



Geospatial Technologies and the Search Management Process

“Search and rescue operations are critical in moments of crisis, assisting in locating & safely retrieving missing individuals.”

[National Association for Search and Rescue \(NASAR\)](#)

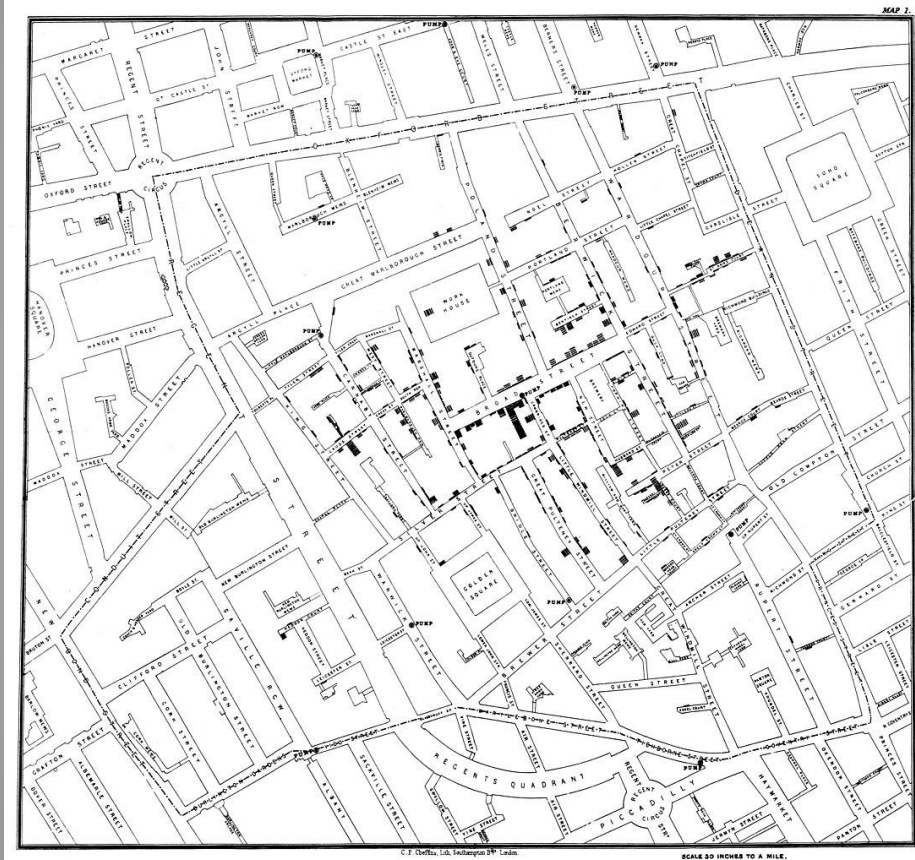
The Questions that Drive the Operation

- What type of search is required?
- Where do we start searching?
- Where have we searched?
- Where do we search next?

Geospatial Technologies

- *Geospatial technologies* is an umbrella term that covers a wide range of tools.
- All technology, even that which seems antiquated to modern experiences, was once new.
- Many years of trial, error, & innovation helped the tools evolve.
- Understanding where the technology started helps users comprehend where technology is now.

1854 Cholera Outbreak, London



- Dr. Snow collected data from the Registrar General Office mortality reports detailing:
 - Residential addresses
 - Date of death
- Additional data from conversations
- Cartographer Charles F. Cheffins visually represented the data & created the 1854 Broad Street cholera outbreak map

Geospatial Technologies Definition and Uses

- Geospatial technologies is “a term used to describe the range of modern tools contributing to the geographic mapping and analysis of the Earth & human societies” ([AAAS, 2025](#))
- Geospatial technologies:
 - Help understand relationships, patterns, & trends in geography
 - Represent trends through maps, graphs, & data models
 - Can be both physical & digital

Geographic Information Systems (GIS)

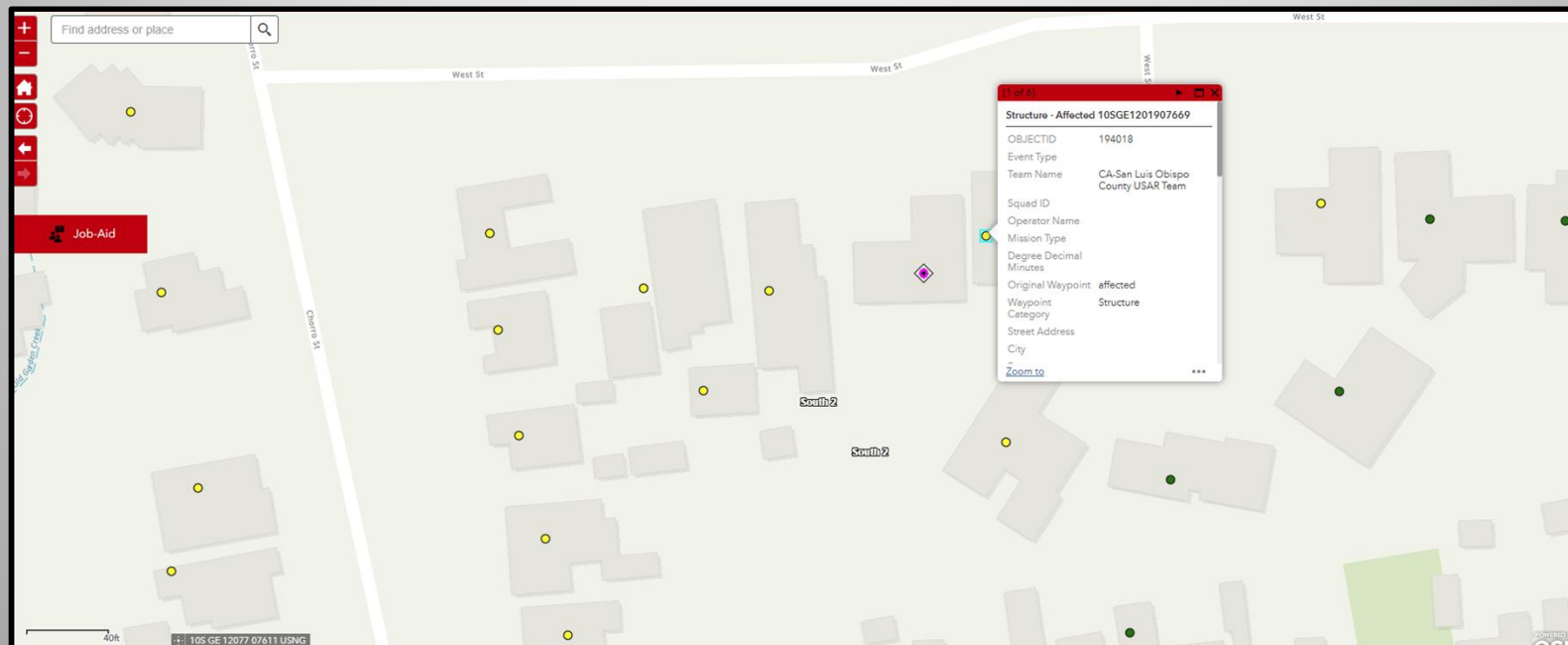
- Defined as “an integrated collection of computer software & data used to view & manage information about geographic places, analyze spatial relationships, & model spatial processes” ([Esri](#))
- Geospatial analytics involving computational analysis, machine learning, & artificial intelligence is the highest level of geospatial analysis

Geospatial Technologies Versus GIS

- GIS has 4 functions:
 - Manage data for storing geographic locations
 - Visualize data (usually using maps)
 - Analyze spatial relationships & patterns using geoprocessing
 - Create new or edit existing data

Points

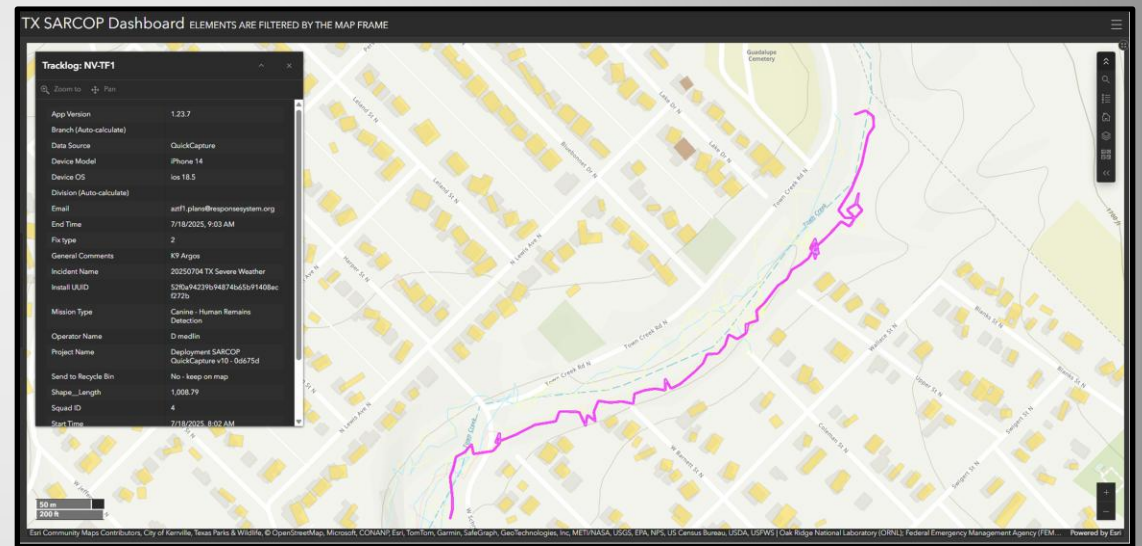
- Point: “A geometric element defined by a pair of x, y coordinates” ([Esri](#))
- Point feature: “A map feature that has neither length nor area at a given scale, such as a city on a world map or a building on a city map” ([Esri](#))



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Lines

- Line: “On a map, a shape defined by a connected series of unique x, y coordinate pairs. A line may be straight or curved” ([Esri](#))
- Line feature: “A map feature that has length but not area at a given scale, such as a river on a world map or a street on a city map” ([Esri](#))
- Contour lines help searchers understand the difficulty of the terrain to be searched



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Polygons

- Polygon: “On a map, a closed shape defined by a connected sequence of x, y coordinate pairs, where the first & last coordinate pair are the same and all other pairs are unique” ([Esri](#))

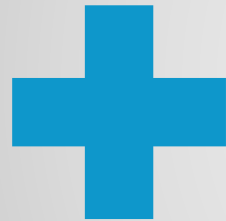


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Creating Geographic Information

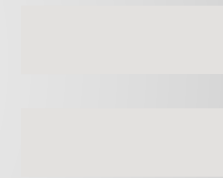
Attributes

Non-location information such as search teams, victims, damage



Location

Describes where the attribute is located on Earth using coordinates



Geographic Data

Combination of attributes with location

Human Interactions and Personally Identifiable Information (PII)

- Universal guideline: protect the privacy of those impacted by the disaster
- PII is “information that permits the identity of an individual to be directly or indirectly inferred, including other information that is linked or linkable to an individual” ([DHS, 2017, p. 483](#))
- **Unless directed otherwise by the appropriate authority, best practices preclude entering PII into the field data collection system**

Geospatial Technologies' Impact on Search & Rescue

- Defining scope & magnitude
- Predictive modeling of wind & currents
- Coordinating search efforts
- GPS technology & search & rescue
- Continued advances

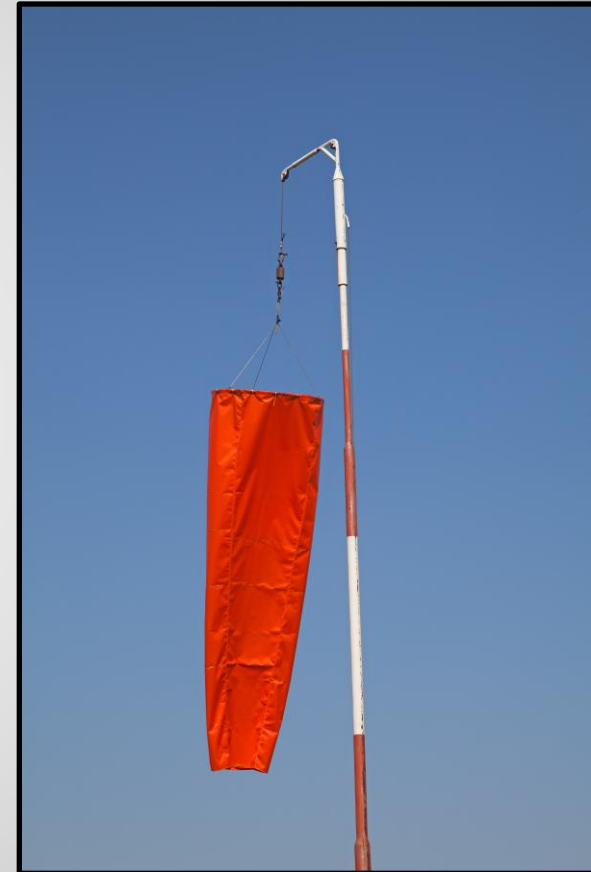


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Maps Used in Search and Rescue

- Maps play a crucial role in search & rescue operations:
 - Graphically contains data layers & analytics to work with
 - Easily shared & accessed

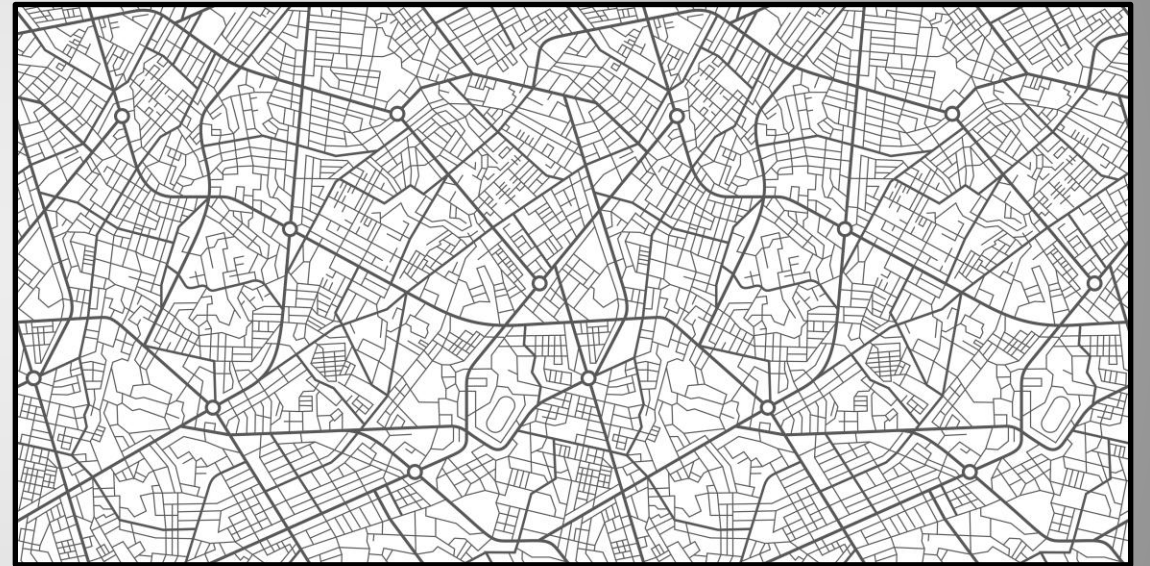
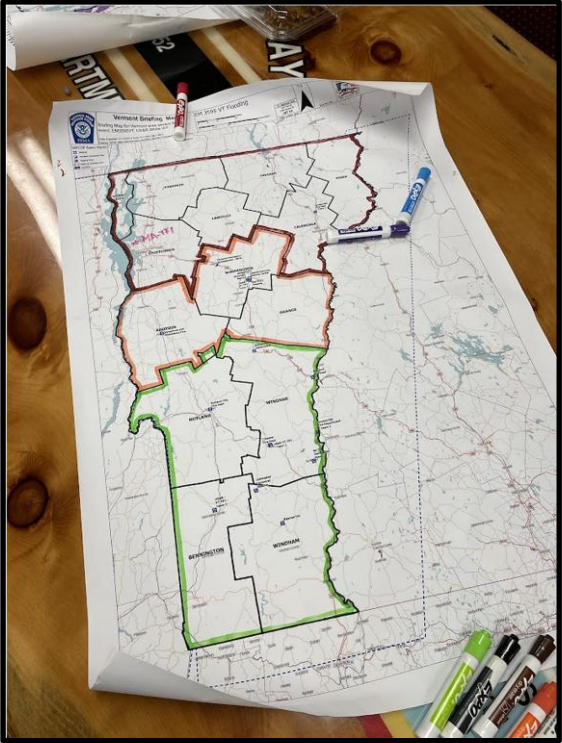


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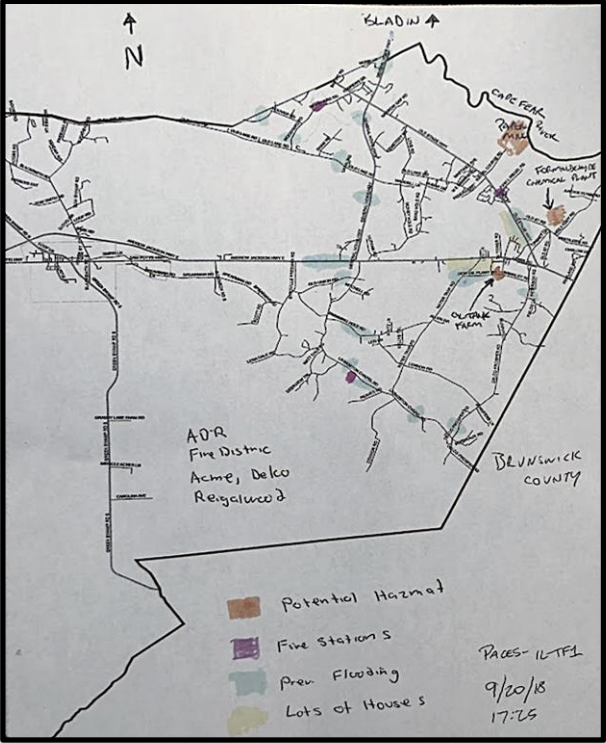
Paper Maps

Printed Map



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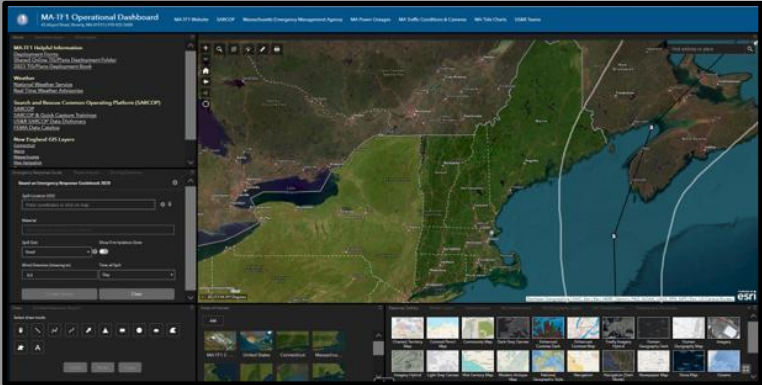
Hand-Drawn Map



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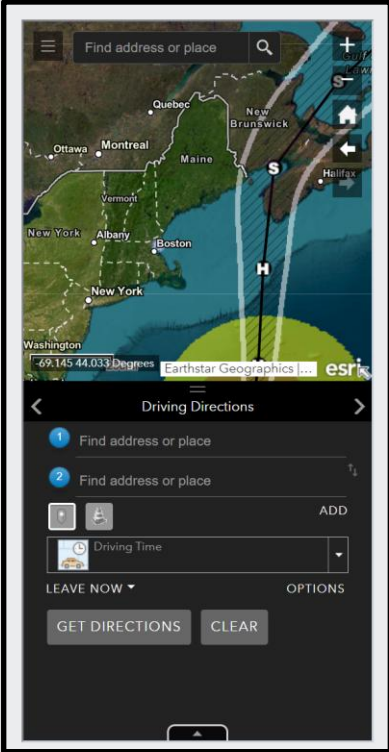
Digital Maps

Computer



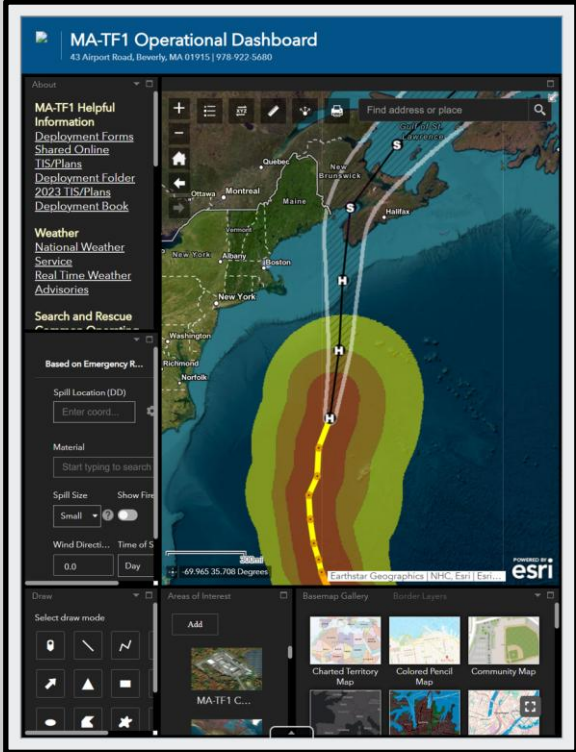
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Phone



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Tablet

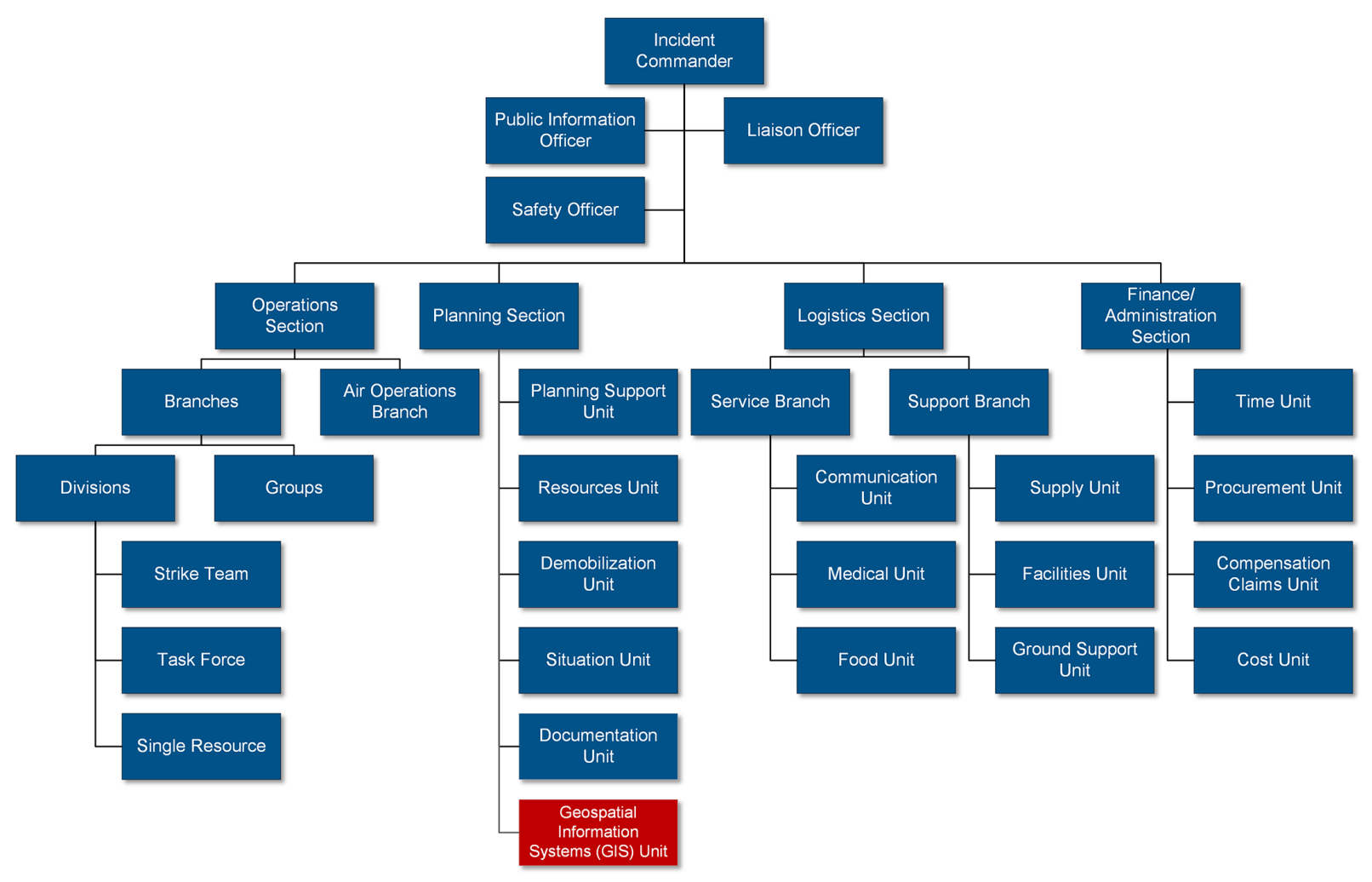


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The End Products

- Situational awareness map
- IAP map
- Strategic planning map
- Tactical assignment map
- Ingress / Egress & evacuation map
- Search progression map
- Lost person probability map
- Logistical information map
- Navigational map
- Building layout / blueprint map
- Aerial footage map
- Public information map
- Fire map
- Field operations map
- Search coverage map
- Planning map
- Post event imagery map
- Exposure analysis map
- Force laydown map
- Damage observations map
- Rapid structural triage map

Incident Command System (ICS)



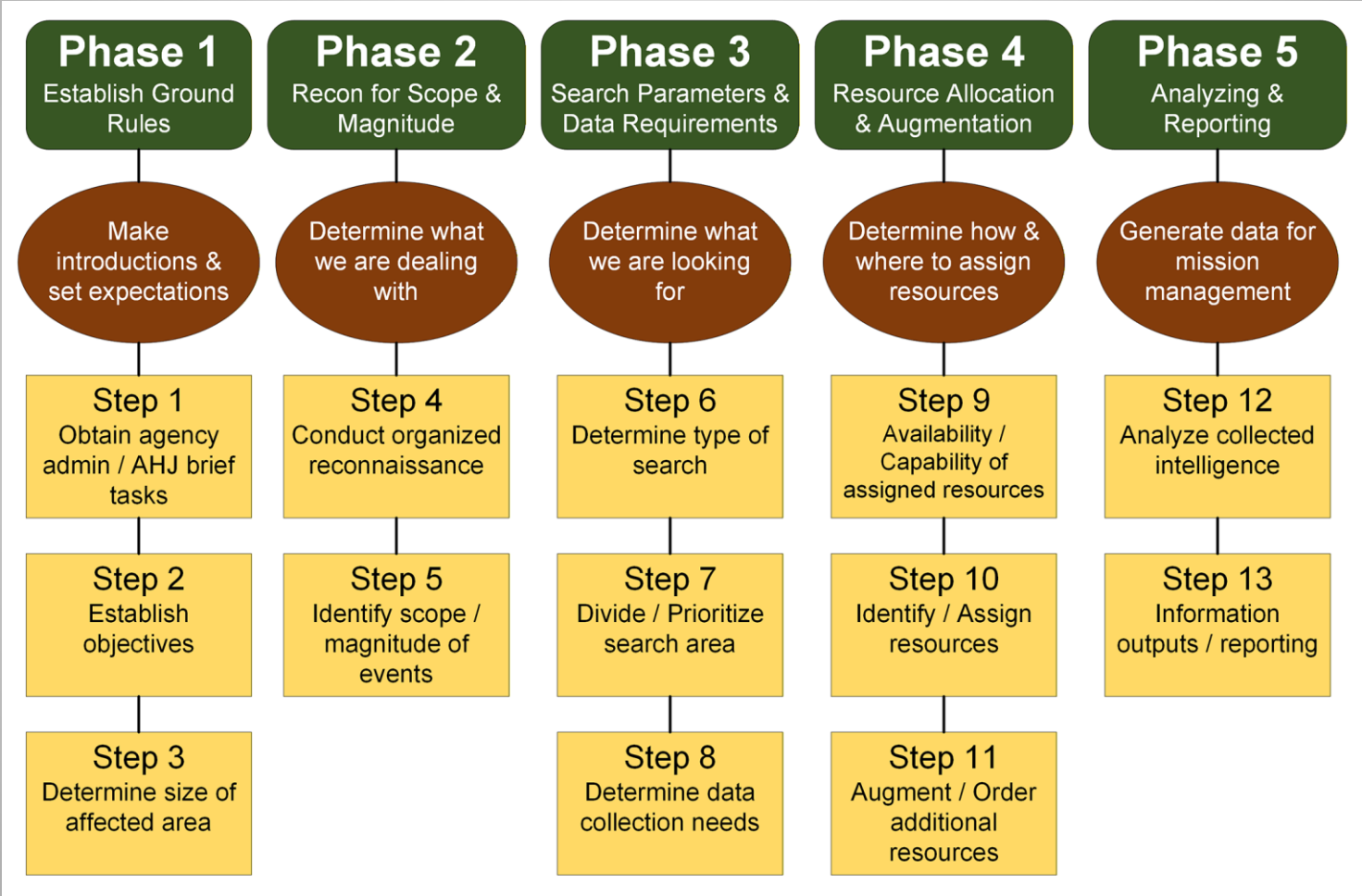
GIS Roles and Responsibilities



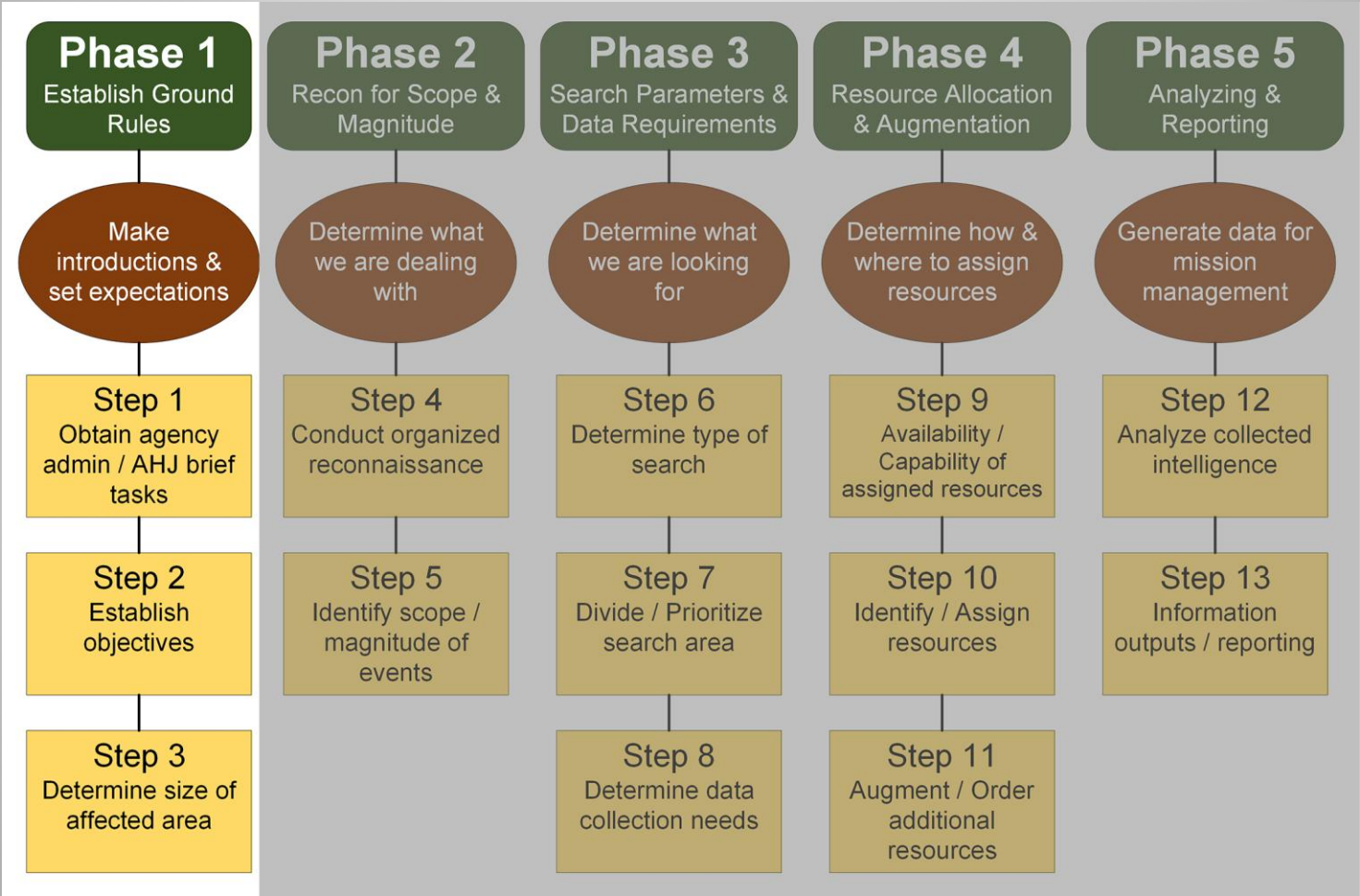
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- Field observers or sensors
- Data editors
- Data analysts
- External partners

Five Foundational Search Management Phases



Five Foundational Search Management Phases



Step 1: Agency Administrator / AHJ Briefing Tasks

- AHJ is usually a:
 - State, county, or municipal leader
 - State US&R coordinator
 - Mayor or city official
 - City or county emergency manager
 - Fire or police chief
- AHJ:
 - Provides overall guidance
 - Makes critical decisions
 - Ensures the incident is managed in alignment with agency policies & objectives
- Roles & responsibilities involving geospatial technology:
 - Conducting an AHJ briefing
 - Identifying the ROE
 - Determining the communication plan
 - Utilizing a COP

Step 2: Establish Objectives

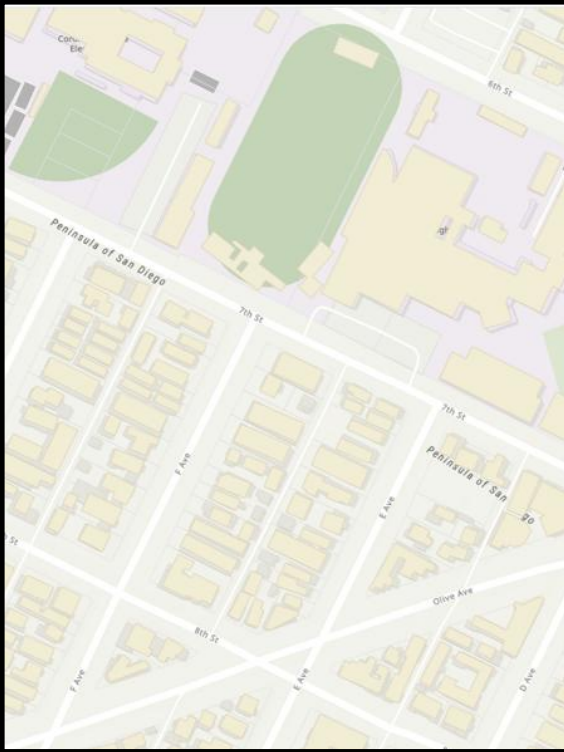
- Decide what overall success looks like.
- Commander's intent helps define the goal.
 - Task
 - Purpose
 - End state / goal
- Establish objectives to support the commander's intent

Step 3: Determine Size of Affected Area

- Size of the operational area has a significant impact on the search planning process
- If resources do not match the size of the operation, overall efficiency & success of the mission will be compromised
- Collection of information & intelligence should begin when the team receives alert / activation notice & continue throughout the response phase

Existing Base Maps and Data Layers

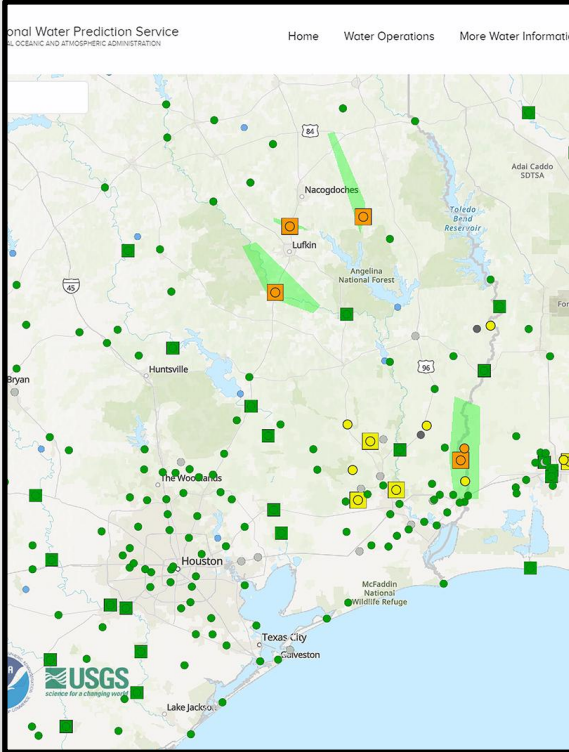
Building Footprints



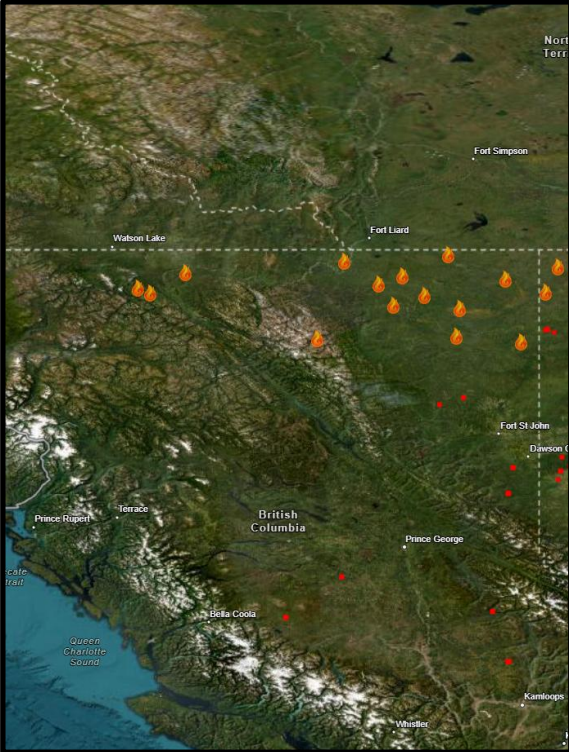
National Hurricane Center



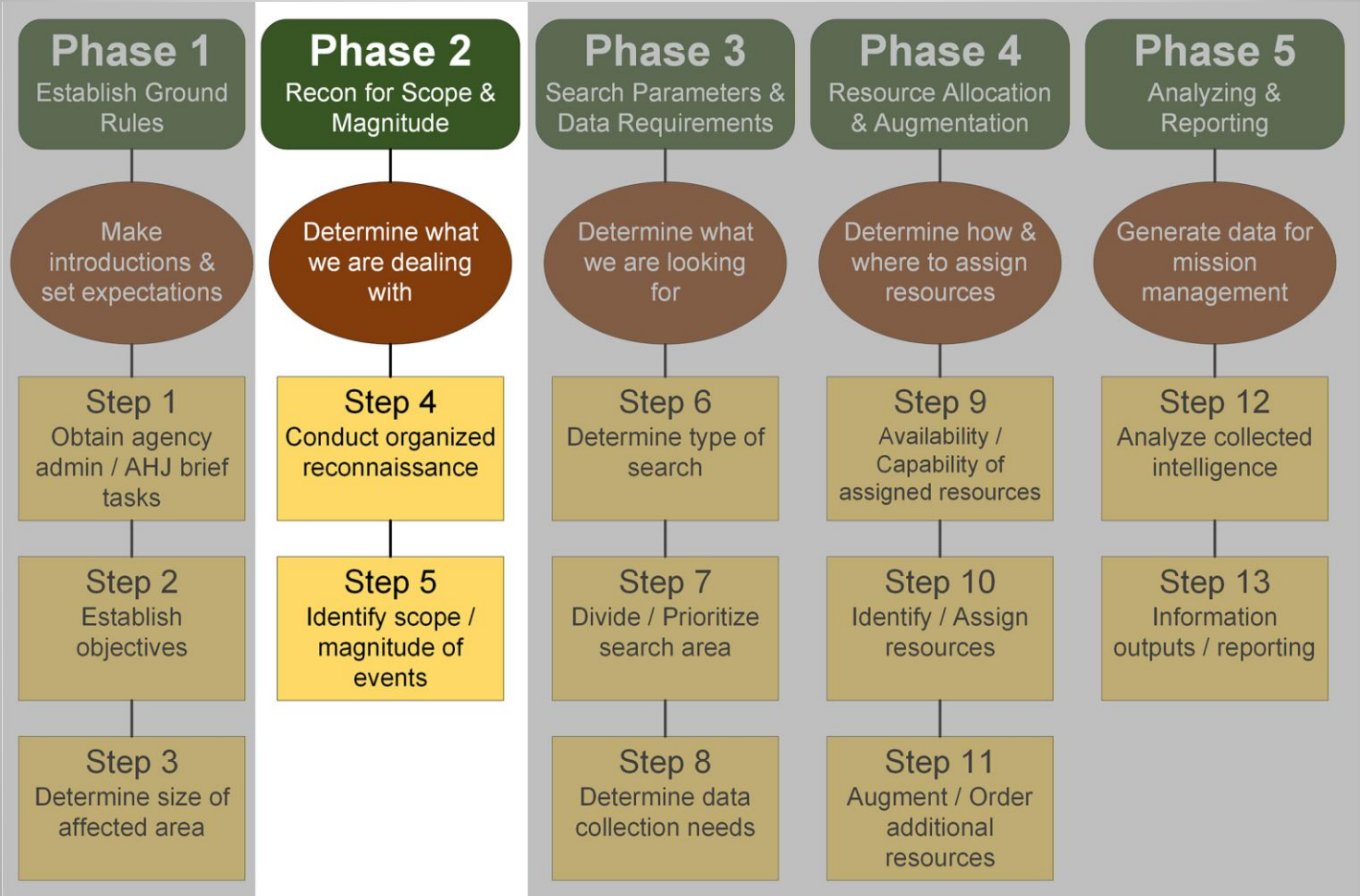
Water Prediction Center



National Interagency Fire Center



Five Foundational Search Management Phases



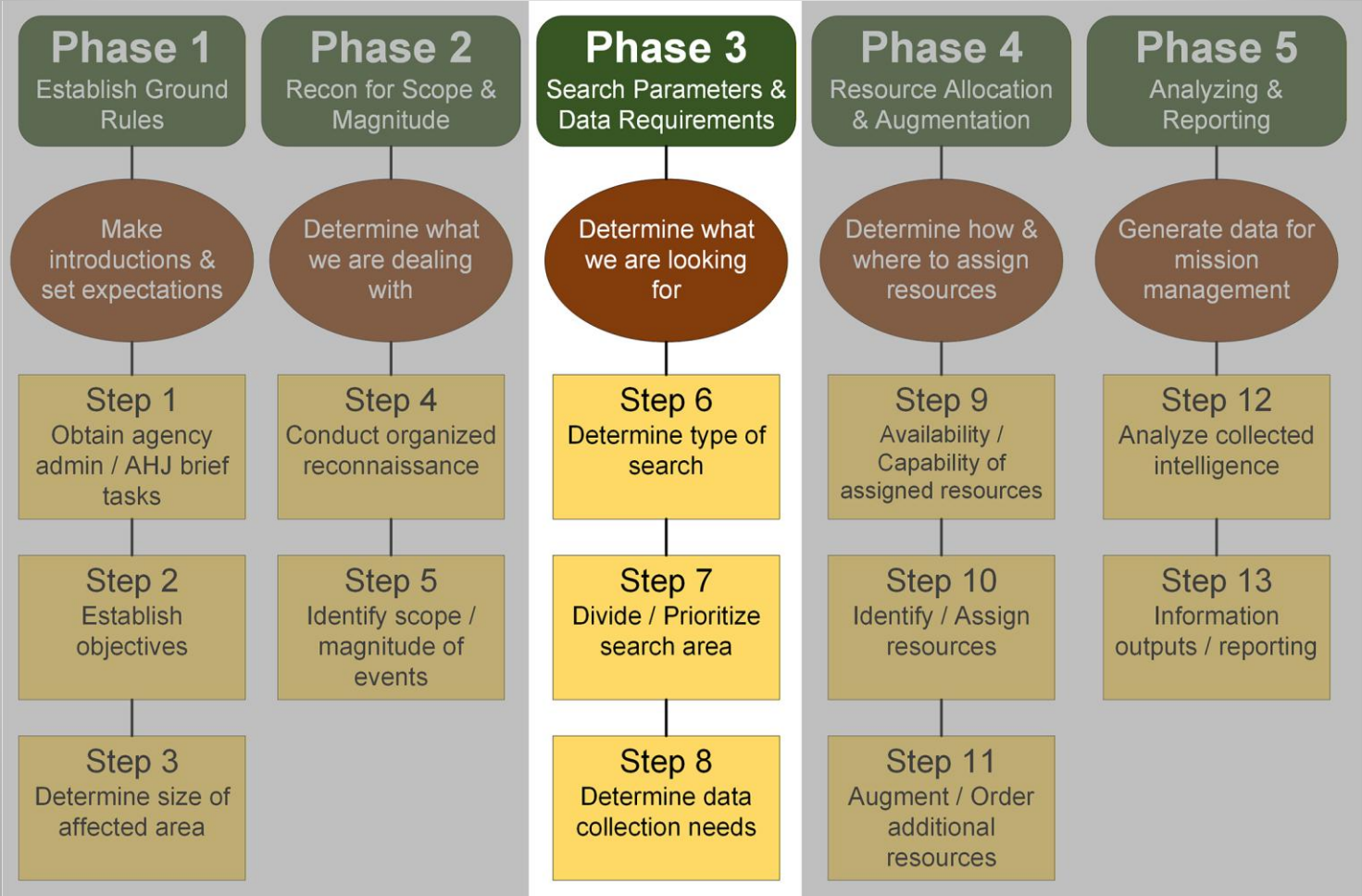
Step 4: Conduct an Organized Structured Reconnaissance

- Involves a systematic & organized approach to gather critical information
- Reconnaissance teams are deployed to gather real-time data assessing:
 - Terrain conditions
 - Accessibility
 - Presence of obstacles or hazards
- Technologies such as drones, GPS, & radios ensure accurate & efficient data collection

Step 5: Identify the Complexity of Events

- Identify various factors that influence the operation's difficulty & resource needs
- Assess:
 - Terrain's nature
 - Weather conditions
 - Number & condition of missing persons, including age, health, & preparedness
 - Availability & capability of search & rescue resources, including personnel, equipment, & technology
- Coordination with multiple agencies & presence of potential hazards further define the incident's complexity

Five Foundational Search Management Phases

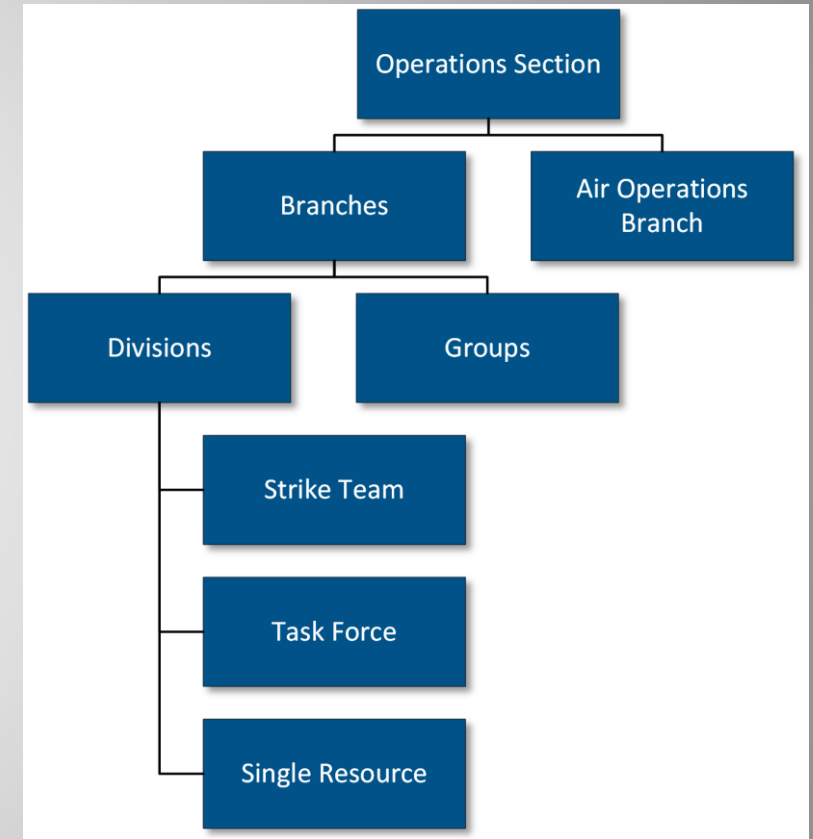


Step 6: Determine the Type of Search

- Influenced by the intended level of coverage:
 - A hasty search might be employed in a case where there is a need to locate & remove many people from an area of imminent danger
 - A secondary search is used for a methodical examination of a large area where victims may be trapped within a collapsed structure
- Influenced by availability of resources & technology
- Once initial analysis completed, searchers can decide how to employ available resources in the early stages of the operation

Step 7: Divide / Prioritize Search Area: Dividing the Affected Area

- Allows:
 - Responders to search systematically
 - Priorities to be managed more effectively
 - Resources to be allocated appropriately
 - Assistance with personnel & time management



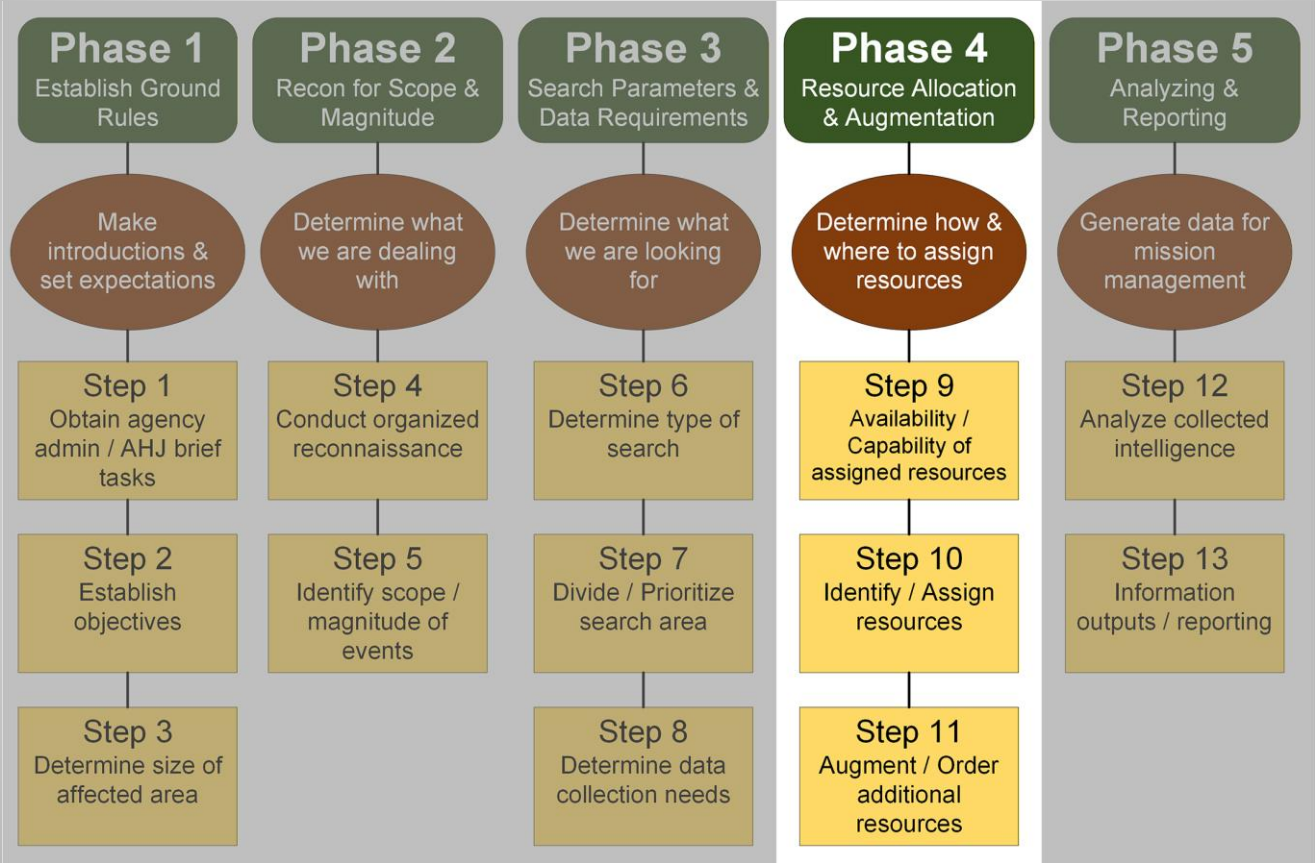
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Step 8: Geospatial Data Collection Methods

Questions & related factors to determine best method:

- What data is being collected?
 - Symbology criteria / dictionary
 - AHJ rules for PII / human remains
 - Data format
- How is data being collected?
 - What devices, software, apps, & platforms are being used?
 - Who is collecting it?
 - Where & when is it be collected?
 - What are the procedures for working offline?
- How is data managed & shared?
 - Quality control
 - Aggregation, analysis, & reporting requirements
 - COP

Five Foundational Search Management Phases



Step 9: Availability / Capability of Assigned Resources

- Initially, resources are allocated based on:
 - Urgency of the situation
 - Size of the search area
 - Complexity of the terrain & conditions
- As the incident evolves, resource needs may change, requiring ongoing assessment & adjustment
- Augmentation involves bringing in additional resources

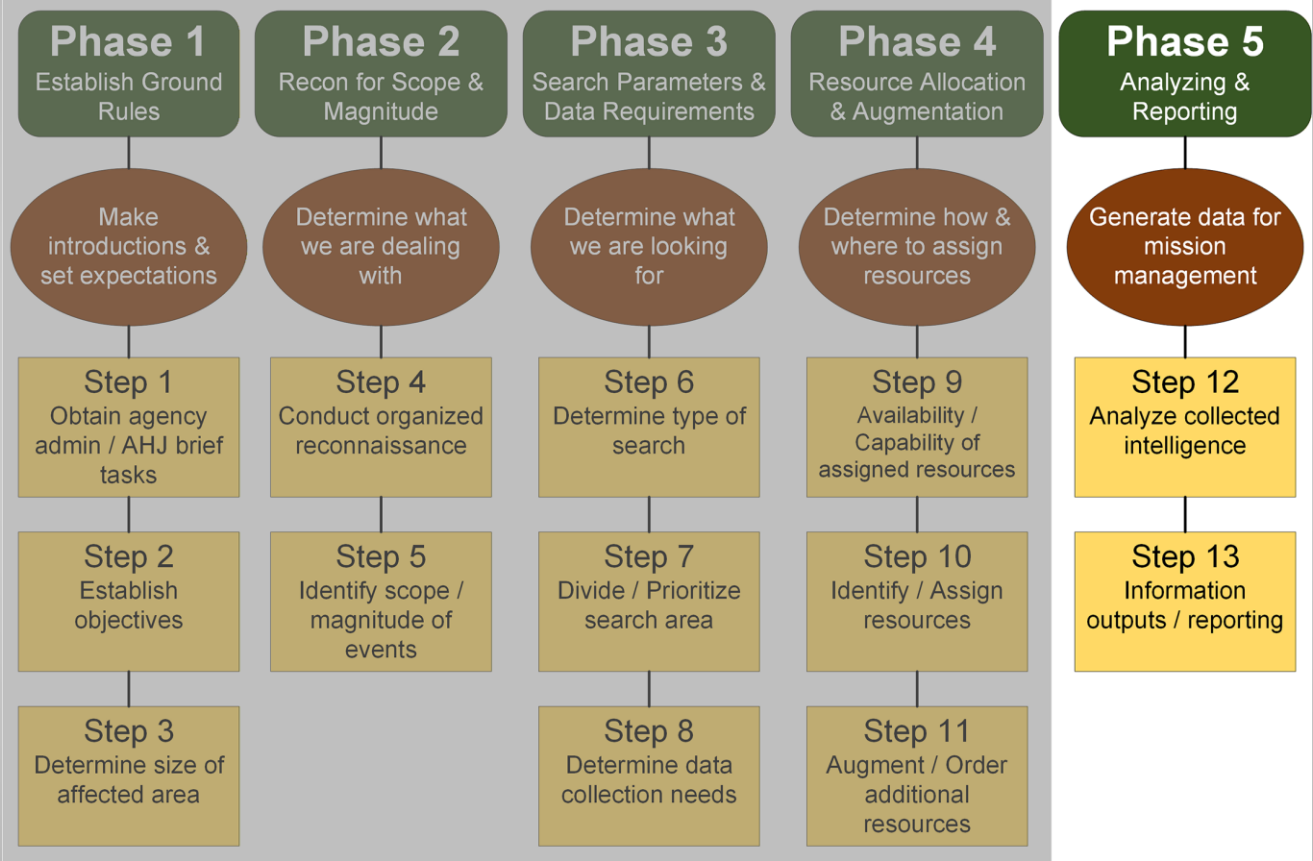
Step 10: Identify / Assign Resources: Resource Planning

- Begins by assessing the specific requirements of the search & rescue operation
- Resources are then identified based on their capabilities & suitability for the tasks at hand
- Once identified, resources are strategically assigned to specific operations objectives & areas based on priority & operational needs
- ICS 215 Operational Planning Worksheet

Step 11: Augment / Order Additional Resources

- Developing a list of unmet resource needs based on unassigned search tasks is a critical process of step 11
- Augmenting & ordering additional resources is essential to address evolving needs & ensure an effective response
- Augmentation involves:
 - Mobilizing additional personnel, equipment, & support
 - From neighboring jurisdictions, specialized agencies, or volunteer organizations

Five Foundational Search Management Phases



Step 12: Analyze Collected Intelligence

- Analysis:
 - Provides a detailed & accurate spatial understanding of the incident area, which informs strategic decision-making & operational planning
 - Purpose of data analysis is to determine if objectives have been met
 - May require some level of conversion from one format to another
 - Analysts should have the ability to convert data delivered in various formats into a common type that can be fed into the COP

Step 13: Information Outputs / Reporting

- Reporting:
 - Regular reports ensure that all stakeholders can access the latest information & make informed decisions
 - Reports help track:
 - Progress of the search
 - Identify gaps or obstacles
 - Need to adjust strategies
 - Reports help enhance the overall efficiency & effectiveness of the search & rescue operation.

Any questions?



State of Florida Urban Search and Rescue
Incident Support Team