Understanding and Implementing Mapping and the US National Grid for Emergency Services

The Federal Geographic Data Committee Online Education Program

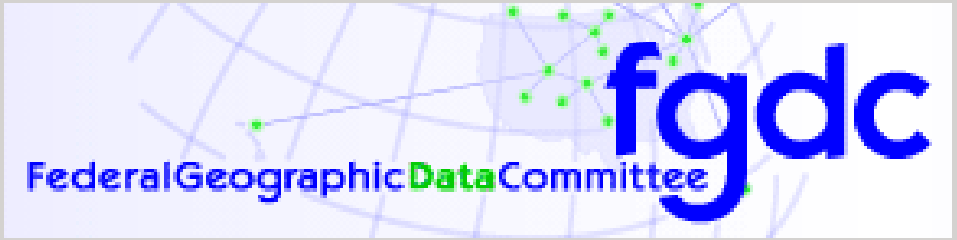
FGDC-STD-011-2001: The US National Grid

Narrated by Talbot Brooks, Director
Center for Interdisciplinary Geospatial Information Technologies
Delta State University

Acknowledgements

This work was completed by The Center for Interdisciplinary Geospatial Information Technologies at Delta State University with the fiscal support from the Federal Geographic Data Committee National Spatial Data Infrastructure Program 2008 Cooperative Agreements Program (Category 6) and USGS Cooperative Agreement 07ERAG0083.

Additional input and contributions courtesy the National Search and Rescue Committee, the State of Ohio Urban Search & Rescue Task Force #1, and the Geospatial Information and Technology Association.



Part I: The Problem

WARNING: Some may find these images disturbing – massive destruction and smoking ruins will be shown

Photos courtesy State of Ohio Urban Search & Rescue Task Force #1

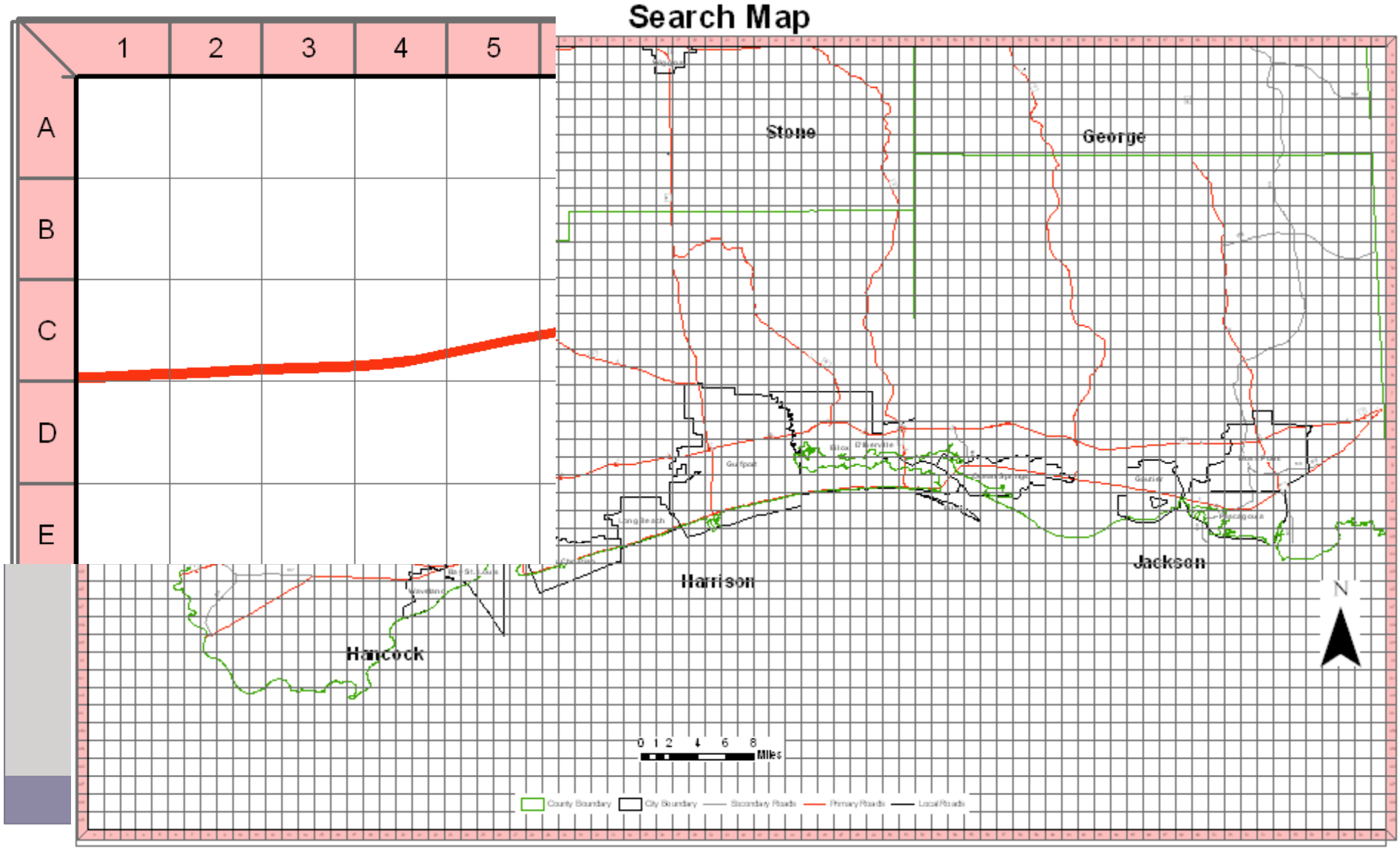

U-HAUL


STOP

"What Do Standards and the US National Grid Have To Do With Hurricane Katrina?"

- On 27 August 2005 I was tasked by the Bolivar County, MS Office of Emergency Management to find 2-4 people with solid computer skills to respond to the Mississippi Emergency Management Agency's Emergency Operations Center in Jackson to help prepare written documents in support of the Hurricane Katrina operation.
- We were soon tasked by MEMA to help provide map support using "that GSI stuff" for emergency responders and decision makers.
- One of the very first products we were tasked with making was a map for search and rescue. The specifications were that it should contain streets with a 1-mile x 1-mile grid squares that could be uniquely addressed. The extent of the map should cover the three coastal counties (Jackson, Harrison, and Hancock).

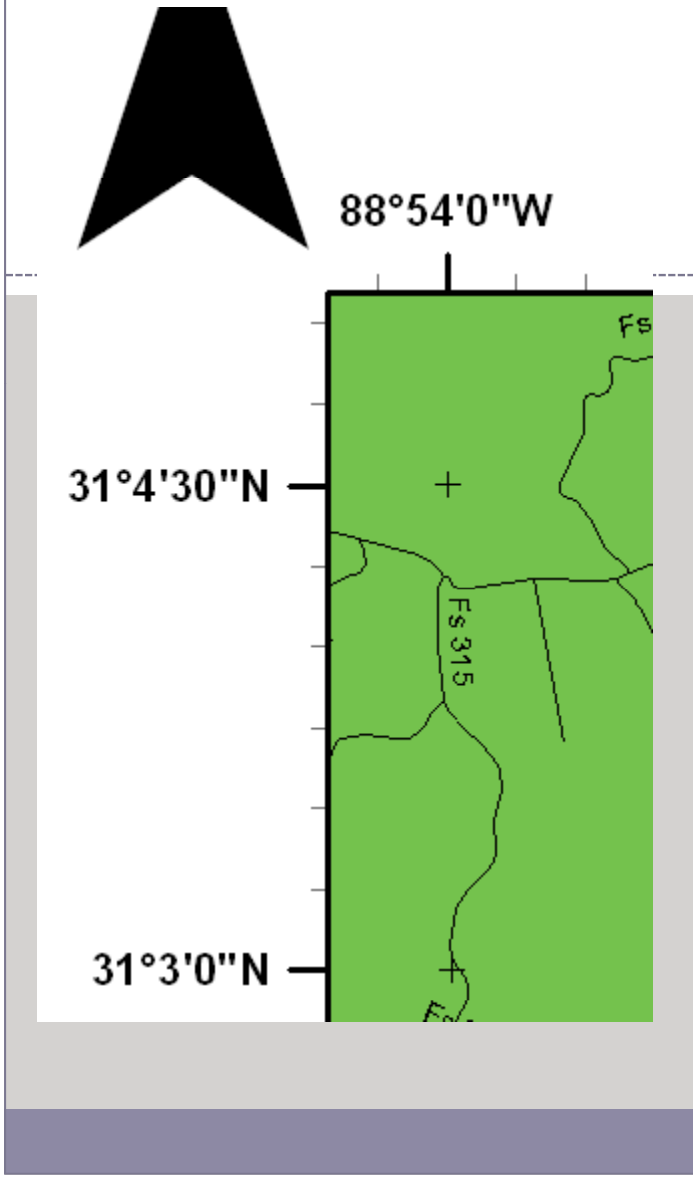
So we made 250 of these and had them laminated and sent to the field...

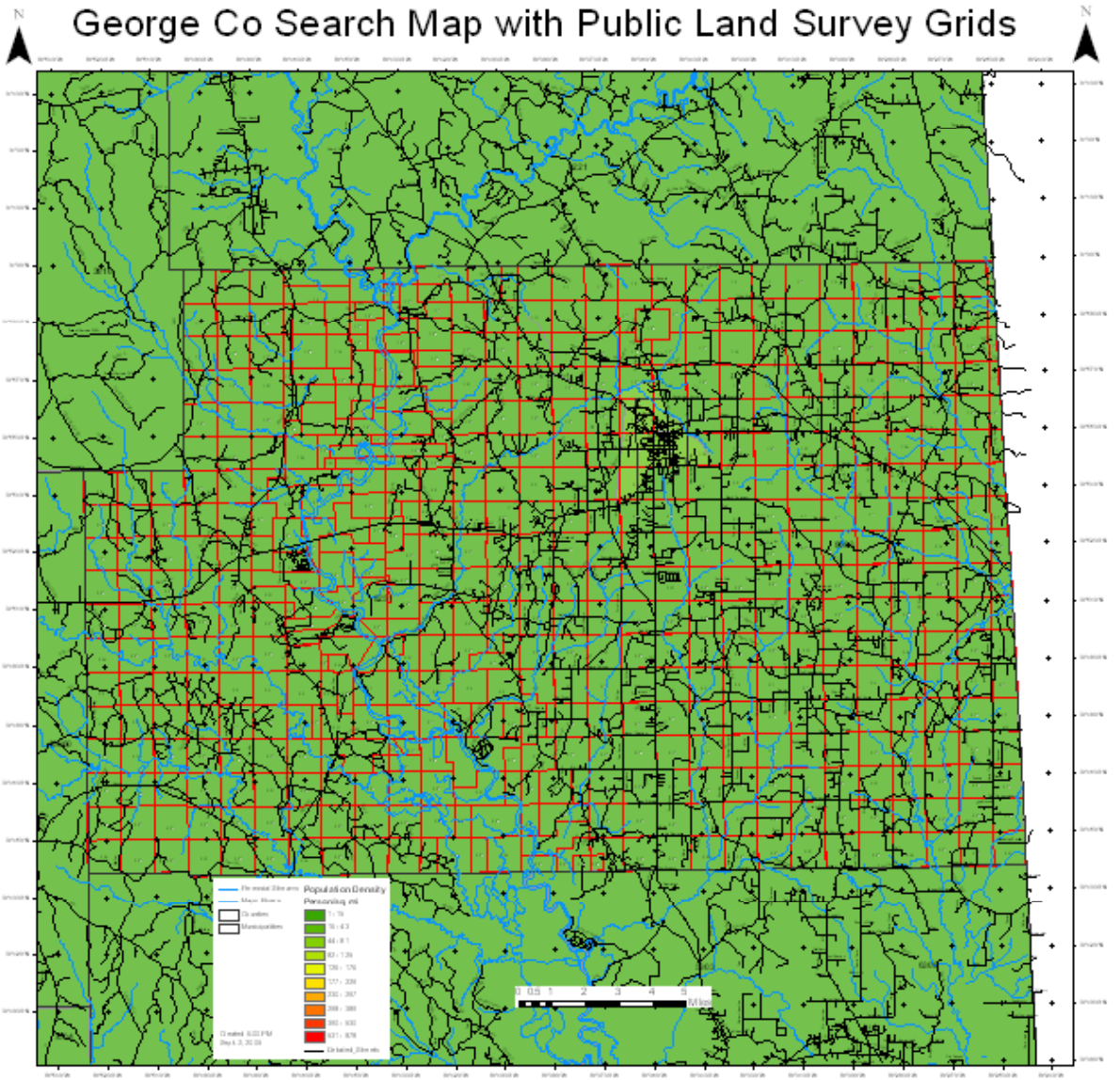


Two days later…

- Katrina had made landfall and the devastation exceeded most expectations
- The search area was expanded to include Stone, Lincoln, George, and Pearl River counties.
- I realized very quickly that I had screwed up. How was I to expand the map to encompass the new search area without altering the grid ID's being used already?

We'll use PLSS – what genius! (NOT!)

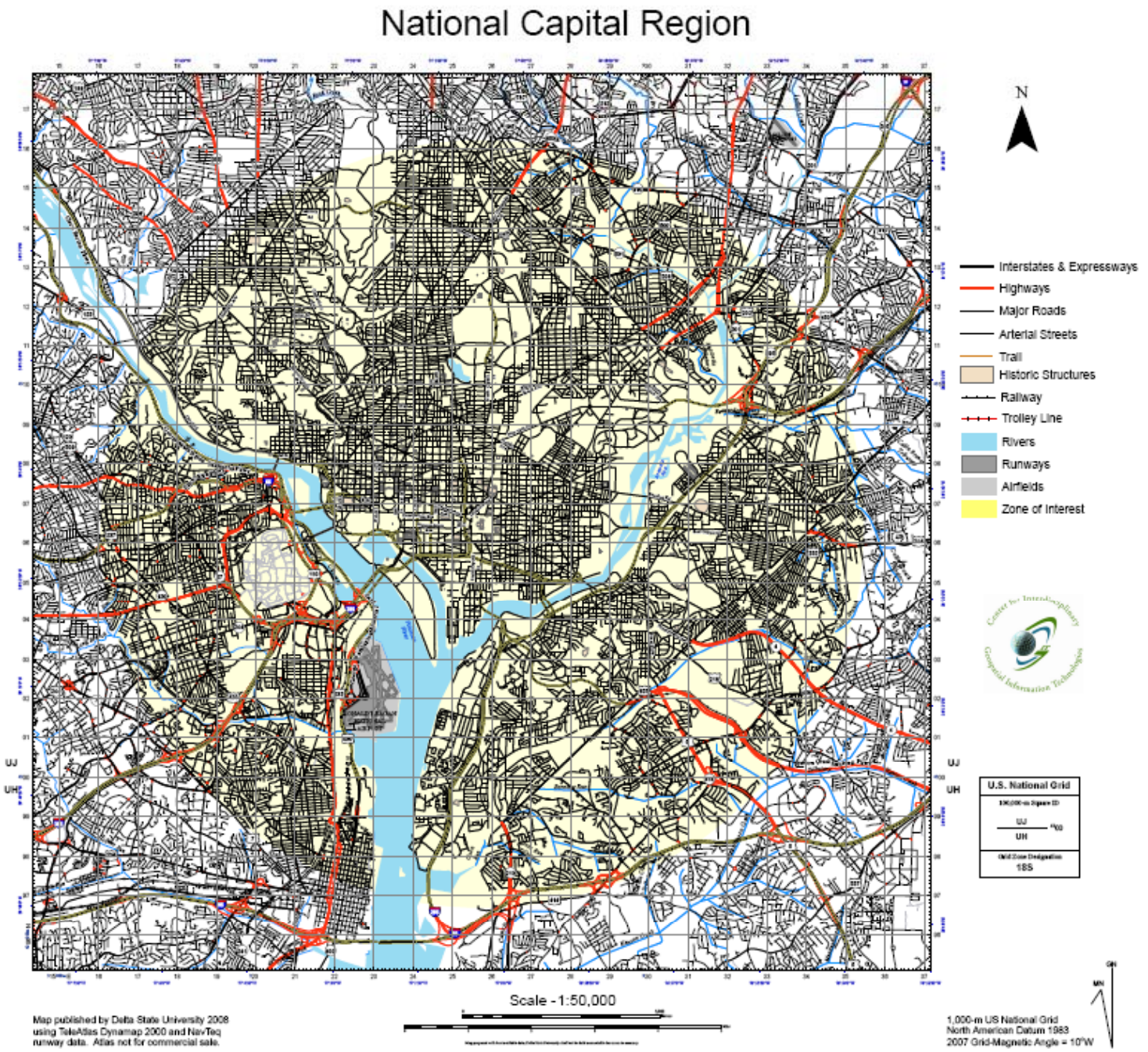




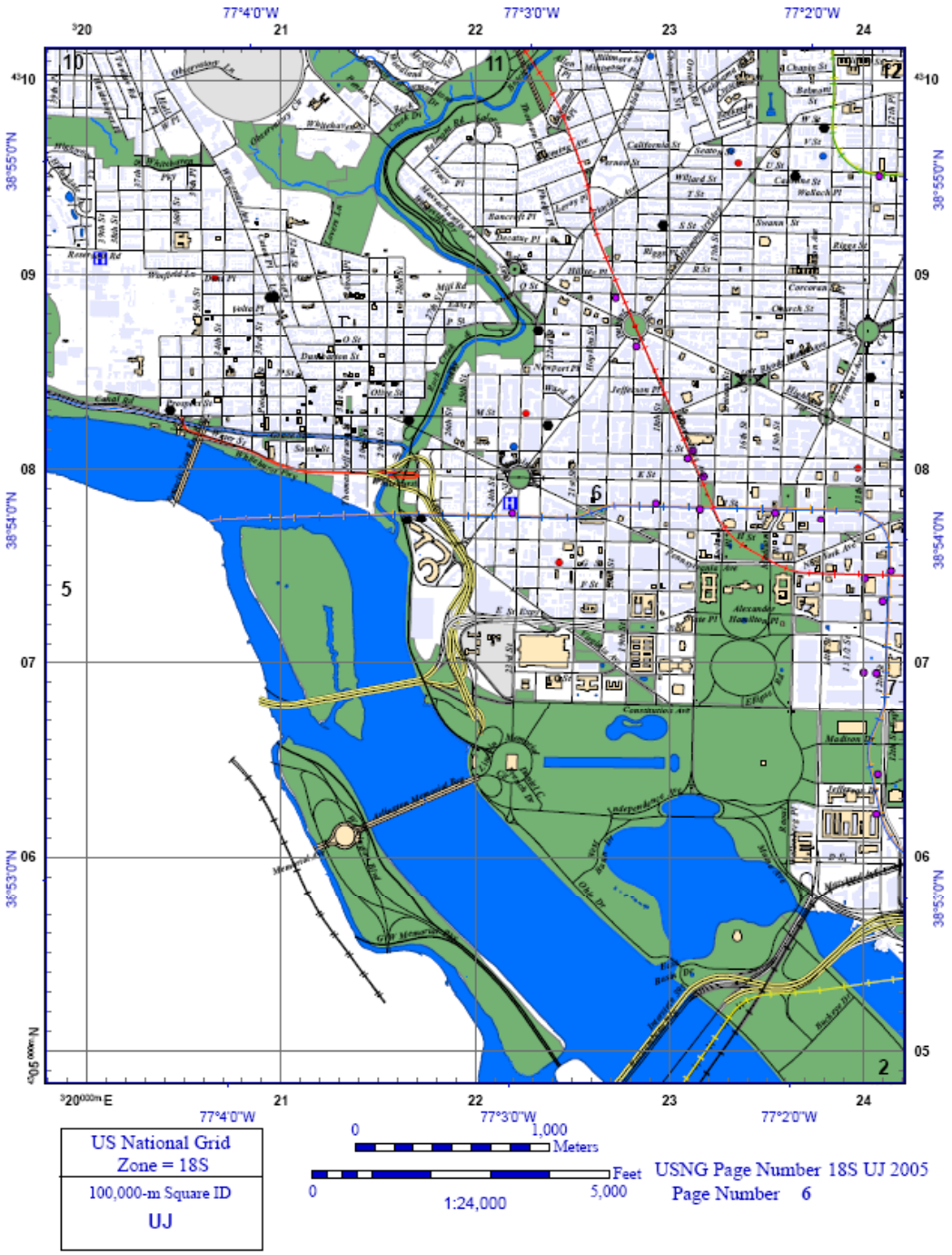
There is a better way…

- It's called the US National Grid and it would have greatly facilitated the solution to a lot of other problems:
  - Reporting of locations for evac, SAR activities, recoveries, etc…
  - It was already being used by 70,000 emergency responders – we call them the MILITARY (USNG is equivalent for most purposes to the Military Grid Reference System)
  - Comes complete with ready made grid boxes
  - Solves many other problems for emergency managers by allowing them to manage an event using maps to provide a **common, spatially-based, operational framework.**

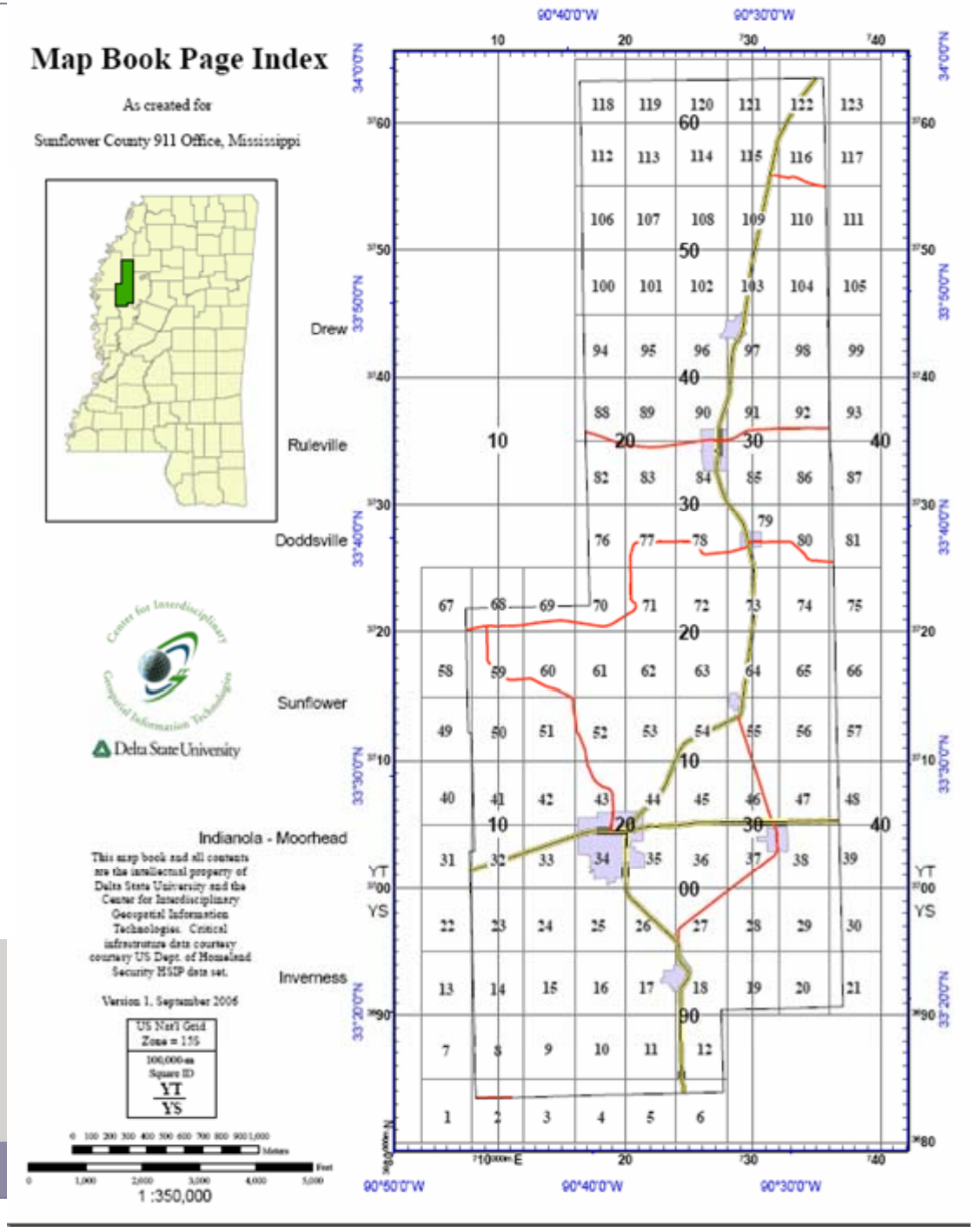
This 1:50,000 map was produced in support of the 2009 Presidential inauguration and furnished to the FBI's Washington, DC field office by the Center for Interdisciplinary Geospatial Information Technologies at Delta State University. The purpose of this map and an accompanying atlas was to provide decision makers and responders with a common, **spatially-based** operational framework based on the US National Grid standard.

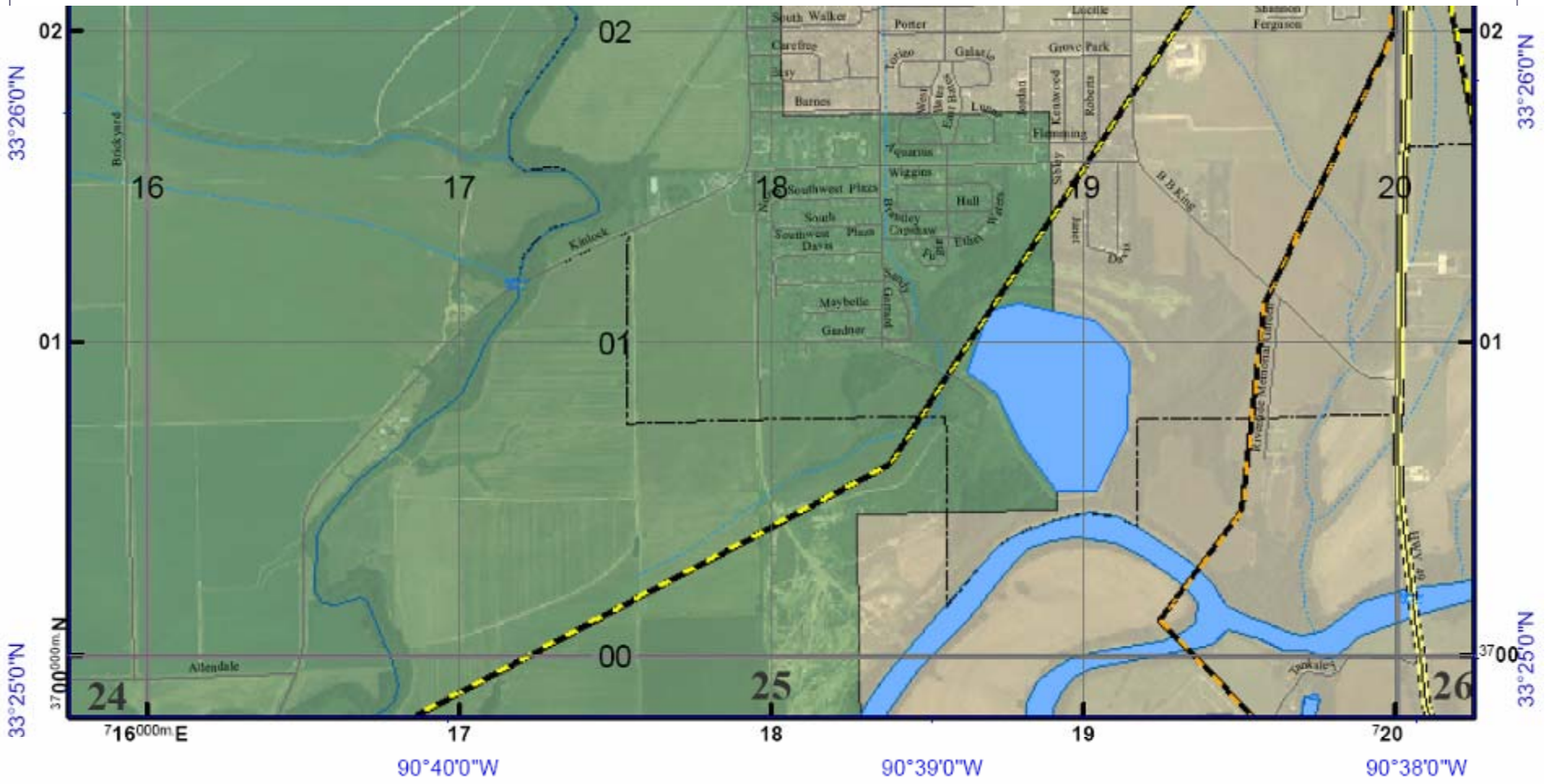


A sample USNG-based map book page created using 1km x 1km USNG grid squares assembled into 4km x 5km polygons. The polygons are used to drive map book creation. The 4km x 5km extent was chosen such that each page may be printed at 1:24,000 scale using most standard letter-sized printers and the scale is consistent with standard USGS map products. Content includes information layers important to emergency responders. Note that both a local (sequential) page number and USNG page number are provided. Once understood, most geospatial professionals should be able to replicate this map quickly if provided the data source (DC GIS), US National Grid coordinate for the lower-left corner of the map, and the scale.



The 4km x 5km polygon layer used to define page extent serves as the overview map for an atlas-style construct. Because each page is based on US National Grid, each page may be assigned both a local page number and a universally unique and standardized US National Grid page number. Therefore, the map page identification for an area beyond extent shown in the overview may be easily determined by a responder and requested on demand.





US Nat'l Grid Zone = 15S
100,000-m Square ID
YT

0 100 200 300 400 500 600 700 800 900 1,000 Meters

0 1,000 2,000 3,000 4,000 5,000 Feet

US Nat'l Grid Page 15S YT 1600

Map Book Page 34

Why not use Lat/long, state plane, 5' grids, 2.5' grids, UTM, etc...?

- Latitude/longitude
  - Many different position reporting formats
  - Just how far is 1 minute of longitude anyway?
  - Ever tried to fix a position to within 10-m using a paper map and DMS?
- But we have GPS!!!
  - Which works great when you're not
    - In heavy weather
    - An urban environment
    - In a time of National crisis when the system gets shut off
  - And is fantastic if
    - Can remember the "-" sign when plotting longitudes
    - You like to lug around batteries
    - Enjoy watching football on 13" black and white TV's
    - Can manage not to loose it while slogging through the mud but still can afford to give one to every person involved in a rescue.
- **But the #1 REASON IS THAT THE US NATIONAL GRID IS A NATIONAL STANDARD!**

Federal Emergency Management Agency

Washington, D.C. 20472

APR 26 2001

Julie Binder Maitra
Standards Coordinator
US Geological Survey
590 National Center
Reston, Virginia 20192

Subject: FEMA's Recommendation on the Proposed US National Grid Standard

Dear Ms. Binder Maitra:

The Federal Emergency Management Agency (FEMA) supports the adoption of the US National Grid (USNG) as a standard for horizontal reference mapping in the United States. The FEMA program offices anticipate that use of this system for identifying locations among emergency management personnel and agencies will help save lives, reduce the costs of disaster, and enhance preparedness, response, recovery, and mitigation efforts. Particularly valuable is its compatibility with the system used by the National Guard and others, the Military Grid Reference System (MGRS). The USNG standard also appears reasonably compatible with current capabilities of the Global Positioning System (GPS), and has the potential to be quite effective as a locational tool if future GPS devices adopt the standard. FEMA recommends that the FGDC adopt the USNG system as the horizontal reference system for all general-purpose mapping.

Sincerely,

Michael K. Buckley, P.E., Director
Technical Services Division
Mitigation Directorate

In Reply Refer To:
Mail Stop 102

MEMORANDUM

September 23, 2003

To: Geography Senior Staff

From: Barbara J. Ryan */s/ Barbara J. Ryan*
Associate Director for Geography

Subject: Support and Promotion of the U.S. National Grid

I want to remind everyone of the importance of promoting the use of the U.S. National Grid (USNG) among our Federal, State, and local partners, particularly its importance for disaster readiness, response, and recovery applications.

The Federal Geographic Data Committee (FGDC) adopted the USNG as a National Spatial Data Infrastructure (NSDI) standard in December 2001 as FGDC-STD-011-2001. That same month, John Marburger, the Director of the Office of Science and Technology Policy, identified the implementation of the USNG as one of the three most important immediate steps that the Government could take to improve homeland security. In June 2002, we revised the technical specifications for our primary series maps to make the USNG our primary grid. It is also our policy to implement NSDI standards in *The National Map*. Pursuant to that policy we have implemented some initial support for the grid in *The National Map* viewer. We have also entered into a verbal agreement with the National Geodetic Survey to promote the implementation of the USNG especially among State and local agencies.

Like all standards, the USNG will be truly effective only if widely implemented. Support for the grid in *The National Map* is an important early step, but it is only one. Public education and promotion are equally important. So I am asking that the regions take steps to assure that support for the USNG is included when presenting information about *The National Map*. Regional and local conferences are key opportunities to promote the USNG, especially when we are discussing the importance of *The National Map* for emergency response applications. I am also asking that we look for ways to include information about the USNG in the educational materials we provide to the public.

Thank you for your continued support with this very important aspect of *The National Map*.

A National States Geographic Information Council White Paper on the National Grid
August 3, 2006

National Grid Awareness and Application

The growing reliance upon coordinated state, local and federal communications in the geospatial field has increased the need for universality and precision in the description of location information. In response to the need to communicate precise location coordinates across all levels of government the Federal Geographic Data Committee (FGDC) has established the United States National Grid (USNG). In order to provide its membership with an awareness and understanding of the USNG as a projection and data reference system the National States Geographic Information Council (NSGIC) has created this position paper.

The United States National Grid

The USNG is based on universally defined coordinate and grid systems and as a result can be easily extended for use world-wide as a universal grid reference system.

The USNG is a nonproprietary, alphanumeric point reference system based upon the Universal Transverse Mercator (UTM) projection. The UTM coordinates are overlaid upon the Military Grid Reference System (MGRS). These combined elements define the USNG. A complete USNG geoaddress provides a unique location value on the earth.

USNG specification defines how to present Universal Transverse Mercator (UTM) coordinates at various levels of precision. It specifies the use of those coordinates along with the grid system defined by the MGRS. Additionally; it addresses specific presentation issues such as grid spacing.

Many current GPS receivers, from recreational to survey-grade instruments, support and report positional information in a USNG format. The USNG specification, as well as information explaining how to use the USNG, can be found at http://www.fgdc.gov/usng/index.html.

Who's using USNG?

The Federal Emergency Management Agency (FEMA) supports the adoption of the USNG as a standard for horizontal reference mapping in the United States.

The FGDC Cadastral Subcommittee has endorsed the use of the USNG as a parcel and cadastral identification scheme. The USNG location identification system, when used as an identifier, provides a location with a method to generate a nationally unique identifier.

The USNG is included in the new URISA Address Standard.

The USNG has proven to be critical in supporting coordinated federal, state, and local relief efforts during emergency situations like Hurricane Katrina.

The USNG can be useful in routing first responders by E911 centers in remote and rural areas because it is supported by many handheld, GPS units.

Recommendations for State and Local Officials

State and local officials that may potentially interact with Federal or Military personnel in the course of their jobs (especially emergency management support personnel and first responders) need to remain aware of two fundamental issues.

1. It is critical that state and local users are aware of what projections and coordinate or grid referencing systems are available on their geospatial software and equipment, and what the settings and capabilities are. We also recommend learning how to use the conversion capabilities of those tools.
2. They should also be aware that Federal or Military personnel may request or supply location information in USNG coordinates. NSGIC strongly recommends, as state and local officials purchase geospatial software and equipment, that compatibility with the USNG be considered.

We encourage state and local personnel to look for or request software and tools that allow for native, on-the-fly, point coordinate conversion and display of the USNG whenever possible. We also recommend including USNG awareness and use as part of regular training and exercises. Finally, they should train all personnel to use the coordinate system and grid reference system conversion capability on their software and equipment.

Recommendations for Vendors and Developers

Geospatial software, application and tool developers are strongly encouraged to include native translation capabilities to and from the USNG Reference System as a requirement for their location based services and products. At minimum the ability to convert, input, locate and display USNG locations is increasingly critical to the states and local governments in support of public safety initiatives. Developers need to build in working conversion routines that automatically populate data fields with the correct USNG values. Developers also should consider the following capabilities as appropriate for their tools and applications.

1. Create a capability that will display the USNG coordinates of a location by selection of a point, input of a point, and/or mouse-over of a point.
2. Create a capability that allows the accurate location and display of an operator input point or list of points referenced to USNG coordinates, it must also highlight, center and zoom to location.
3. Allow for operator entry of the input USNG point(s) by standard, "word processing style" cut-and-paste methods.
4. Create a USNG display command that will allow the user to graphically overlay the USNG on their display screen (toggle on, off) for reference purposes and allow the user select the grid line spacing display level(1,000m, 500m, 100m, 50m, 10m, 1m).
5. Where given an address, return the USNG coordinates.
6. Locate the nearest address to a USNG coordinate pair.
7. These functions should be operational for display and conversion to/from all generally accepted reference systems in the US.

Multiple coordinate systems and reference grids have long been a reality of the geospatial world. The difficulty of system to system conversion and interoperability can be reduced in today's digital environment. The potential for error will still exist, however, that probability will decrease as those who use geospatial services and equipment are adequately aware of the problem through proper training and education.

NSGIC is not advocating, at this time, that the USNG should be identified as 'The National Reference System'. But, we do believe that USNG awareness is one of a number of map reading or geospatial skills that emergency personnel should have. We also recognize the widespread use of USNG in the federal environment as well as its increasing acceptance in location based services.

The USNG provides a seamless, common reference system upon which all first responders nation-wide may be trained. In the event of a disaster where national assets are deployed to assist local responders USNG will be the language used to communicate location. To enhance response times and minimize bottlenecks at critical and stressful times, we must provide useable location information in a consistent and uniform format to all first responders as quickly as possible. We owe it to our citizens in a time of need where seconds truly matter, to provide data to everyone in a usable format that will increase the likelihood of their safety and well being.

Final Draft

GEOSPATIAL INFORMATION & TECHNOLOGY ASSOCIATION

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July 3, 2007

Mr. Talbot Brooks
Director
Center for Interdisciplinary Geospatial Information Technologies
Delta State University
110 Kethley Hall
Cleveland, MS 38733

Dear Talbot:

On behalf of the Board of Directors and membership of GITA, I am pleased to provide this letter of endorsement and support for the US National Grid, a Federal Geographic Data Committee-endorsed standard that is being promoted in order to create a more favorable environment for developing location-based services within the United States and to increase the interoperability of location services with printed map products.

As a user friendly, nationally consistent language of location optimized for local applications, it does not require users to change how their data is digitally stored, as in latitude and longitude degrees-decimal-degrees, for example. Instead, its use facilitates new functions and capabilities previously unavailable.

The US National Grid enables the concept of a universal map index, similar to how a community uses only a standard set of names for its streets. Beyond its use in describing street and feature locations on paper maps depicting a full fine line USNG grid, USNG map index values are directly usable with Global Positioning System (GPS) receivers and other digital technology. As a globally extent consensus based standard, it reduces training and other costs as well as operational friction between and among organizations. These capabilities can be particularly important to those geospatial professionals, as represented by GITA members and constituents, with a vested interest in operating, maintaining and protecting the nation's infrastructure.

For example, the US National Grid has proven to be of significant value in meeting emergency response and address/parcel identification requirements, serving in part as a bridge between analog (paper maps) and digital applications. This can be a particularly critical function in the aftermath of a natural or other disaster, as when the street sign infrastructure of coastal Mississippi was destroyed by Hurricane Katrina.

Accordingly, given the significant benefits adoption and use of the US National Grid would provide, the Board of Directors of the Geospatial Information & Technology Association (GITA) endorses and strongly encourages the appropriate implementation and use of the Federal Geographic Data Committee US National Grid standard by its members and others.

In addition, the GITA Board of Directors:

- supports the US National Grid (USNG) as a nationally consistent grid reference system and as the preferred grid for National Spatial Data Infrastructure (NSDI) applications;
- believes that other geospatial reference systems must also be standardized and available for application and use, but strongly supports the USNG as a seamless, common reference system for emergency management;
- recommends widespread awareness, training and education on the use of the USNG for first responders nation-wide; and
- supports consideration by the ANSI/INCITS Technical Committee L1 of adoption of the USNG as an American National Standard.

We will continue to encourage GITA members to list their implementations and lessons learned on the website provided by FGDC (www.fgdc.gov/usng) and also encourage wide distribution of the "White Paper" prepared by the National States Geographic Information Council, dated August 3, 2006, that cites a number of the values and benefits of the US National Grid.

Thank you for the opportunity to comment on this important issue on behalf of the constituents of GITA and the people and infrastructure-based institutions that they serve.

Yours sincerely,

Robert M. Samborski
Executive Director

c: Richard Hogan, Director, EROS Center, USGS
Tom Terry, US Marine Corps, Geospatial Planning and Policy Branch

National Search and Rescue Committee

NSARC Georeferencing Matrix: Catastrophic Incident SAR

Georeference System User	USNG	Latitude/Longitude DD-MM.mmm(1)	GARS
Land SAR Responder(2)	Primary	Secondary	N/A
Aeronautical SAR Responders (3)	Secondary	Primary	Tertiary
Air Space Deconfliction (4)	N/A	Primary	N/A
Land SAR Responder/ Aeronautical SAR Responder Interface (5)	Primary	Secondary	N/A
Incident Command: Air SAR Coordination Land SAR Coordination	 Secondary Primary	 Primary Secondary	 N/A N/A
Area organization and accountability (6)	Secondary	Tertiary	Primary

http://www.uscg.mil/hq/cg5/cg534/nsarc/Gita_March08.pdf

Some Important Points About The US National Grid

- The US National Grid is not intended to replace current geospatial data storage methods or mapping and spatial measurement methods, but rather is designed to provide supplemental information for use in determining position by creating a common language of location.
- The US National Grid is extremely similar to the Military Grid Reference System – the primary difference is that MGRS uses WGS 84 as the datum and USNG uses NAD83. For nearly all appropriate USNG applications, the difference between these two datums is insignificant. Thus, if USNG is not available (as is the case in some older model GPS units and mapping packages), users may use MGRS as if it were USNG as a means of last resort.

The Bottom Line

- US National Grid is a standard – standards promote interoperability and reduce operational friction when more than one agency/entity are involved
- US National Grid works and has been tested in numerous GIS applications and GPS devices, however many users have limited experience and knowledge regarding implementing such standards-driven map production and presentation.
- Additional modules about the implementation of US National Grid are provided in additional lessons available from this source and the FGDC web site.