

# Developing Standards for Map Symbology

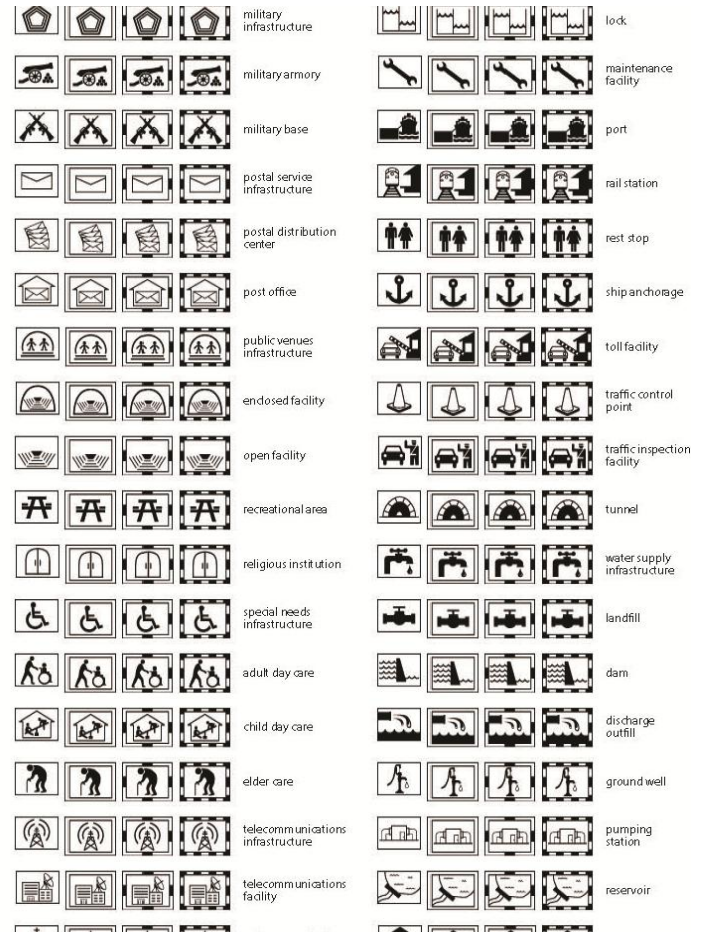
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# Outline

- Motivation
- Methodological Approach
- Interview Results
- Survey Results
- Future Challenges



# Sponsorship, Motivation, and Scope



- **Diverse DHS organizations produce or use maps daily**
  - Audiences range from geospatial analysts to general public
- **No consistent set of map symbols used across DHS**
- **ANSI INCITS 415-2006 intended for emergency management mapping**
- **Objective: Develop process for symbol standardization**
- **Sponsored by DHS S&T Directorate's Command, Control, and Interoperability (CCI) Division**

# ANSI Standard



- **Point symbol set designed for emergency response**
  - Goal was to facilitate common situational awareness
- **Federal/state/local stakeholders took part in the process**
- **Symbols designed to work in black & white**
  - Outline shapes used to distinguish between symbol types (incidents, natural events, operations, infrastructure)
- **Evaluation conducted with first responders**
  - Made use of an “accept” or “reject” methodology

# ANSI Standard



## ANSI INCITS 415 point symbology standard for emergency mapping - Federal Geographic Data Committee Homeland Security Working Group

INCIDENTS		NATURAL EVENTS		OPERATIONS		INFRASTRUCTURE	
civil disturbance incident	flammable gas	after shock	emergency medical operation	law enforcement operation	food retail	natural gas facilities	airport
civil demonstrations	flammable liquid	avalanche	EMT station	Bar, Alcohol, Tobacco, Firearms & Explosives	grain storage	nuclear facilities	bridge
civil displaced population	flammable solid	earth quake epicenter	ambulance	border patrol	banking finance & insurance	petroleum facilities	bus station
civil rioting	non-flammable gas	landslide	medical evacuation helicopter station	customs service	ATMs	propane facilities	ferry terminal
criminal activity incident	organic peroxides	subsidence	health department facility	Drug Enforcement Administration	banks	government site infrastructure	helicopter landing site
bomb threat	oxidizers	volcanic eruption	hospital	Department of Justice	federal reserve bank	military infrastructure	lock
bomb	radioactive material	volcanic threat	hospital ship	FBI	financial exchanges	military armory	maintenance facility
bomb explosion	sportaneously combustible	drizzle	medical facilities not patient	police	financial services other	military base	port
looting	toxic gas	drought	pharmacies	prison	commercial infrastructure	postal service infrastructure	rail station
poisoning	toxic and infectious	flood	biological sensor	secret service	chemical plant	postal distribution center	rest stop
shooting	unexploded ordnance	fog	chemical sensor	Transportation on Security Admin.	firm manufacturers	post office	ship anchorage
fire incident	air incident	hail	intrusion sensor	US Coast Guard	firm retailers	public venue infrastructure	toll facility
hot spot	air accident	inversion	nuclear sensor	US Marshals Service	hazardous material production	enclosed facility	traffic control point
non-residential fire	air hijacking	rain	radiological sensor	emergency operation	hazardous material storage	open facility	traffic inspection facility
origin	marine incident	sand dust storm	emergency operations center	emergency collection evaluation point	industrial site	recreational area	tunnel
residential fire	marine accident	snow	emergency public information center	emergency incident command center	landfill	religious institution	water supply infrastructure
school fire	marine hijacking	thunder storm	emergency shelters	emergency food distribution center	pharmaceutical manufacture	special needs infrastructure	landfill
smoke	rail incident	tornado	emergency staging sites	fire suppression operation	superfund sites NPL	adult day care	dam
special needs fire	rail accident	tropical cyclone	emergency teams	fire hydrant	toxic release inventory	child day care	discharge outfall
wild fire	rail hijacking	tsunami	emergency water distribution center	other water supply location	educational facilities	elder care	ground well
hazardous material incident	vehicle incident	bird infestation	emergency food distribution center	file station	college university	telecommunications infrastructure	pumping station
chemical agents	vehicle accident	insect infestation	file suppression operation	agriculture and food infrastructure	schools	telecommunications facility	reservoir
corrosive material	vehicle hijacking	microbial infestation	fire hydrant	agricultural laboratories	energy facilities infrastructure	telecommunications tower	storage tower
hazardous when wet		reptile infestation	other water supply location	animal feedlots	generation stations	telecommunications infrastructure	surface water intake
explosive		rodent infestation	file station	commercial food distribution center	energy facilities infrastructure	telecommunications infrastructure	water treatment facility
				farms ranches	generation stations	telecommunications infrastructure	
				food production center		telecommunications infrastructure	

\*yellow highlight = symbols changed in latest release, green highlight = new symbols in last release

# Basic Approach



- **Survey use of ANSI symbols and other point symbols across tasks and components within DHS**
  - Interviews (narrow audience)
  - Online survey (wider audience)
- **Develop a repeatable process for creation of symbol standard(s)**
- **Test the process on a selected domain or application area**

# Focus Areas



- **Primary DHS missions of interest**
  - FEMA – primarily Mapping and Analysis Center
  - Customs and Border Protection
  - Coast Guard
  - National Protection and Programs Directorate
  - Infrastructure Information Collection Division
  - National Operations Center
  - Fire Service
- **Plus other federal/state/local parties identified by DHS**

# Interviews



- **Conducted 14 interviews with map producers and users in various DHS missions**
- **Audio recordings for 10, written notes for 4**
- **Formative study using semi-structured format**
- **Question set centered on:**
  - ANSI Standard
  - Critical Incidents Related to Symbology
  - Technical / Organizational Challenges
  - Map Examples Provided by Participants
  - Ideas for New Symbol Standard Process



# Results: ANSI Standard



- **Standard not used by most participants**
  - Only FEMA / IICD use a small subset of the symbols (nobody using the complete set)
- **In general, the reason for lack of use is not technical**
  - Minor problems using fonts, etc... seen as easy to fix
- **Key reason for lack of use is reported lack of match to missions/information customers**
  - Participants only use the symbols from the set that could be considered in common use (hospital “H”, airport, etc...)

# Results: ANSI Standard



- **Many of the symbols are too intricate and difficult to parse without explanation**
  - Especially symbols that attempt to mix together information from a type of event happening to a type of infrastructure
  - One participant suggested it's easier to simply put two symbols next to each other to indicate the type of feature and its current condition
- **The ANSI symbols do not scale well beyond local situations**
- **Participants assume ANSI symbols should work for local responders**

# Results: Key Design Issues



- **Some groups label every symbol put on maps by default, adding to clutter issues**
- **Some groups are taking symbols and applying different meanings apart from the standard**
- **Outline set (damage levels) does not match all mission types, and few data sources provide such details**
- **Different groups assign common colors (red, green, etc...) to conditions that do not match the ANSI standard**
- **No participants are required to design for b/w**

# Symbology Development Process



- **Key issues are organizational, not technical**
  - Must involve all groups that generate and use maps in the process of developing symbols templates
  - Need “buy-in” within and across organizations to mandate the creation and application of standards
  - Need training materials to disseminate standards
- **Developing a single common symbol set is judged to be reasonable only for a small subset of features**
  - E.g., for basic infrastructure that everyone must show

# Symbology Development Process



- **Participants suggest that divisions should develop their own standards and share with others**
- **Multiple web-GIS platforms in development at different DHS components provide point of entry for new standards**
  - It's not hard for them to show things the way they want to see them as long as they have adequate metadata

# Map Example Feedback



- **Many maps are thematic / analytical in nature and symbols must co-exist with a range of additional data**
- **Web mapping tools are becoming more important than printed matter**
  - Systems include iCAV, DHS Earth, eGIS, VirtualUSA
- **Few participants can provide examples of instances in which they needed to transform output media substantially (e.g., to a PDA)**

# On-line Survey



- **Designed to elicit feedback from interview participants in a structured form**
- **Also has the goal of acquiring outside input from a wider community of interested federal/state/local partners**
- **Question set features a range of questions using rating scales, keyword responses, and short answers**
- **Topics mirror those covered in the interviews**

# Survey Results



## How frequently do you use maps in your own daily work?

Answer Options	Never	Yearly	Monthly	Weekly	Daily	Rating Average	Response Count
Frequency:	0	0	2	2	8	4.50	12
<b><i>answered question</i></b>							<b>12</b>
<b><i>skipped question</i></b>							<b>2</b>

## What types of maps do you use in your own daily work? (check all that apply)

Answer Options	Response Percent	Response Count
Online Maps (Google Maps/Earth, Yahoo! Maps, MSN Live, etc...)	90.9%	10
Aerial Photos / Satellite Imagery	90.9%	10
Infrastructure Maps (energy, industry)	72.7%	8
Navigational Maps (roads, airways, waterways)	72.7%	8
Demographic Maps (economy, society)	36.4%	4
Topographic Maps (USGS Quadrangles)	36.4%	4
Environmental Maps (hydrography, geology, ecology)	36.4%	4
Other (please specify)	36.4%	4
Building Plans	27.3%	3
<b><i>answered question</i></b>		<b>11</b>
<b><i>skipped question</i></b>		<b>3</b>



# Survey Results



## What tools are used to create maps at your agency/department? (check all that apply)

Answer Options	Response Percent	Response Count
ESRI ArcMap / ArcGIS / ArcInfo	100.0%	12
Online Mapping Services (Google Maps, GeoCommons Maker)	75.0%	9
Autodesk CAD	33.3%	4
ERDAS Imagine	25.0%	3
Graphic Design Software (Adobe Illustrator, CorelDRAW)	25.0%	3
Pens and Paper	16.7%	2
Other (please specify)	16.7%	2
Intergraph GIS	8.3%	1
ENVI	8.3%	1
MapInfo	0.0%	0
<b><i>answered question</i></b>		<b>12</b>
<b><i>skipped question</i></b>		<b>2</b>

# Survey Results



**What types of information do you typically show on maps at your agency/department?  
(check all that apply)**

<b>Answer Options</b>	<b>Response Percent</b>	<b>Response Count</b>
Political Boundaries	100.0%	12
Transportation Networks	100.0%	12
Aerial Photos	91.7%	11
Incidents	83.3%	10
Planned Actions	66.7%	8
Landuse / Landcover	58.3%	7
Demographics	58.3%	7
Environmental Features	58.3%	7
Other (please specify)	41.6%	5
<b><i>answered question</i></b>		<b>12</b>
<b><i>skipped question</i></b>		<b>2</b>

## **Other Answers:**

tactical infrastructure (fencing, vehicle barriers, etc.) and other border assets (cameras, sensors, etc.)

Weather conditions, fuel conditions

detectors, security alarms, crit. infrastructure, weather, blue force tracking (units)

incident management, response/recovery, after incident imagery, damage assessment, surveillance

infrastructure, installations, assets, project management (AEC industry), flood plain, contours, runoff, sampling stations, storage tank fuel water oil, communications, utilities, surveys, etc

# Survey Results



- **Common mapping tasks**
  - Infrastructure mapping
  - Planning for special events
  - General reference maps
  - Land use planning
  - Incident response
  - Develop common operating picture
  - Recovery planning
- **Emergency response is not a common map-related task among our participants**

# Survey Results



- **9 / 12 make maps themselves**
- **Most respond to requests for maps, are given info on what map needs to convey, etc...**
- **9 / 12 are aware of ANSI standard**
  - Learned from website, participation in HSWG
- **1 / 10 uses the ANSI standard (2 nulls)**

# Survey Results



- **Reasons for not using the standard**
  - Symbols only work for large scale maps
  - Difficult to interpret symbols
  - Symbols do not match mission needs
  - Other standards that pre-date ANSI are still used
- **Avg. ratings for the standard (1 poor – 5 excellent)**
  - Ease of use: 1.7
  - Satisfaction: 1.6
  - Congruency: 1.9

# Survey Results



- **10 / 12 indicate they use their own internal standards for symbols**
  - Created from ESRI symbols, previous standards, MILSPEC 2525
  - Ad hoc, as needed, development processes
- **Ratings are higher (1 – poor, 5 – excellent)**
  - Ease of use: 3.7
  - Satisfaction: 3.0
  - Congruency: 3.0

# Future Work



- **Complete analysis of interview data**
  - Coded transcripts currently in process
- **Gather additional responses for survey**
- **Symbol standard development process**
  - Currently in draft stage
- **Pilot new process and refine based on results**
  - Process will emphasize formalization of de facto standards
  - Take advantage of online tools for asynchronous feedback as much as possible
  - Currently working with DHS to identify the best partner for an initial trial

**Thanks for your attention!**



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# 10,000 miles away...



- **The Australian Gov't looked around for a map symbol standard to use**
- **Found the ANSI set while it was still in draft form**
  - This was incorporated into their National Incident Management System
- **The AU military adopted the ANSI symbols as well**
  - Largely because our military added the ANSI set (with their own set of colors and outlines) to the MILSPEC standard
- **Meanwhile, the standard is hardly used here at all**