improve awareness of flash floods.[vii] The unique characteristics of a flash flood is an important issue faced by the first responder community when alerting the public. It is difficult for first responders to predict the timing and severity of flash floods, which makes alerting both critical to life safety and difficult at the same time. In addition, residents often doubt the credibility of flash-flood messages since they may not see any physical signs of the hazard around them until it is too late.

Understanding the Community

Understanding the community that will receive alerts and warnings is critical to the success of the program. Demographic information such as primary language spoken and access to social media platforms will impact who will receive the message and how they may act.

Consider leveraging "community brokers" or those with ties to specific populations. Coordinate with GIS staff to ensure that maps and applications are designed for the end user, knowing that the end user is varied and will be accessing this information in various formats (e.g., computer vs tablet vs phone). Consider utilizing available social indices datasets to better understand the community.



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Social Indices Overview Chart

Access PDF Version

	CDC SVI	SoVI®	CRIA	BRIC	NRI
Stated Objective	Social Vulnerability	Social Vulnerability	Community Resilience	Community Resilience	Risk
Full Title	CDC Social Vulnerability Index	Social Vulnerability Index for the United States	Community Resilience Indicator Analysis	Baseline Resilience Indicators for Communities	National Risk Index
Owner	Centers For Disease Control and Prevention (CDC)	University of SC Hazards & Vulnerability Research Institute (HVRI)	FEMA National Integration Center (NIC), Argonne National Laboratory	University of SC Hazards & Vulnerability Research Institute (HVRI)	Federal Emergency Management Agency (FEMA)
Granularity	• County • Census Tract	• County	• County • Census Tract	• County	• County • Census Tract
Coverage	• Continental US • Alaska • Hawaii • Puerto Rico	• Continental US • Alaska • Hawaii	• Continental US • Alaska • Hawaii • Puerto Rico	• Continental US • Alaska • Hawaii	• Continental US • Alaska • Hawaii

Figure 2 Social Indices Comparison

Constant testing and feedback will be critical to the ongoing success of these systems. Ensuring that the community understands the message by testing message variations, graphics, maps, and other information sources is important.

Warning Language

When crafting alerts, avoid technical language and instead use "plain language," the language used in ordinary, everyday speaking and writing rather than language which may not be understood by the average person. For example, the National Weather Service (NWS) constantly revisits their use of the terms "Watch," "Advisory," and "Warning," for describing weather events. Survey research they conducted confirmed widespread misunderstanding around the "advisory" term. To clarify these warnings, the NWS rephrased to longer messages like "The NWS forecasts the potential for…" or "The NWS advises caution for…" or "The NWS has issued a warning for a dangerous…". Using everyday phrasing instead of terms that require definitions increases the chances that the NWS's broad audience will understand the messages and act accordingly.[viii] In most GIS applications, there is an opportunity to provide helper text and legends to better explain different terminology.

Spotlight: Plain Language Action and Information Network (PLAIN)

The Plain Language Action and Information Network (PLAIN) is a community of federal employees dedicated to the idea that citizens deserve clear communication from government. PLAIN maintains a website of requirements, guidelines, examples, training, and resources. Visit https://www.plainlanguage.gov/ to learn more.

As seen in the graphic below, the NWS initiated a "Path Towards Simplification" by 2024. Watches and warnings will remain unchanged, but advisories and special weather statements will be converted to plain language headlines.

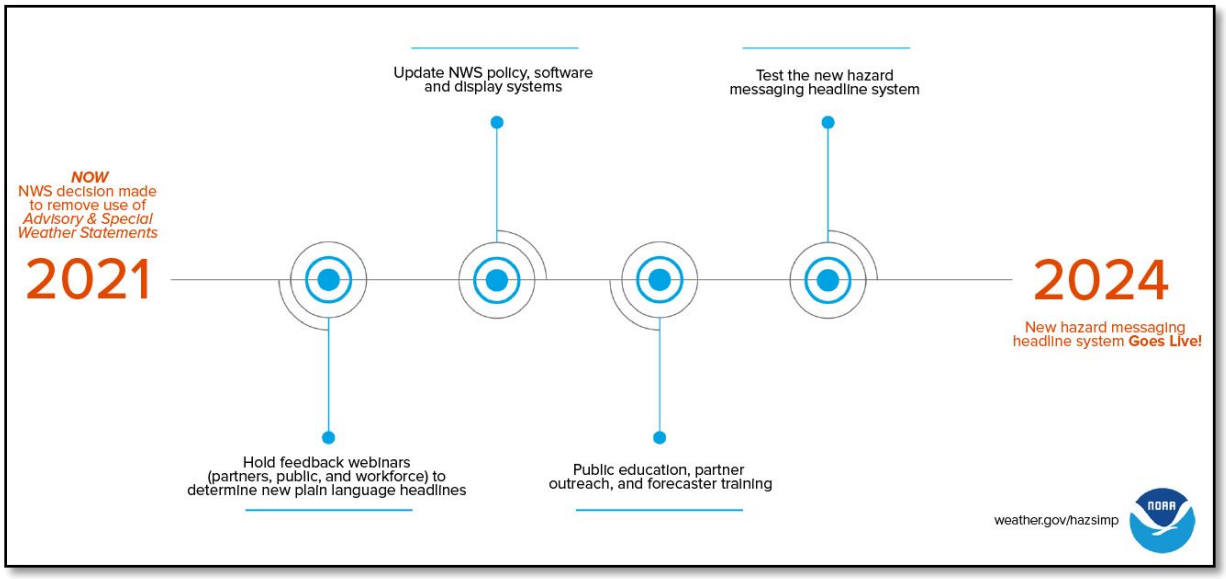


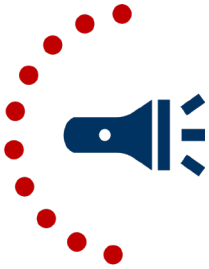
Figure 3 NWS Roadmap

The Potential of Social Media

Online communities like Facebook, Twitter, Nextdoor, and LinkedIn can broadcast hazard information to a wide viewership quickly, although these tools may not target the information to those who need it most based on location. In recent years, social media has also shown the potential to produce misinformation very quickly as messages are modified by users and passed among their individual networks. However, using social media is not just about broadcasting your message; it also is a tool for listening to the community and gathering additional situational awareness of an event in the community.

Geotagged social media content can easily be integrated into GIS as a data layer for additional situational awareness. Consider using ArcGIS StoryMaps, or preconfigured applications such as Esri's Emergency Management Operations Solution, or adding geotagged social media content directly to web maps. Numerous software programs have been developed to sort through social media posts and identify those relevant to a disaster before mapping them.

To improve the data quality of social media, DHS recommends that it be developed as a "science gateway" or portal with clearly defined tools, data, and applications that would "allow EMA [Emergency Management Agency] personnel to supervise the sharing of risk information publicly in a streamlined, consistent manner."[ix] Consider that the methods in which you broadcast geotagged content to the community and how you gather geotagged content into your operations may impact the reliability of incoming information. By also setting up lists of known or trusted users in your own network, you can more effectively leverage the social network to communicate accurate details into the community and amplify the overall message.



Spotlight: #firemappers and #photomappers

Leveraging crowdsourced and volunteer information can provide decision makers with immediate feedback during and after an event, sometimes before responders even arrive on scene. #firemappers leverages volunteers through CEDR Digital and GIS Corps to provide general awareness of wildfire activity and allows users to submit new wildfire locations that are not mapped in IRWIN/NIFC. #photomappers, through a similar process, helps to gather, upload, vet, engage, and analyze geolocated damage photos from social media, news reports, and people in affected areas to provide rapid initial damage assessments.

Chapter 2: Resource Management and Coordination

First responders who manage resources are challenged with how to improve the processes for identifying, requesting, and sharing their own resources with other departments and jurisdictions. Flash flooding and other no-notice events can exacerbate resource management and coordination challenges, often leading to double counting of resources or creating an environment where the fastest, not the most in need, jurisdictions receive resources. Resource management activities are also often complicated and dependent on the unique circumstances of local jurisdictions (e.g., volunteer organizations, private EMS providers, automatic aid).[x] Resource management tools that accurately estimate resource availability and facilitate communication between agencies, especially if they can do so in real-time, can help first responders better leverage their resources and respond more effectively to disasters.

Key Takeaways

- Review and implement NIMS protocols and procedures for resource documentation and management. Build Mission Ready Packages to fully understand the supporting factors for a resource to sustain it over the duration of an event.
- Strive for interoperability with other industry and discipline specific systems such as EMAC's MASS resource management system, or by utilizing open standards.
- Utilize RIS, OneResponder, and the RTLT from FEMA to improve your preparedness posture and provide the community with an awareness of your resources and personnel.
- Design a resource management dashboard to help operationalize your resources in relation to current event data. These dashboards may contain resource and personnel location, availability, and associated attributes like resource costs and points of contact. Resource management dashboards should cover preparedness, response, and recovery efforts.

Existing Federal Systems

FEMA addresses resource management through its National Incident Management System (NIMS), a comprehensive approach for how to structure incident command systems. NIMS is meant to standardize operational structures and actions to facilitate cooperation between public and private entities during disasters. Regarding resource management, NIMS delineates what resources are required for different disasters and how they are to be ordered, reported, and mobilized.[xi] FEMA also provides resource management guidance through the NIMS Guideline for Resource Management Preparedness and NIMS Guideline

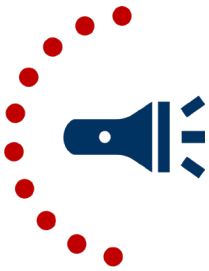
for Mutual Aid. To aid the community in implementing NIMS and to support a consistent approach for resource management, FEMA provides the National Resource Hub. The National Resource Hub serves as a no-cost suite of web-based tools for all state, local, tribal, and territorial government agencies, non-governmental organizations, and other mission partners.

One tool within the National Resource Hub is the Resource Inventory System (RIS), a software tool that "is a centralized, secure, and cloud-hosted resource inventory solution… designed to help your organization implement NIMS by supporting both resource inventorying and typing practices. The tool can be used to inventory equipment, personnel, teams, facilities, and supplies."[xii]

FEMA works in conjunction with the Emergency Management Assistance Compact (EMAC)—the national disaster-relief compact that helps during governor-declared states of emergency or disaster, allowing states to send personnel, equipment, and commodities to assist with response and recovery efforts in other states. EMAC provides agencies with the construct to build Mission Ready Packages (MRPs). MRPs contain details about the resource and a breakdown of the personnel, equipment, travel (lodging, meals, etc.), commodities, and other items along with their associated costs.

For more information on these federal systems, please see:

- NIMS: https://www.fema.gov/national-incident-management-system
- The National Resource Hub: https://preptoolkit.fema.gov/web/national-resource-hub
- EMAC: https://www.emacweb.org/
- MRPs: https://www.emacweb.org/index.php/mission-ready-packages



Spotlight: National Resource Hub

The National Resource Hub (NRH) consolidates existing FEMA-provided systems including the Resource Typing Library Tool (RTLT), Resource Inventory System (RIS), and the OneResponder Qualifications Management System. The NRH is a no-cost solution and provides web-based tools for resource management preparedness.

National Resource Hub

Unifying Resource Management Nationwide

GIS provides data management capabilities that support all these efforts, and it also has functionality that enables users to analyze the relationships between resources and many other variables in a disaster to support response operations. During every phase of a disaster, the locations of resources are critical to decision-making. Location information,

such as proximity to certain populations, infrastructure, or hazards, is a deciding factor in whether to deploy resources or where resources should come from when making a request. Location information is best stored in GIS, where it can be used as an organizing principle when performing analysis. Not only do maps quickly and clearly visualize operational information, but they also allow the user to query data based on location quickly and accurately. Questions such as how many civilians are within the reach of different assets, what routes are available for transporting resources, or what staging locations are available can be answered most accurately and in the least amount of time by GIS.

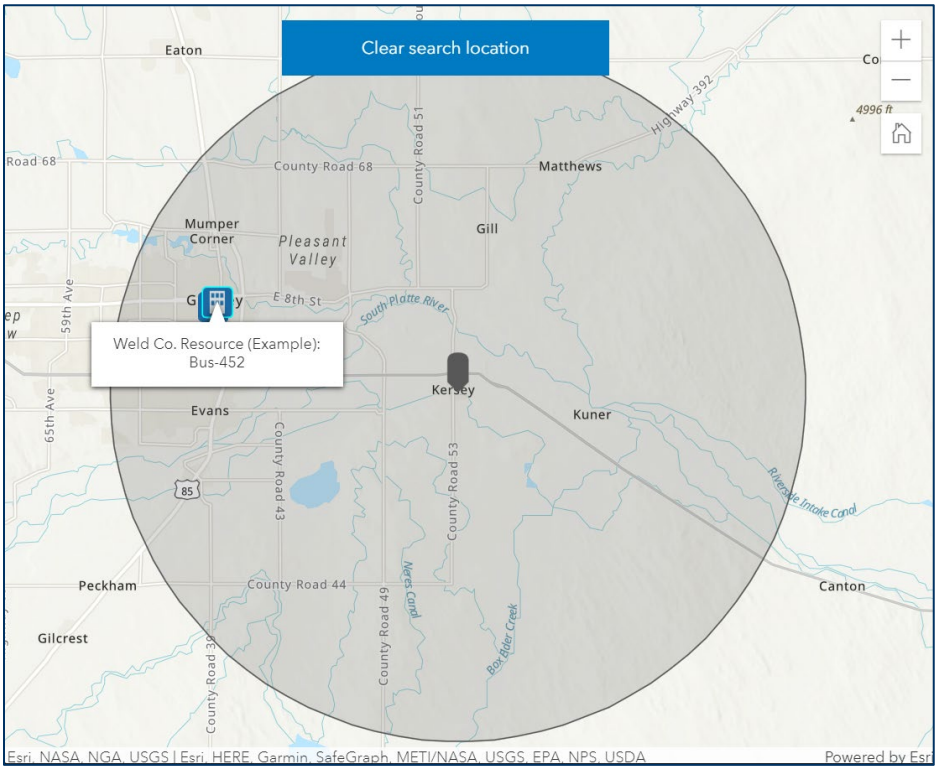


Figure 4: Notional Application Depicting Available Resources within a Given Distance

Other Mutual Aid Systems

Although interoperable multi-disciplinary and multi-jurisdictional systems are ideal, some legacy systems and use cases necessitate discipline specific solutions. One such system, the Interagency Resource Ordering Capability (IROC), is a "dynamic, modern, flexible and scalable application that aligns with interagency business needs for resource ordering for all hazard incidents." The successor of the Resource Ordering and Status System (ROSS), IROC provides a mutual aid system for mostly fire-based resources.

Resource Management Dashboards and Technology

Resource management dashboards help first responders make more informed decisions. A dashboard refers broadly to a visual display designed to deliver actionable information quickly and clearly to decision-makers within an organization. It is typically a collection of applications, widgets, and data that provides useful and relevant information to whoever

interacts with it. Dashboards are completely customizable and are an effective way of integrating geospatial information to enhance daily decision-making.

Dashboards may be well-suited to managing public safety resources if resource availability is regularly updated. A dashboard can be designed to track equipment (such as vehicles), personnel, and even consumables such as personal protective equipment (PPE). Dashboards can be used during preparedness activities to support readiness exercises, during response by helping responders make resource allocation decisions based on current conditions and potential impacts, and in recovery to aid in the demobilization process.

Based on research by NAPSG Foundation, an effective resource management dashboard should be capable of providing the following information that may be contained within resource management systems:

- **Event description:** type, complexity, extent, and general location.
- **Event forecast/magnitude and prediction:** direct and indirect impacts to communities.
- **Demographic trends**: population, number of households, primary languages spoken, socio-economic/income brackets, populations with access or functional needs, transportation dependencies, and analysis of commodity and support service requirements.
- **Critical infrastructure impacts:** community lifelines such as transportation infrastructure, electricity, communications, health systems, etc.
- **Mission/mobilization requests:** details regarding response area timing and staging.
- **Resource kind:** consistent with NIMS resource typing definitions.
- **Resource status/availability:** response availability of a given resource and for what type/level of mutual aid.
- **Deployment time:** how long it will be until the resource arrives at staging and can be employed in operations.
- **Resource cost:** estimated cost of a resource and identification of "responsible party" with fiscal obligation to pay for the resource, searches Mutual aid agreements that involve direct payment.
- **Home and Present Locations:** the resource's home location and present location.
- **Contact and Owner Information:** point of contact for the resource as well as ownership information.
- **Time/Date stamp:** the last update of the resource attributes.

Consider utilizing an application programming interface (API) to easily share data across systems. A dashboard should also be linked with official documentation or processes required to officially initiate mutual aid requests and other actions.

Chapter 3: Modeling and Trigger Points

During a flash flood event, information delays put lives at risk. Decreasing the time information takes to arrive in a decision maker's hands is vital to saving lives. Predictive modeling, integrated sensors with known triggers, and pre-planned information products can inform timely decision-making.

Response to flooding events typically includes a four-step process: estimate impacts, identify critical interdependencies, anticipate resource requirements, and provide response assessment. To do this efficiently, subject matter experts with relevant expertise must incorporate rapid hydrology and hydrologic (H&H) modeling. While there are numerous models employed from the local to national level, we have chosen to highlight a few of the most common ones utilized.

Key Takeaways

- Understand your flooding risk and the potential impact of floods on your community by using modeling tools like Hazus. Build expertise in these more advanced tools before an event occurs.
- Strive to replace national datasets with locally sourced data. This data is typically more accurate and current and will provide better model outputs.
- Integrate data from models, such as the National Water Model, into GIS and operations for more actionable alerts. Learn how the new model can help with alerts for streams near your location and find the point of contact for your area to train and exercise.
- Work with partners (USGS, NOAA, etc.) to increase local sensor networks. Consider investing in low-cost sensor systems where appropriate to speed up the alerting in critical areas. These sensors can help you identify needed actions in common data "blind-spots" – areas where more formal and expensive sensors do not exist.
- Develop known trigger points of when to act and integrate these trigger points into GIS and other protocols. Work with your staff to transition this knowledge into data that can help "trigger" actions more quickly in the absence of sensors and data.

Flood Models

Utilizing flood modeling during preparedness activities helps with establishing resource needs and improves alert and warning polygons. The following models are not exhaustive of the models that exist.

US Army Corps of Engineers (USACE)

The Corps Water Management System (CWMS) models can estimate inundation using formulations of HEC-RAS (Real Time Simulation). These models take NWS Forecasts, hypothetical events, and real-time streamgage data and provide inundation mapping for operational decisions. Models are either calibrated and validated prior to an event, or CWMS models can be deployed in regions where existing CWMS models have not been fully deployed or developed. The later have not been calibrated or validated and use the best available information. During an event, the models can typically run once per day. Also of note, USACE inundation libraries including dam break and levee breach inundation libraries.

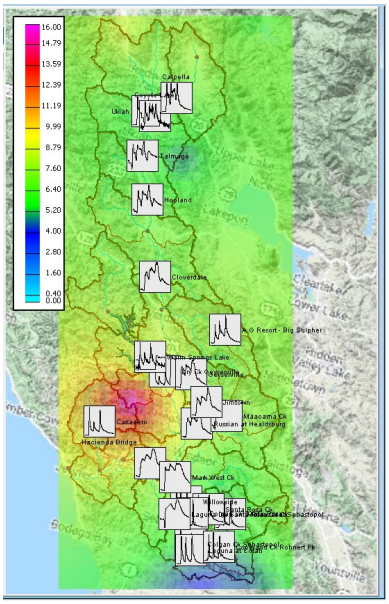


Figure 5 HEC-RAS example

US Geological Survey (USGS)

Inundation mapping corresponding to NWS flood categories were developed for select USGS gage locations by the USGS or submitted by partners if the modeling meets specific documentation and performance standards that align with the NOAA Advanced Hydrologic Prediction Services (AHPS) standards.

The Interagency Flood Risk Management (InFRM) team is a regional interagency coalition comprised of FEMA, USACE, USGS, and NWS offices within the domain of FEMA Region VI. The InFRM team has designed an interactive web application, the Flood Decision Support Toolbox (FDST), to display mapping libraries and current-flood related weather conditions within FEMA Region VI.

Integrated Flood Inundation Mapping (iFIM) Concept

The Integrated Water Resources Science and Services (IWRSS) agencies are working towards an integrated Flood Inundation Map (iFIM) that identifies and employs “best available” IWRSS-agency maps as appropriate during a flood event. IWRSS agreed to coordinate the integrated map via the NWC as the authoritative voice speaking for the group. The proposed concept maintains National Water Model maps as a background layer across the Continental United States (CONUS), with other maps slotting in to form the integrated map. This is enabled through a decision tree to identify the best available map given a variety of factors. The iFIM could be enabled through investment in either shared cloud computing and storage environment or “bring your own” infrastructure model.

Hazus

FEMA provides guidance to state and local authorities regarding how to estimate potential losses from natural disasters. Hazus is a free GIS modeling tool used for estimating potential impact and damage from floods, hurricanes, and earthquakes using the latest in scientific knowledge. Hazus has been used by FEMA for many years. It continues to be refined and is updated often.[xiii] It should be noted that Hazus requires GIS expertise and specialized training on the use of the package. It also utilizes national level data, which are often less accurate and less up to date than locally available data. Where possible, utilize local data first to achieve the best outcomes.

Using Hazus, jurisdictions can create a realistic picture of the damage they will need to address after a disaster, including:

- Physical damage to residential and commercial buildings, schools, critical facilities, and infrastructure
- Economic loss, including lost jobs, business interruptions, repair, and reconstruction costs
- Social impacts, including estimates of shelter requirements, displaced households, and population exposed to scenario floods, earthquakes, and hurricanes.[xiv]

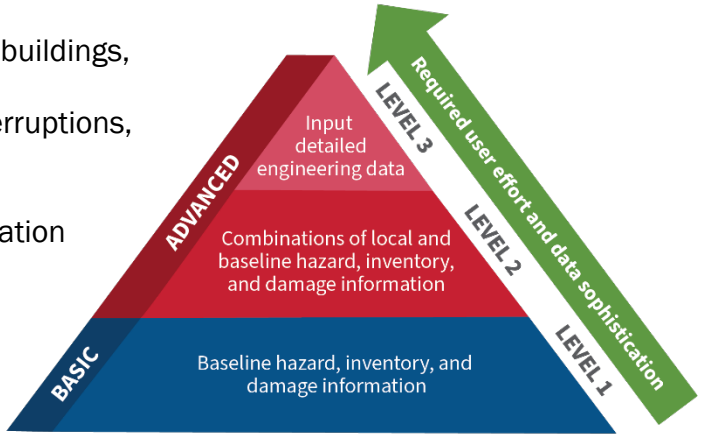


Figure 6 Hazus level of effort

FEMA also provides the Hazus Loss Library. The Hazus Loss Library is a centralized repository for accessing natural hazard risk information, curated by FEMA's Natural Hazards Risk Assessment Program (NHRAP). The goal is to make quantifiable risk information accessible nationwide to improve mitigation strategies, response efforts, and to expedite recovery.

National Water Model

In August of 2016, the National Oceanic and Atmospheric Administration (NOAA) released a flood forecasting tool which reportedly represents the largest advancement in flood prediction modeling in the country's history. [xv] Called the National Water Model, it is run on a Cray XC40 supercomputer and analyzes data from over 8,000 U.S. Geological Survey (USGS) gages across the country. The model can simulate conditions for more than 2.7 million river reaches across the country's river network and creates forecasts for the entire network every hour. Before the National Water Model, NOAA could only predict conditions for approximately 4,000 locations every few hours.[xvi]

There are numerous ways emergency managers and agencies can use this information to better prepare for and respond to floods. Data from The National Water Model can be used by states and localities across the nation to monitor potential flood event forecasts both in the short-range (0-15 hours) and long-range (0-30 days) time periods. This provides much more targeted stream forecasting and supports more actionable decisions at the local level.

National Oceanic and Atmospheric Administration (NOAA) National Water Center (NWC)

For all National Hydrography Dataset - Plus (NHDPlus), the NWC has developed pre-computed Height Above Nearest Drainage (HAND) Inundation Libraries. The interpolation process is conducted for a range of discharge values, and a pre-computed library is built from these estimates. The forecast is provided for the 5-Day maximum NWS RFC streamflow forecast and for the 18-Hour, 3-Day, 5-Day, and 10-Day NWC NWM (National Water Model) streamflow forecasts.

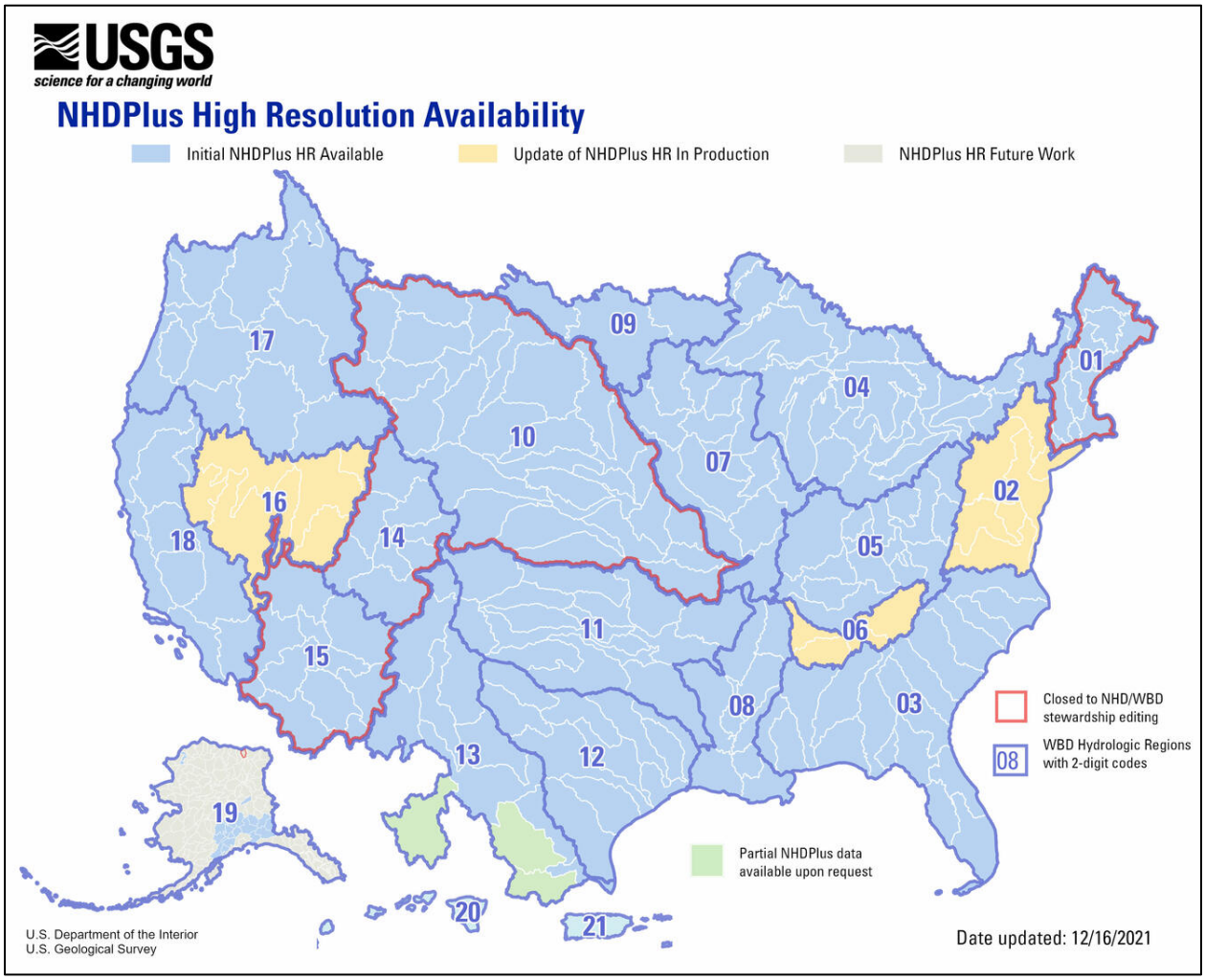
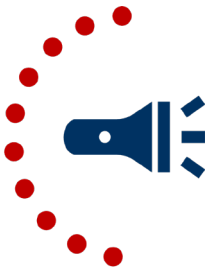


Figure 7 NHDPlus HR Status Map

Considerations with Flash Flooding

Unlike fluvial or coastal flooding, flash flooding is characterized by its sudden onset, sometimes in places with no other signs of a weather event. Flash flooding is the product of rising waters in a location with impermeable ground surfaces, or fully saturated soils, which produces runoff because the ground cannot absorb the excess water. Urban environments are particularly at risk for flash flooding due to the prevalence of concrete and other impermeable building materials. This runoff water then moves quickly across a landscape, building momentum, and sweeping up cars, civilians, and structures in its path. A flash flood can travel a long distance, impacting locales far from the original source of excess water. Irregular or hilly topography can exacerbate the movement of excess runoff, making flash floods stronger and more dangerous. Out of 457 deaths caused by weather related hazards in 2020 (the latest update of the Summary of Natural Hazard Statistics from the National Weather Service[xvii]), 39 of those were due to flash flooding – the fifth most of any hazard reported.



Spotlight: Community Flood Resilience Support System (CFRSS)

Compound flooding caused by the combined effects of tides, storm surges, inundating precipitation, and river discharge can be difficult to model. A DHS S&T partnership with Deltares USA looks to simplify this process through a new community-oriented, flood-hazard modeling and impact assessment decision support tool known as the Community Flood Resilience Support System (CFRSS), which uses open-source data, models, and software. This is currently being tested in Charleston, SC, and will help communities "make informed decisions around flood risk and climate mitigations."

Because flash floods require the right combination of favorable meteorologic and hydrologic conditions, predicting their occurrence can pose technical challenges that are often beyond the scope of existing tools and systems. The American Meteorological Society explains that "gaps exist in hydrometeorological research/technological approaches," and that research into hydrologic models that properly model runoff, soil moisture, hydrologic response of urban areas needs to be conducted. Furthermore, the Society says that the impact of spatial scales of soil moisture is an area of essential importance to understanding flash flooding and that "data requirements for conducting the research and developing predictive models necessitates the utilization of geographic information systems for specifying catchment geometrical properties pertinent to surface runoff development." The Society concludes that flash flooding patterns are so particular to local environments that "fundamental

uncertainties are inherent in any attempt to forecast these events." [xviii] Common variables that influence flash flood forecasting include: [xix]

- knowing how much water runs off (as well as where it runs to)
- how strong the stream is flowing
- how wide an area is getting rain
- how hard and fast it is raining
- how long it has been raining in a particular drainage basin
- where the storm is located and how fast or slow it is moving
- how porous the soil is and how much water it already holds
- the amount of vegetation covering the soil
- how much surface is paved
- whether there are storm drains or closely spaced buildings
- the general geography and slope of the land

Given the limitations of current flash flooding research and technology, localities that face flash flooding should make every effort to document local knowledge of flash flooding patterns, dynamics, topography, and elevation patterns to disseminate among staff, and integrate it into operational protocols. Because there is often little time to issue alerts based on sensors and models, having these pre-determined actions in place is critical.

Emergency managers often rely on informal means to understand and respond to flash flooding. For example, when an area prone to flooding reaches a certain level, they know that there will be flash flooding consequences in another location. Because of this, they made need to rely upon certain personal connections to initiate operational responses instead of waiting on sensors and modeling data.

Develop Trigger Points

One effective way to address the unpredictable nature of flash flooding is to integrate known "trigger points," or thresholds, into a location-enabled GIS system or dashboard. Locally understood trigger points should be discussed and documented as events that will trigger certain response actions. Where possible, sensor technology or gages can be used to help alert that a trigger point has been reached.

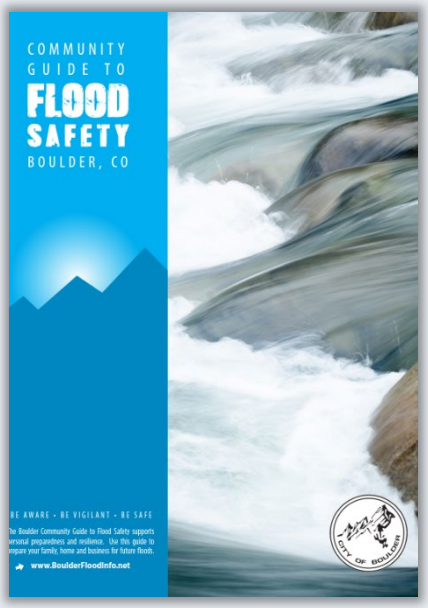
Mapping the location of trigger points and incorporating them into mapping applications will make the most of this local wisdom. Mapping applications will help emergency responders analyze the broader impacts of trigger points as well as help model their role in disaster scenarios. By locating and mapping the known trigger points in context with other data, emergency response personnel will be able to better prepare for an event's potential impact on nearby populations, infrastructure, and environment. Loading trigger points into GIS maps and applications will also automate workflows and protocols in the event of a disaster.

Trigger Points: Educating the Community on Early Warning Signs

Another way to integrate known trigger points into your response protocols is to create a community education program centered around them. Trigger points should be conveyed with specific and clear ways that residents can observe early warning signs and instructions on what to do. GIS provides communities a way to analyze and understand where populations are most at-risk and the characteristics of that population. Developing this knowledge in advance can help communities more effectively target and educate citizens.

Spotlight: City of Boulder

The City of Boulder (CO) created the Community Guide to Flood Safety to provide information about what to do before, during, and after a flood. Topics include flood history, mitigation projects, maps and floodplain regulations, information about protecting your property and flood insurance, flood protection measures, and how to access flood alerts and other emergency notification systems.

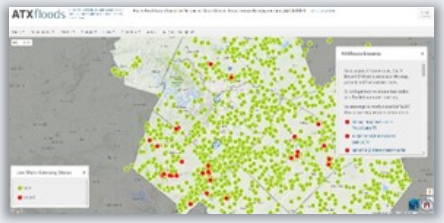


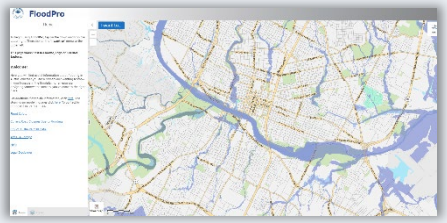
Like fire emergency protocols in office buildings, agencies can create community hazard groups for civilians in flood zones to help them protect themselves in a disaster scenario. All members could sign on to an action plan that goes into effect given a certain trigger point, and designated leaders could initiate the action plan. A hazard group could use any number of tools or applications based on GIS to rapidly communicate with each other with warnings and alerts if a trigger point is reached. Like a building fire marshal, leaders could also account for all members of the group in a disaster. The group could also help emergency managers by reporting to authorities if trigger points are reached as well as whether any of

their members are known to be in danger. Finally, research by DHS shows that individuals are more likely to act when those in their social network do too. When they receive alerts from emergency authorities, people check with family and friends before they act.[xx] Putting information directly into the hands of communities at risk, and bringing them together as a group, will empower them to act more decisively when disaster hits.

Spotlight: City of Austin

The City of Austin maintains a listing of known lower-water crossings and common locations that "trigger" actions when activated. This data evolved into what is known as the ATXfloods website to help alert the community to flash flood hazards. Visit the site to learn more! Another application is FloodPro, which provides the community with useful information about floodplains and stormwater design.



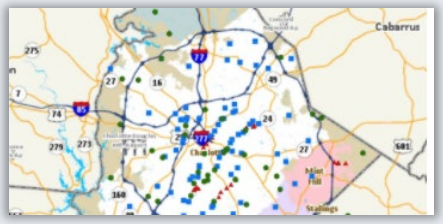


Using Low-Cost Sensors

For many local jurisdictions, the cost of installing, maintaining, and operating traditional sensors is prohibitive. Working with partners like the USGS, NOAA, and others to jointly build out the sensor network is a common approach. However, innovation in sensor technology – specifically smaller and lower costs sensors – increasingly provides jurisdictions with alternatives to fill the gaps in traditional sensor networks.

The Department of Homeland Security's Science and Technology Directorate (S&T) partnered with small businesses to develop a network of inexpensive, deployable flood inundation sensors. These sensors help fill in gaps and provide greater coverage for flood events.

Spotlight: Charlotte-Mecklenburg Storm Water Services



Charlotte-Mecklenburg Storm Water Services (CMSWS) incorporated low-cost flood sensors into their Flood Information Notification System (FINS). To learn more about the low cost flood sensors, see this technical article and the installation guide.

Chapter 4: Data Management and Interoperability

As the use of modeling, sensors, and the availability of incident-specific information becomes more readily available, there is a need to ensure that the information is trustworthy and includes adequate checks and balances. This can be achieved through data standardization practices, to include accurate metadata and data transparency. Data should also be put through a rigorous quality assurance and quality control process (QA/QC). Once these are accomplished, jurisdictions can confidently use the data for operational purposes as well as securely share it with collaborating partners. It should also be managed in such a way as to not overwhelm users who are looking to utilize either base or incident data. The data should be used in everyday workflows and incorporated into exercises whenever possible.

Key Takeaways

- When using data feeds from outside providers, refer to the metadata, including timestamps and confidence levels when making critical decisions. Provide the same for your internal, locally sourced data and information products to support critical decisions.
- Utilize standard symbology to bring clarity and common understanding across all your applications. When you begin to share information within and among partner organizations, common symbology helps to tell a clear story. A public safety symbology guideline and library are available in the NAPSG Symbol Library.
- Implement rigorous QA/QC practices for geospatial data. This includes regularly maintaining sensor systems to ensure they are operational and testing their integration into decision-making products like maps, applications, and business systems.
- Utilize data sharing best practices and build an information hub to manage and exchange data within your organization and across partner agencies. Common platforms exist that allow you to exchange data in both public and secure ways. Leverage community best practices and solutions where appropriate to allow for the broadest interoperability of your chosen system.
- Utilize information sharing standards such as those outlined by the Organization for the Advancement of Structured Information Standards (OASIS).

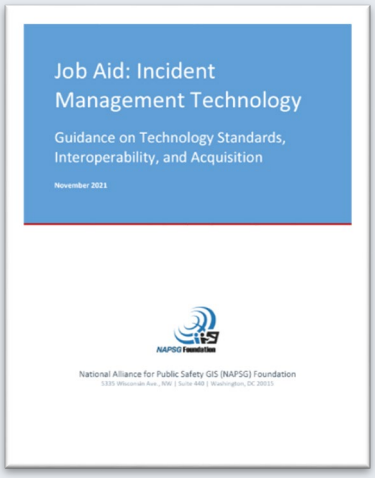
Data Standardization, Transparency, & Interoperability

The Federal Geographic Data Committee (FGDC) is the lead entity for the "development, implementation, and review of policies, practices, and standards relating to geospatial data" within the United States.[xxi] Whenever possible, agencies should use FGDC-endorsed standards to facilitate the use and sharing of geographic data. According to the FGDC, "Standards harmonize technical specifications of products and services; make industry more efficient; optimize operations…improve quality; enhance customer satisfaction…and benefit users by reducing costs and enhancing performance."

Agencies should also adhere to strict metadata standards. Metadata is defined as information about data and helps to document the who, what, when, where, how, and why of the data. Metadata is critical to geographic data discovery, access, assessment, integration, distribution, and archival. It can help all users of the information better understand its value and intended use, and it can start a dialogue about its quality and reliability for critical decision-making. For example, data sources intended to help responders make real-time decisions should include timestamps within its metadata. Timestamps with the last update period help first responders know how current the information is, which is a simple step that can go a long way towards increasing the trustworthiness and usability of data for decision making. You can find out more about metadata standards and how to implement them for your agency at www.fgdc.gov/metadata.

Spotlight: Information Sharing Standards

Incident management technology helps support the public safety community by managing resources and mutual aid information. NAPSG Foundation has published Version 3 of the Guidance on Technology Standards, Interoperability, and Acquisition to help agencies and technology developers utilize interoperable data standards.



Additionally, data transparency and interoperability should be a primary goal where possible. Data transparency is the "assurance that data being reported are accurate and are coming from the official source." One way to improve data transparency is with confidence levels, such as weather predictions from the National Weather Services (NWS), which should be included with forecast information to help decision makers know when and where to act. As confidence levels are increased, decision makers also increase their trust in the data source.

Data interoperability is defined by the Geospatial Interoperability Reference Architecture as "the ability to transfer and use information in a uniform and efficient manner across multiple organizations and information technology systems. It is the ability of two or more systems or components to exchange information and use the information that has been exchanged.[xxii]" To promote data interoperability, agencies should refrain from implementing proprietary systems that use non-standard data formats that cannot be easily exchanged between systems.

Utilize Standard Symbology

To increase the confidence and trust of operators and first responders in communications, it is important to use consistent and clear conventions. During fast-paced disaster response efforts, which usually use visual tools like maps, it is especially useful to adopt visual symbols for common incidents and operations. In 2008, NAPSG Foundation identified the need for a common set of incident symbology across the public safety community. It created a working group devoted to harmonizing existing standards and designing a standard incident symbology and framework for everyday incidents and response operations that would be governed by the principles of the Incident Command System (ICS) and NIMS. The symbols NAPSG Foundation designed are categorized into three major types: pre-incident, hazard, and incident command. The working group designed the symbols to communicate a hierarchy of information, to be flexible and to adapt to different map scales.

Symbology Jumpstart Toolbox

- NAPSG Symbol Library
- Incident Symbology Framework & Guideline
- Technical Implementation Guidance: How to implement the guideline
- Technical User Guide: How to download and install symbols from the library

Data Quality Assurance and Quality Control (QA/QC)

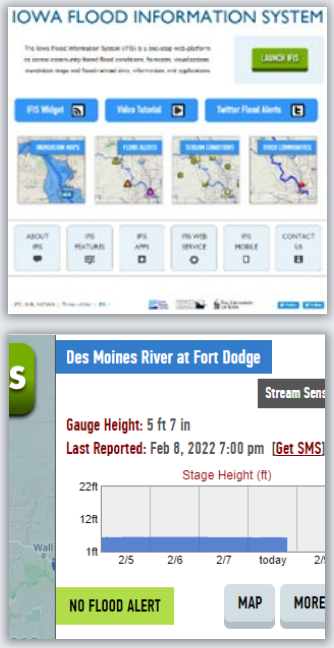
Agencies should create, document, and implement a thorough data QA/QC strategy throughout the entire data lifecycle. Quality Assurance is the process or methods to help prevent errors from being introduced into the data. This can be accomplished by using standard data models and schemas, standard data collection processes, and editing templates. Editing templates are one method of data validation and ensure a permissions-based process, whereby the user can only enter data into specific fields and in specific formats. Quality Control on the other hand is the processes or tools to identify errors that are already in the data[xxiii]. These can be Standard Operating Procedures (SOPs) for manually checking and approving field data as well as the use of automated geoprocessing models that can identify data errors.

For agencies utilizing remote sensors, such as low-cost flood sensors, sensor management and maintenance, to include QA/QC processes, should be a central part of their preparedness strategy. In 2016, failure of a sensor and gate system along a commonly flooded road in Pittsburgh was blamed for the deaths of four people during a flash flood. The City of Pittsburgh did not know that it was responsible for maintaining the sensor and gate; it had been turned over to the city in 2013 from another governmental agency and dropped from the city's rolls during a change in administration.[xxiv] This example shows how easily systems and sensors can become stagnant. It is important that public safety agencies cooperate effectively and clearly delegate maintenance responsibilities to ensure sensors work when they are needed. Integrating sensor data into a public safety dashboard or GIS system will not only enhance situational awareness and operational effectiveness, but also keep this data in a centralized database that can assist in operational continuity during staff changes before, during, and after an event. It should be noted that sensors should be incorporated into exercises to further confirm their operating status and let decision makers practice utilizing them for trigger points.

Likewise, QA/QC processes should be integral to field data collection workflows. The Search and Rescue field data collection tools developed under the DHS S&T supported Technology Innovation for Flood Preparedness and Operations project incorporates a data approval processes. Any human interaction waypoints that are recorded in the field are flagged in the tactical dashboard and personnel are required to follow up on them to confirm the data is accurate. Data can also be restricted from being displayed on the Strategic Dashboard used by senior leaders until it has been reviewed and approved at the tactical level.

Spotlight: The Iowa Flood Center

The State of Iowa and the University of Iowa have created a public data portal to provide reliable and actionable flood data to the community. This data contains relevant metadata to assist with critical decision-making during a flood emergency. Visit the site to learn more! The streamgage sensors are provided in an easy-to-understand format to include last reported date, if there is a flood alert, and links to additional information such as SMS alerts and map products.

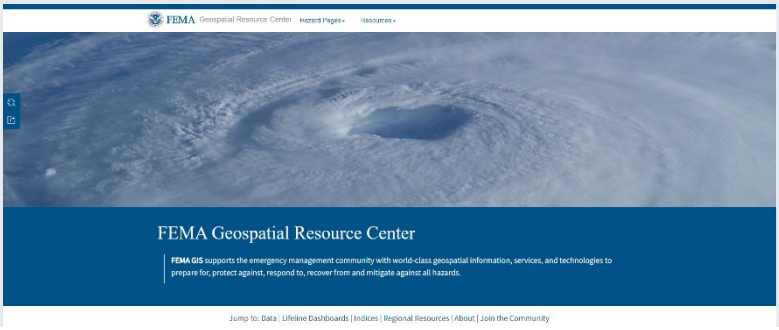


Data Sharing and Interorganizational Collaboration

Information-sharing is vital for decision making both within an agency as well as among partner organizations during all phases of a disaster – planning, preparedness, response, recovery, and mitigation. Without access to relevant and timely information, decision makers are forced to make decisions blind and in potential conflict with other ongoing actions. Information-sharing hubs that provide both secure and public data exchange can facilitate the movement of vital information into the hands of decision makers at the right time. Many examples exist in the public safety community, such as the US Data.gov portal[xxv], the DHS Homeland Infrastructure Foundation-Level Data (HIFLD) data portal,[xxvi] and the commercial provider Esri's ArcGIS Online.[xxvii] Each example supports the use of common, standards-based, open data exchange. Investing in a similar capability and configuring it to match your organization's mission and structure is the first step to true data management and information exchange.[xxviii]

Spotlight: FEMA Geospatial Resource Center

The Federal Emergency Management Agency (FEMA) Geospatial Resource Center supports the emergency management community with world-class geospatial information, services, and technologies to prepare for, protect against, respond to, recover from, and mitigate against all hazards. Learn more and access a hub of resources at gis-fema.hub.arcgis.com/.



In addition to building the information hub, consideration should be given to developing information sharing agreements where needed to ensure that data are available, and that data are used appropriately. Information sharing agreements come in many different formats depending on the agency and data being transferred: Non-disclosure agreement (NDA), Memorandum of Understanding (MOU), or Memorandum of Agreement (MOA). The USGS provides a good resource on data sharing agreements, and where one agreement may be used over another. Once a data sharing agreement is in place, partnered collaboration can be leveraged to securely share data layers between agencies using inter-organizational groups within ArcGIS Online. For more information, Esri provides additional information on creating and managing partnered collaborations here.

Chapter 5: Operationalizing GIS

During a disaster, operational cadence and the flow of information increase dramatically. Decision makers need filtered and actionable intelligence, not raw data, to make critical decisions. Role-based, mission-focused applications can help with this process; however, there is still a need for a human to synthesize information and convert it into actionable information for decision makers. It is critical to train and test these systems and processes prior to an incident through exercises, followed by an after-action analysis to identify gaps that should be filled prior to future incidents.

Key Takeaways

- Create mission-focused applications to provide decision makers critical information. Consider how you transition from massive catch-all applications, which include all your data and tools, into an environment that better serves the end user.
- Targeted applications will help you avoid information overload.
- GIS-based tools can help process information into actionable intelligence, but you still need context to support decision-making.
- Include the use of location-enabled decision support tools into your exercises to test data assumptions, tools and solutions, and how effective they are at helping achieve data-driven decision-making.
- Review your after-action reports (AARs) with an eye toward data needs and perform post-event analysis to determine both data and analytical gaps that can be addressed before the next event.
- Include your GIS/IT staff in exercise design and during AARs.

Configure Mission-Focused Applications

Mission-focused applications should be built to collect, analyze, and interpret incident data, and should be configured to align with individual roles within an organization. Follow the organizational structure of your agency, or the common organizational structures outlined in the NIMS guidance, as an outline when creating and configuring applications. By focusing on role-based, mission-centric applications, "noise" such as the extra data layers not needed for the current mission, or tools that are not useful for the user, are removed to better serve the user and avoid information overload. [xxix] How the end user will access and utilize the applications should also be taken into consideration. First responders in the field will need mobile based field data collection tools, while Emergency Managers in the EOC will want to take advantage of large screens and enhanced computing power of web-based or desktop applications. It should also be noted that while some applications are best designed for use

on a computer, efforts should be made to make them adaptable so that they can be accessed on a mobile device or tablet when users are on the move.

An example of user specific, mission-focused applications that can be used for flood response, as well as other all-hazard incidents, is the Search and Rescue Common Operating Platform (SARCOP). The SARCOP brings together multiple user specific applications, such as mobile field data collection tools designed for first responders and dedicated US&R personnel, as well as multiple web-based dashboards that are intended to be accessed on a computer by personnel working in the EOC. One of these dashboards is the "Tactical Dashboard" that US&R Task Force Plans Team members use to track the progress of search teams in the field and has indicators for waypoints that need approval and follow-up. The second dashboard is the "Strategic Dashboard" that provides a high-level overview of incident operations, including the number of people assisted and the number and severity of damaged structures. The "Strategic Dashboard" is often used by emergency managers and high-level senior leaders to get a general understanding of the overall impact of a disaster.

Search and Rescue Toolbox

- SARCOP Sandbox
- Battlecards and field training resources
- Intel Manager
- More information
- Join the National Search and Rescue Geospatial Coordination Group

Information to Intelligence

Information is defined as raw, unfiltered data from various sources. Once information has been verified, evaluated, processed, and provided context, it may be considered actionable intelligence. At the beginning of an incident, the needed information is very high, yet the availability of it is low. As the incident progresses, more information becomes available until there is ultimately more information than is needed. It is important to keep these concepts in mind as you start to implement information hubs and mission-focused applications for your agency. At some point, you run the risk of inundating responders with too much information that they will not be able to process in a timely manner.

One way to produce actionable intelligence is to configure dashboards and other applications with notifications for predetermined trigger points. As discussed earlier, when a trigger point for a flood sensor has been reached, GIS applications can notify you of the situation so that response actions, such as evacuations, can be taken. Applications can also be configured to provide intelligence using auto-calculations and scripting. For example, if you know that a flood has displaced X number of people based on previous incidents, you may know that this requires Y number of meals, bottles of water, and blankets. You can

build these calculations into the application so you know the number of resources that should be ordered.

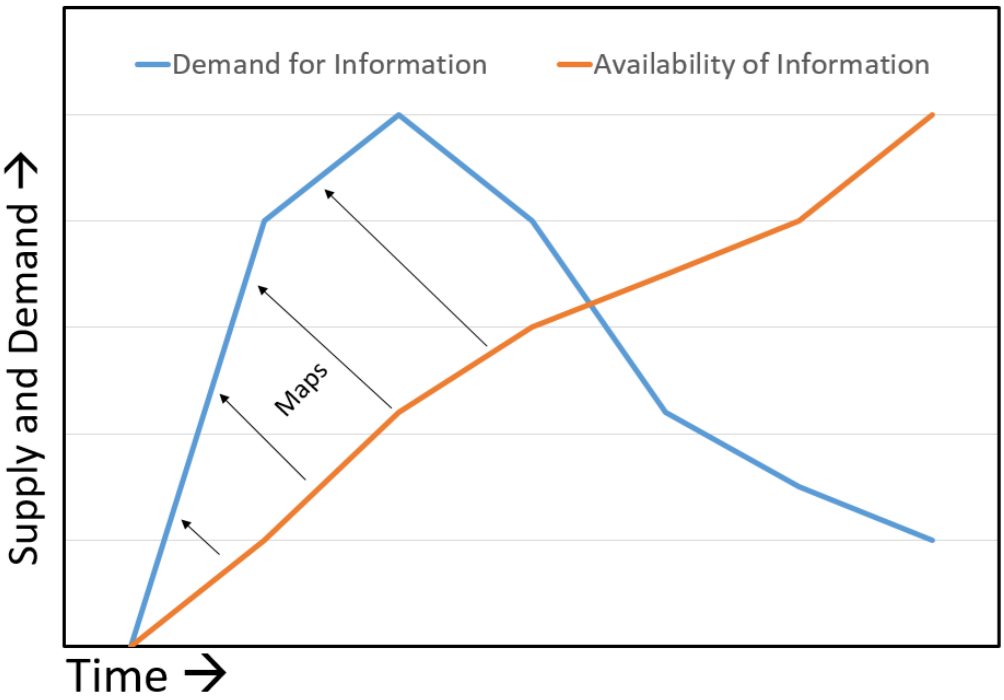


Figure 8 Information demand spectrum

As useful as GIS-based applications are, they cannot fully replace the human element in tactical or strategic decision-making. To an extent, the applications and hubs can provide good information and actionable intelligence, but you still need someone to interpret what all the numbers mean. When reporting up to senior level decision makers, you cannot always just send them a link to a dashboard and expect them to understand what the metrics mean. You need to provide context for the numbers to turn the "what" into the "so what" so that they can determine the "now what."

Exercise and After-Action Analysis

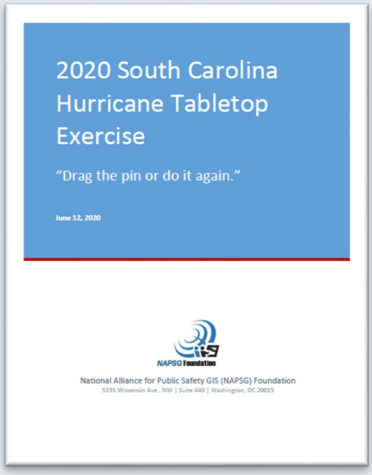
Once an agency has built out their data hubs and mission-specific applications, they should exercise them. Exercises can simulate the integration of data and test the validity and usability of the information for critical decision-making, thereby building trust and confidence in the available systems and data outside of a disaster. Exercises can also highlight decision points within a scenario where information may or may not be very reliable, while helping to focus on how to improve the quality of that information. Including your GIS/IT staff in all exercises is essential to building good communication, trust, and knowledge of the technical capabilities and limitations of GIS before the next disaster hits. FEMA provides guidance on effectively integrating GIS into the Exercise Planning Process in its Preparedness Toolkit.

While it is ideal to get multiple departments within an organization and partnering agencies together at the same time to conduct a large-scale exercise, COVID restrictions and staffing

shortages have recently made this difficult. Leveraging technology to conduct asynchronous exercises where participants can work towards the exercise objectives at a time that works for them is a useful work-around. To conduct an asynchronous exercise, first establish objectives and a time frame for which you want them to be carried out. Then, use a communication platform such as Microsoft Teams or Zoom to introduce the exercise. Be sure to record it so that it can be sent out to those who are unable to attend the initial meeting. Personnel can then conduct their piece of the exercise, whether that be field data collection or analysis, as they are able. Finally, develop an improvement plan to track corrective actions and improve outcomes in future incidents.

Spotlight: NAPSG asynchronous exercise

NAPSG Foundation conducted an asynchronous exercise with US&R participants in South Carolina in 2020. This exercise has since been adapted and used for an exercise with all 28 FEMA US&R teams. The exercise focused on using geospatial tools in disparate locations with different jurisdictions and ended with a single common operating picture. Access the exercise plan and training slide deck here.



In addition to after-action reviews, post-event analysis can help agencies understand the quality of the data they received during a disaster away from the hectic cadence of the actual event. The Weather Forecast Office (WFO) of Tallahassee, Florida, analyzed storm forecasts over a 3-year period, from 2004-2007, to ascertain how accurate their predictions had been. The WFO systematically called road and highway departments, law enforcement agencies, storm spotters and utility companies after each storm season for input on whether extreme weather had occurred in the WFO warning area as forecasted. They augmented this first-hand information with additional damage assessments and created data verification statistics to evaluate their storm warning program. [xxx]

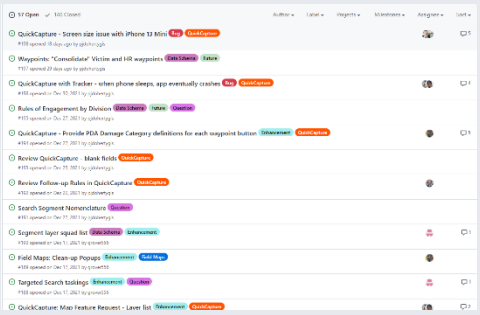
After-action reports that analyze the quality of the information first responders relied upon in a disaster can be used to generate data verification statistics. These statistics can be used in a manner like confidence levels – how accurate were the incoming data at showing real-world activity? This allows officials to give individual sensors and data feeds confidence levels and more effectively act based on "trusted" data. Consider the process of exercising and implementing the results of after-action analysis an effort to identify "trust gaps," or points in your workflow where responders and operators do not feel they can trust the information they are receiving.[xxxi]

Documentation

As information hubs, mission-focused applications, and AAR processes are created, it is important to document the process so that it may be replicated by new staff, neighboring jurisdictions, and mutual aid partners. GitHub, traditionally used as a code repository, provides robust documentation tools. Repositories can include detailed readme files, issue logs, and enhancement requests.

Spotlight: GitHub

GitHub has proven to be a good option for tracking bugs, enhancement requests, and overall documentation related to mission-focused applications. The open-source nature allows anyone to provide comments and track the progress of app development. See the Wide Area Search Templates repository for an example.



Appendix A: Acronym List

AAR	After-Action Report
ARC	American Red Cross
CAP	Common Alerting Protocol
CDC	Center for Disease Control
COP	Common Operating Picture
DHS	Department of Homeland Security
DOT	Department of Transportation
D-SNAP	Disaster Supplemental Nutrition Assistance Program
EAS	Emergency Alert System
EMA	Emergency Management Agency
EMAC	Emergency Management Assistance Compact
EMI	Educational Management Institute
EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
GIS	Geographic Information Systems
IT	Information Technology
HIFLD	Homeland Infrastructure Foundation-Level Data
IAFC	International Association of Fire Chiefs
ICS	Incident Command System
IPAWS	Integrated Public Alert Warning System
IRIS	Incident Resource Inventory System
Lat/Lon	Latitude/Longitude
LCRA	Lower Colorado River Authority
LGIM	Local Government Information Model from Esri
MASS	Mutual Aid Support System
MGRS	Military Grid Reference Systems
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MRP	Mission Ready Package
NAPSG	National Alliance for Public Safety GIS Foundation
NAS	National Academy of Science

NDA	Non-Disclosure Agreement
NGA	National Geospatial Intelligence Agency
NGAC	National Geospatial Advisory Committee
NHC	National Hurricane Center
NIMS	National Incident Management System
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Services
POD	Point of Distribution
PSAP	Public Safety Answering Point
RTLT	Resource Typing Library Tool
SAR	Search and Rescue
START	Study of Terrorism and Responses to Terrorism
TIGER	Topologically Integrated Geographic Encoding and Referencing
TNRIS	Texas Natural Resources Information System
USGS	United States Geological Survey
USNG	United States National Grid
VOAD	Volunteer Organizations Active During Disasters
WEA	Wireless Emergency Alerts
WFO	Weather Forecast Office

Appendix B: United States National Grid (USNG)

The USNG is a standard area and point grid reference system that quickly enables multi-discipline and multi-jurisdictional emergency service agencies to precisely locate incidents and universally communicate locations using paper maps and/or electronic applications. It is recognized nationally and is used throughout many communities. The USNG is often safer to use than other systems, such as Latitude/Longitude (Lat/Lon), which can be communicated in multiple formats and lead to misunderstandings. The USNG has one format that reduces the possibility for error.[xxxii]

In the public safety arena, it is important to use USNG to ensure that your agency's operations are compatible with major federal agencies and industry leaders. FEMA, the National Search and Rescue Committee (which governs all federal Search and Rescue (SAR) operations), the National Geospatial Intelligence Agency (NGA), and the US Geological Survey have all adopted USNG as the primary coordinate system for their paper and electronic mapping products and systems. [xxxiii] State organizations, like the Florida Fire Chiefs Association (FFCA)[xxxiv], have also adopted the use of USNG.

USNG Jumpstart Toolbox

- Implementation Guide to the USNG
- Video on Introduction to the USNG for Public Safety
- How to Read the USNG
- USNG Grid Card Reader Template
- Guideline for Building USNG Polygons
- Online Web-Based USNG Location App (Preconfigured)

A common reference grid for operations is critical for situational awareness, particularly in large catastrophic events which cross jurisdictional boundaries and require operational support from multiple disciplines.[xxxv] NAPSG Foundation reports that "in every major event since Hurricane Andrew, after-action reports by the military, federal civilian responders as well as local responders have pointed out the need for a uniform geographic point and area reference system."[xxxvi] The US military, the assistance of which is often required during a large disaster, also uses a coordinate system called the Military Grid Reference System (MGRS), which functions the same as USNG, enabling their responders and operations staff to communicate location-based information and quickly join forces with other first responders.[xxxvii]

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