

Lightning Talk Presentation

Grid-Based Risk Modeling: A Standards Approach

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Grid-Based Risk Modeling: A Standards Approach

OR: Saving the World One Grid Square at a Time

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Dedicated to Ezra Boyd



Mapping the lives lost after Hurricane Katrina - CNN



DisasterMap.net National Overview Map

Stay informed in realtime with our interactive webmap and related data streams for following natural disasters that impact the United States.









Overview

- Geospatial standards
- Why use grid coordinates?
- Introduction to the US National Grid
- Standardizing maps
- Plotting point positions
- USNG as an area system for analysis



Background: Standards Are Important

In those days, the thread on fire hydrants and fire hoses was not standardized; each county and city had its own kind of thread. When the first out-of-town firefighters rushed from Washington to help, they could do little because hoses from their apparatus could not hook to Baltimore's hydrant system or local fire trucks...



Maryland Digital Cultural Heritage Project at <http://www.mdch.org/fire/#>

Fire departments learned that they needed to standardize when Baltimore burned in 1904.



331 Years of Experience in the US



- Emergency services are standards based organizations
 - Standard of care
 - Interoperability/interchangeability
 - Organizational consistency (NIMS/ICS)
 - Scalability
 - Continuity of operations
- When the incident occurs IS NOT the time for innovation



George Washington was a volunteer firefighter
with Friendship Veterans Fire Co.

Geospatial Standards

- Colors
- Symbols
- Scale
- Coordinate system
- Projection
- Page size



Map of Australia, pet rock, or "other"?
<http://www.abc.net.au/rural/content/2009/s2742168.htm>



Office of Management and Budget Circular A-16 (rev. 2002) mandates the coordination of geospatial information and technologies among Federal agencies through the Federal Geographic Data Committee (FGDC).

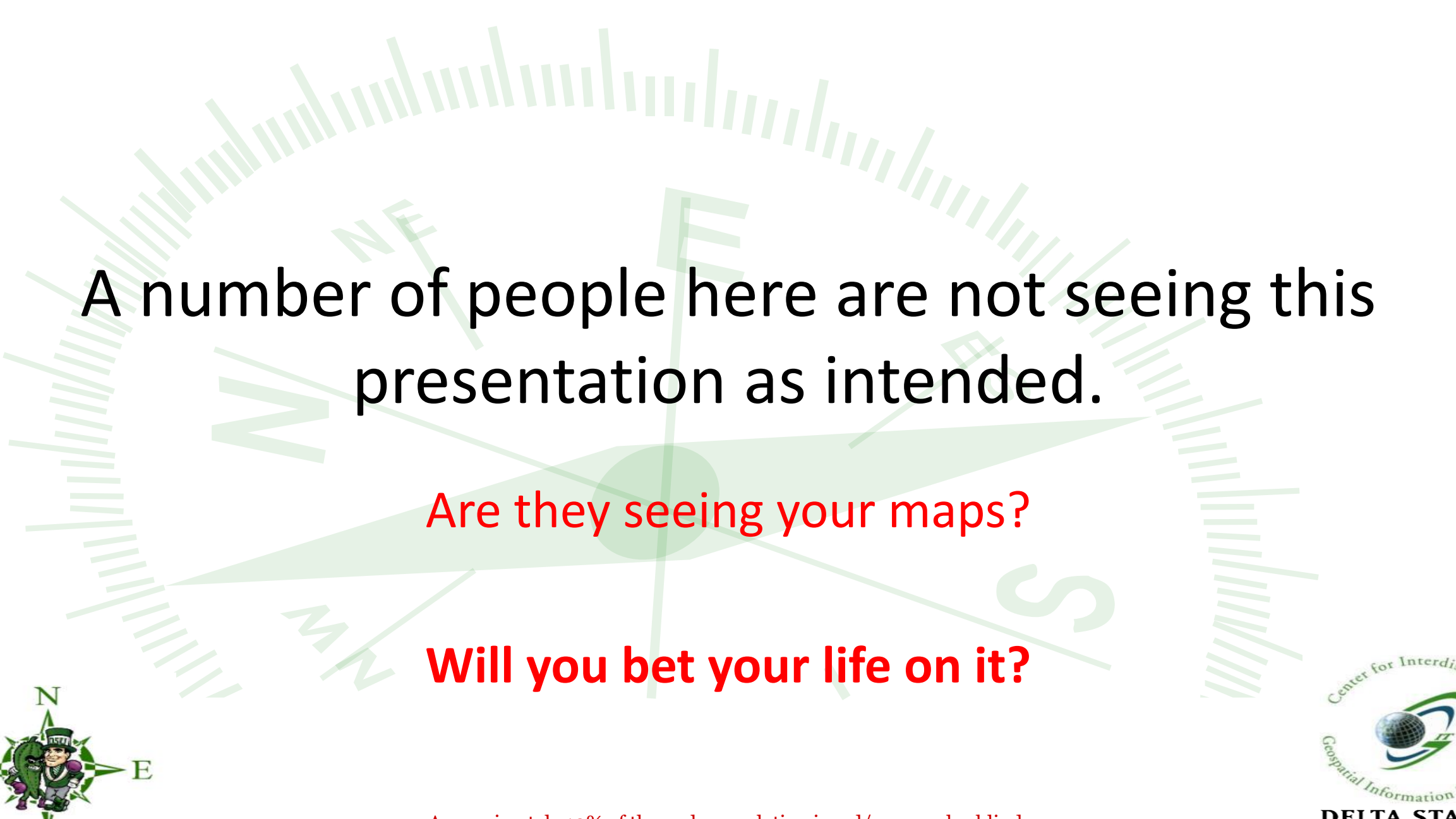
Standards Bodies

- Federal Geographic Data Committee
 - <http://www.fgdc.gov>
- Open Geospatial Consortium
 - <http://www.opengeospatial.org>
- ANSI and ISO for paper sizes
- US National Grid and the National Search and Rescue Committee
 - Search “NSARC” and “Georeferencing”



OGC's Carl Reed was there to tell Roger Tomlinson how to format the data when he “invented” GIS...





A number of people here are not seeing this presentation as intended.

Are they seeing your maps?

Will you bet your life on it?



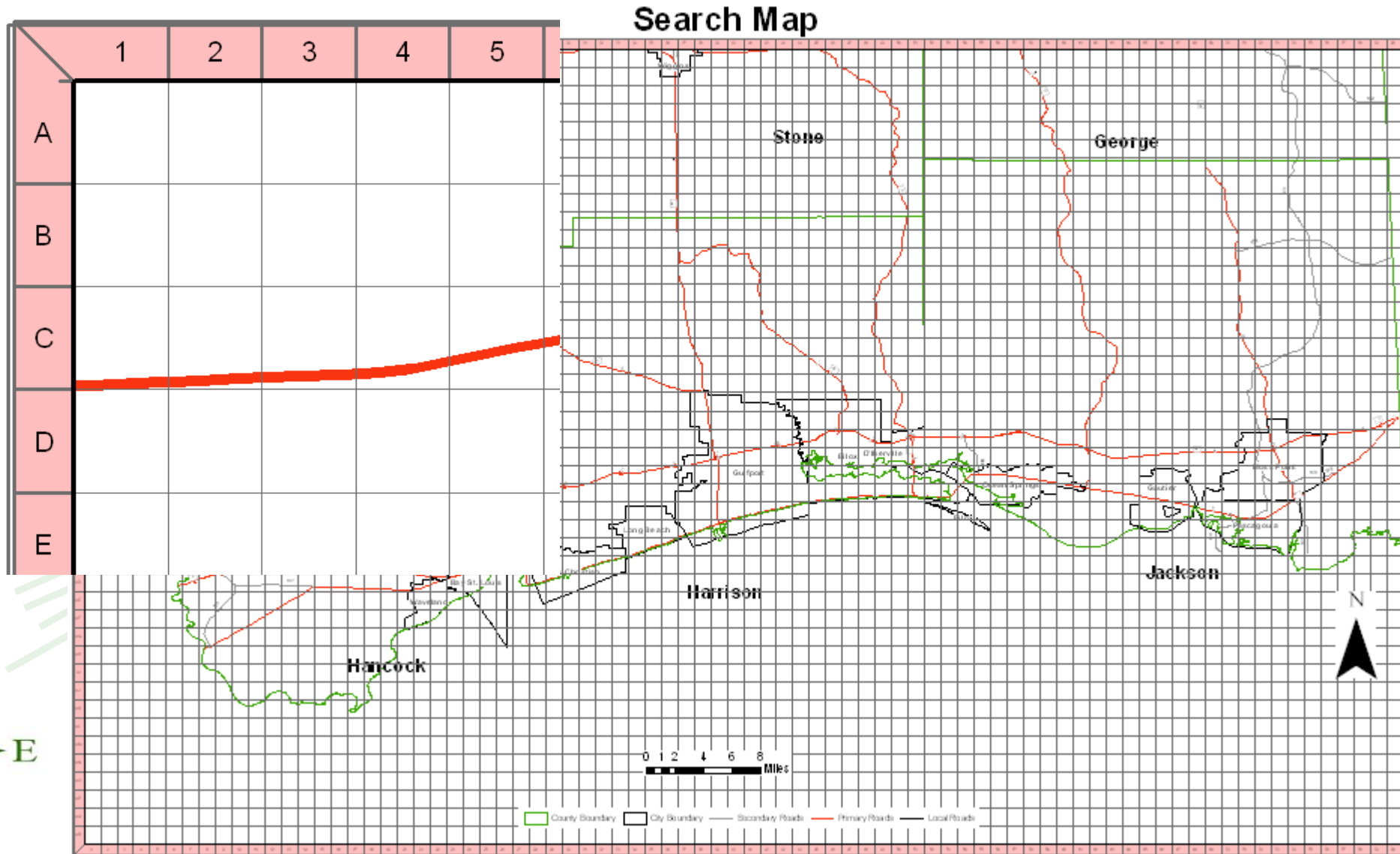
Approximately 10% of the male population is red/green color blind.

“Can you do that GSI stuff?”

- 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?



Search Map

Grid Columns: 1, 2, 3, 4, 5
Grid Rows: A, B, C, D, E

Counties: Stone, George, Harrison, Jackson, Hancock

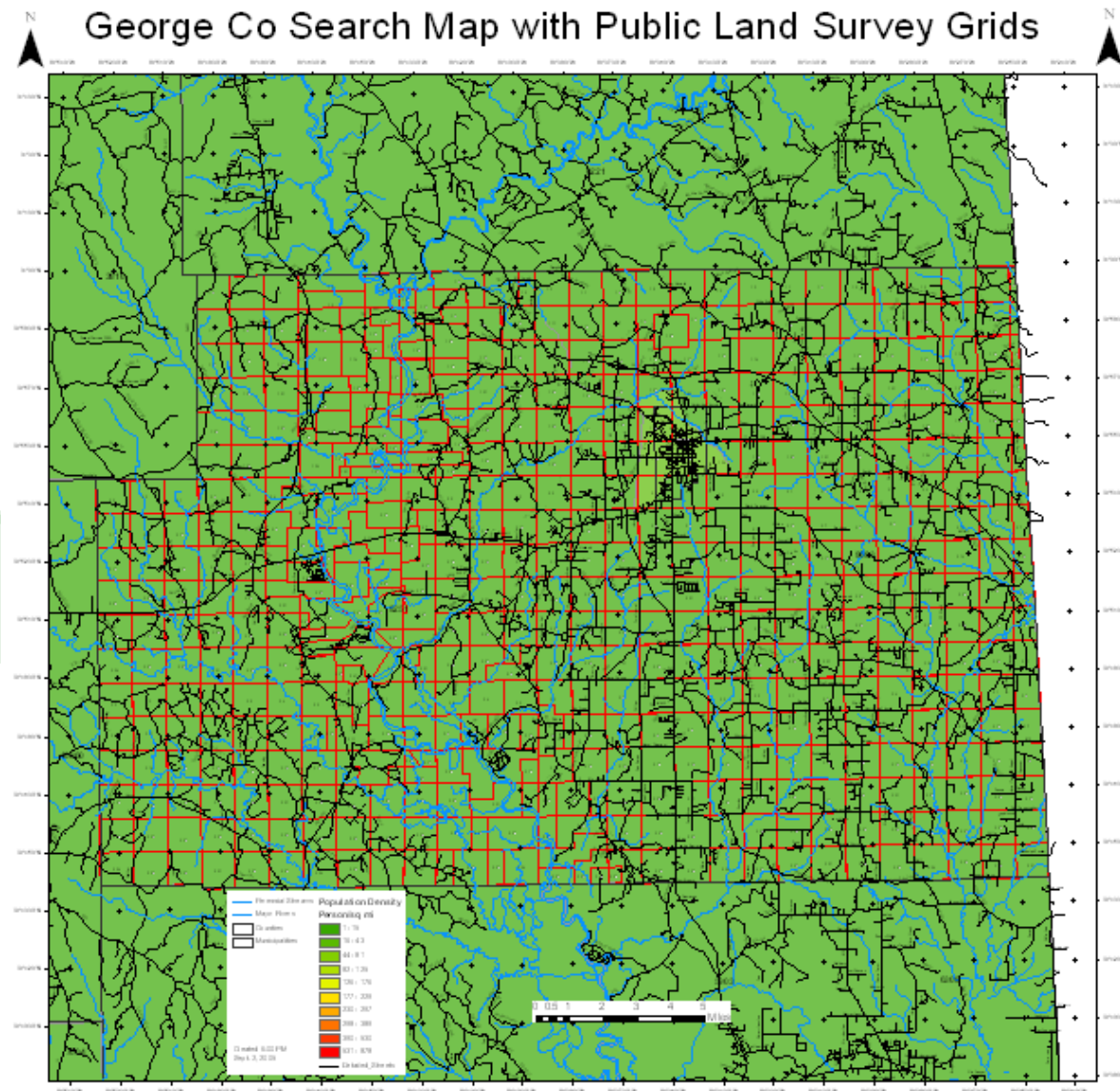
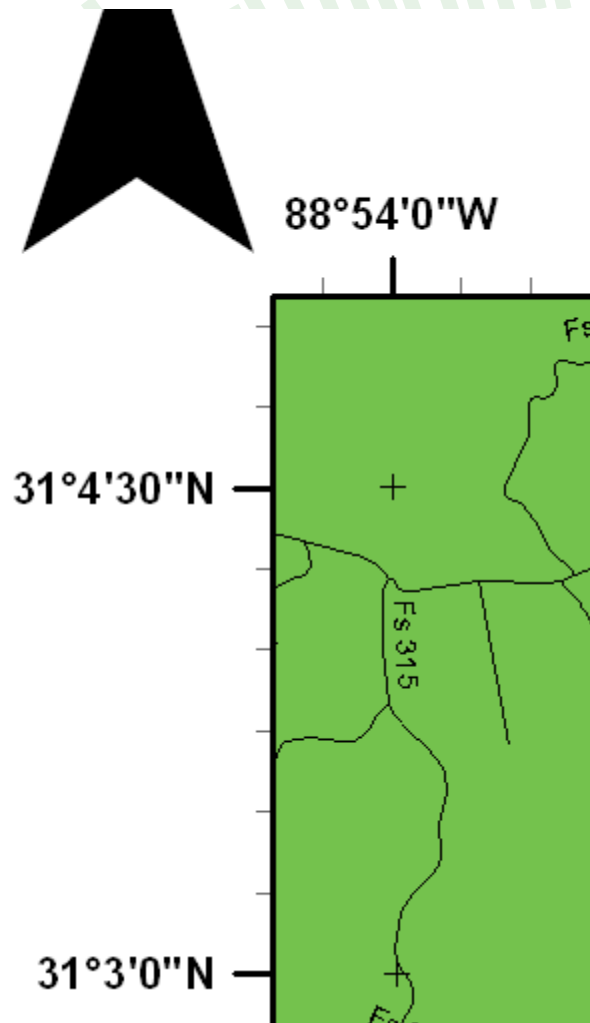
Legend:
 - County Boundary (Green line)
 - City Boundary (Black outline)
 - Secondary Roads (Thin grey line)
 - Primary Roads (Red line)
 - Local Roads (Thin black line)

Scale: 0 1 2 4 6 8 Miles

North Arrow: N



I'll use PLSS – what genius! (NOT!)



Maryland Trooper 2





NTSB Report on Trooper 2

- National Transportation and Safety Board (NTSB) report
- Highlights confusion about coordinates

“...The shift supervisor relied on ADW tower controllers or SYSCOM DO to provide him with the last known location of the helicopter. However, he said that he did not plot the coordinates that the SYSCOM DO gave him because he did not know what the coordinates meant.”
- The shift supervisor relayed the coordinates to the PG County dispatcher, adding that the location of the coordinates were approximately two nautical miles SW of FedEx field
- He did not indicate the numbers were in the form of *degrees, minutes, seconds*



NISB Report on Hooper

- Patrol personnel plotted coordinates using an online map
- Dispatchers assumed coordinates were in form of *degrees, decimal of degrees* (normally used)
- Crash site was actually located near Calvert Cliffs, Maryland (almost 30 miles away)



- Patrol personnel plotted
- Dispatchers assumed coordinates were in *for degrees, decimal of degrees* (normally used)
- Crash site was actually near Calvert Cliffs, Md (almost 30 miles away)



Grid Coordinate Systems

- Grid coordinates use a measured distance from a known set of reference lines for measuring location
- The standardized grid coordinate system used in the United States is called the **US National Grid (USNG)**
 - It is the only coordinate system recognized as a standard by the Federal Geographic Data Committee, the standards body for geospatial technologies in the US
- The basic unit of measure used is the meter





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,

A handwritten signature in black ink, reading "Michael K. Buckley".

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



**Appendix I: National SAR Committee (NSARC)
Georeferencing Policy -
Catastrophic Incident Search and Rescue.**

Georeference System User	USNG	Latitude/Longitude (DD-MM.mmm) (Note 1)	GARS-compatible
Land SAR Responder (Note 2)	Primary	Secondary	N/A
Aeronautical SAR Responders (Note 3)	Secondary	Primary	Tertiary
Airspace Deconfliction (Note 4)	N/A	Primary	N/A
Land SAR Responder/ Aeronautical SAR Responder Interface (Note 5)	Primary	Secondary	N/A
Incident Command: Air SAR Coordination Land SAR Coordination	Secondary Primary	Primary Secondary	N/A N/A
Geospatial information aggregation/dissemination (Note 6)	Tertiary	Secondary	Primary



Recommended solution using US National Grid to create 1km x 1km grid squares (contact DSU for procedure as it is involved and not straight forward – especially when working at zone junctions, but still preferable to any other lat/long or other grid system.

The 1km x 1km grids may be used as the basis for 4km x 5km map pages (ideal for 8.5" x 11" printing). Because each page is based on USNG, each page may be assigned both a local page number and a universally unique and standardized USNG page number.

Map Book Page Index

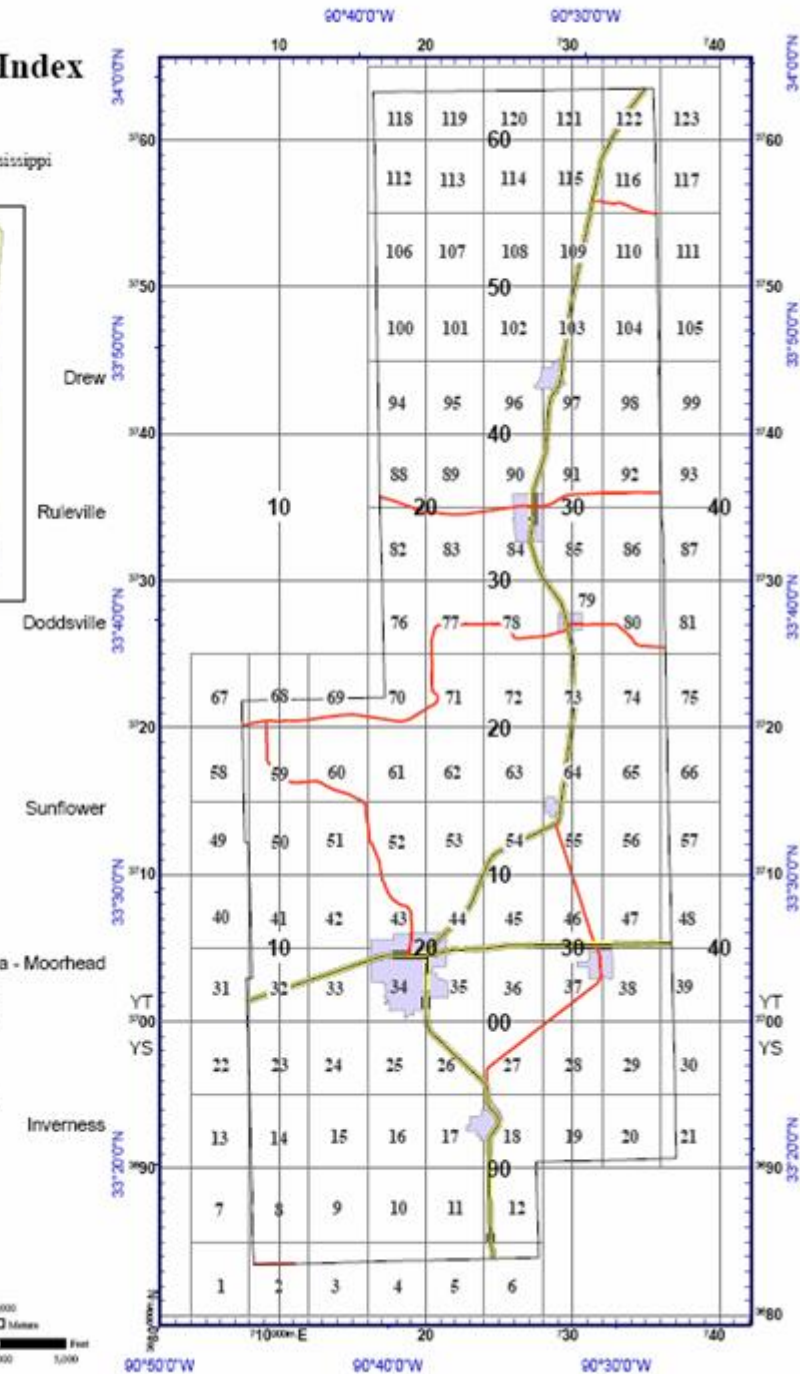
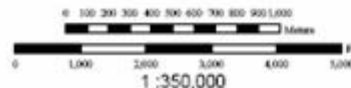
As created for
Sunflower County 911 Office, Mississippi



Indianola - Moorhead
This map book and all contents are the intellectual property of Delta State University and the Center for Interdisciplinary Geospatial Information Technologies. Critical infrastructure data courtesy US Dept. of Homeland Security HSIP data set.

Version 1, September 2006

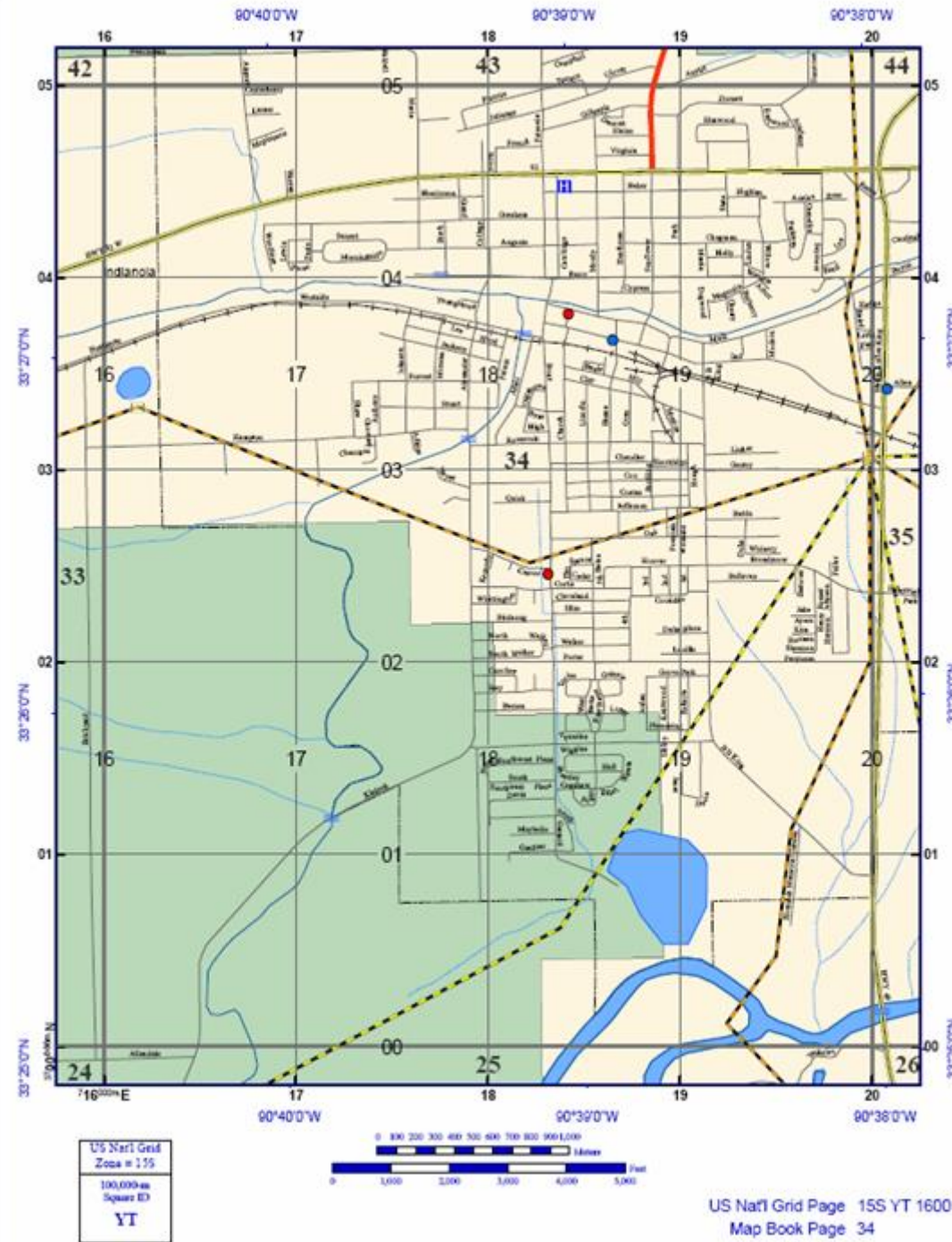
US Nat'l Grid
Zone = 15S
100,000-m
Square ID
YT
YS

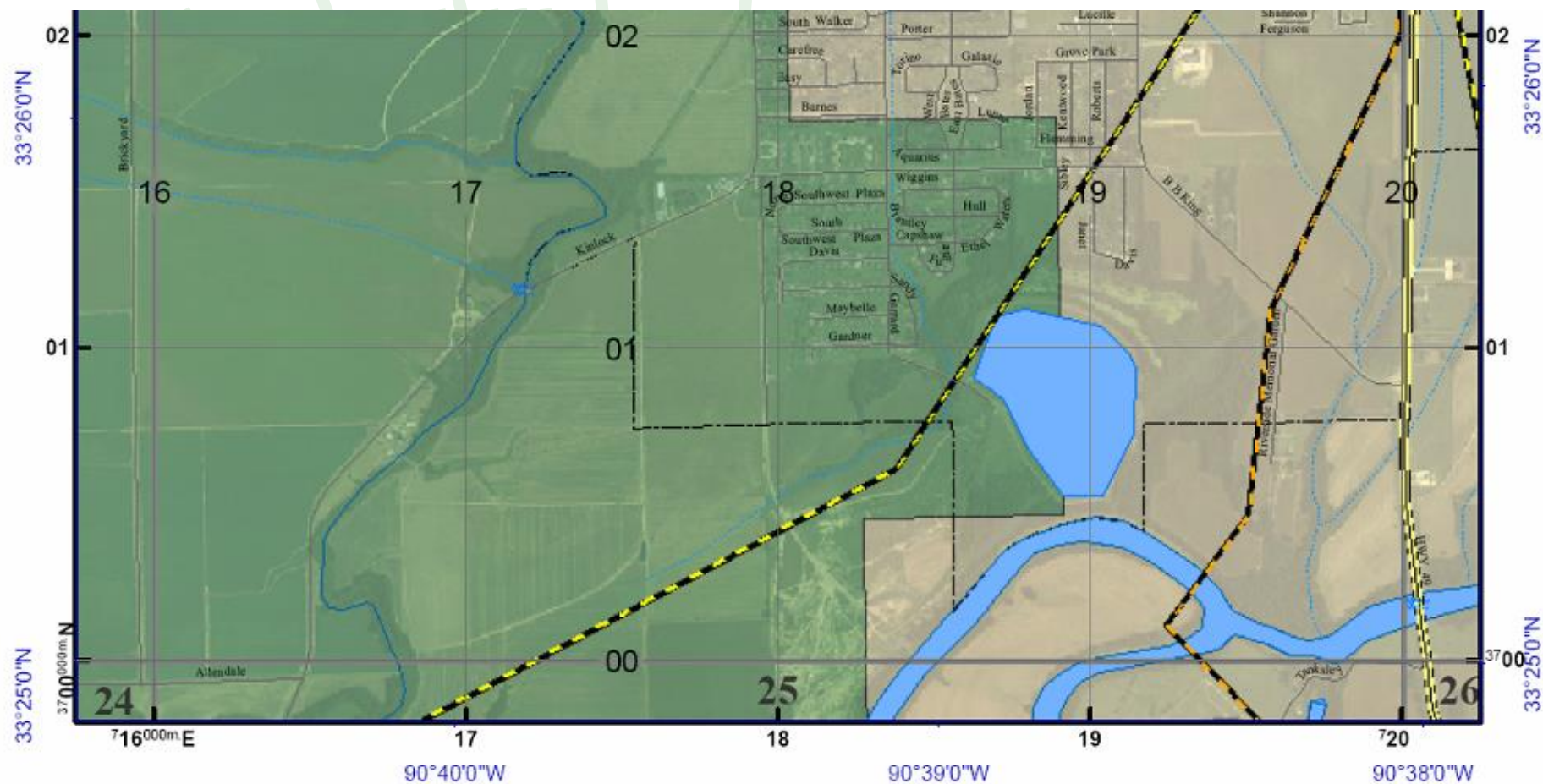


DELTA STATE UNIVERSITY
Join in. Stand out.

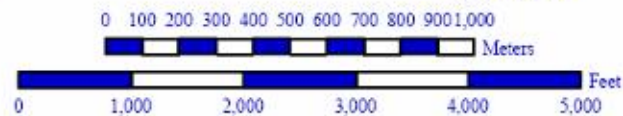


Sample USNG-based map Book page created using 4km x 5km assemblies of 1km x 1km USNG grids with layers for critical infrastructure. Background polygon layer is Electric utility Service Areas. Note that both a local page number and USNG page number are provided.





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



US Nat'l Grid Page 15S YT 1600
Map Book Page 34



DELTA STATE UNIVERSITY
Join in. Stand out.

Orientation to the USNG Format

Water Tank at grid: 16R BU 1028 0976

100,000-m Square ID

USNG format: 16R BU 1028 0976

Grid Zone Designation (GZD)
(6° lat x 8° longitude quad)

Easting Northing

Grid Coordinates

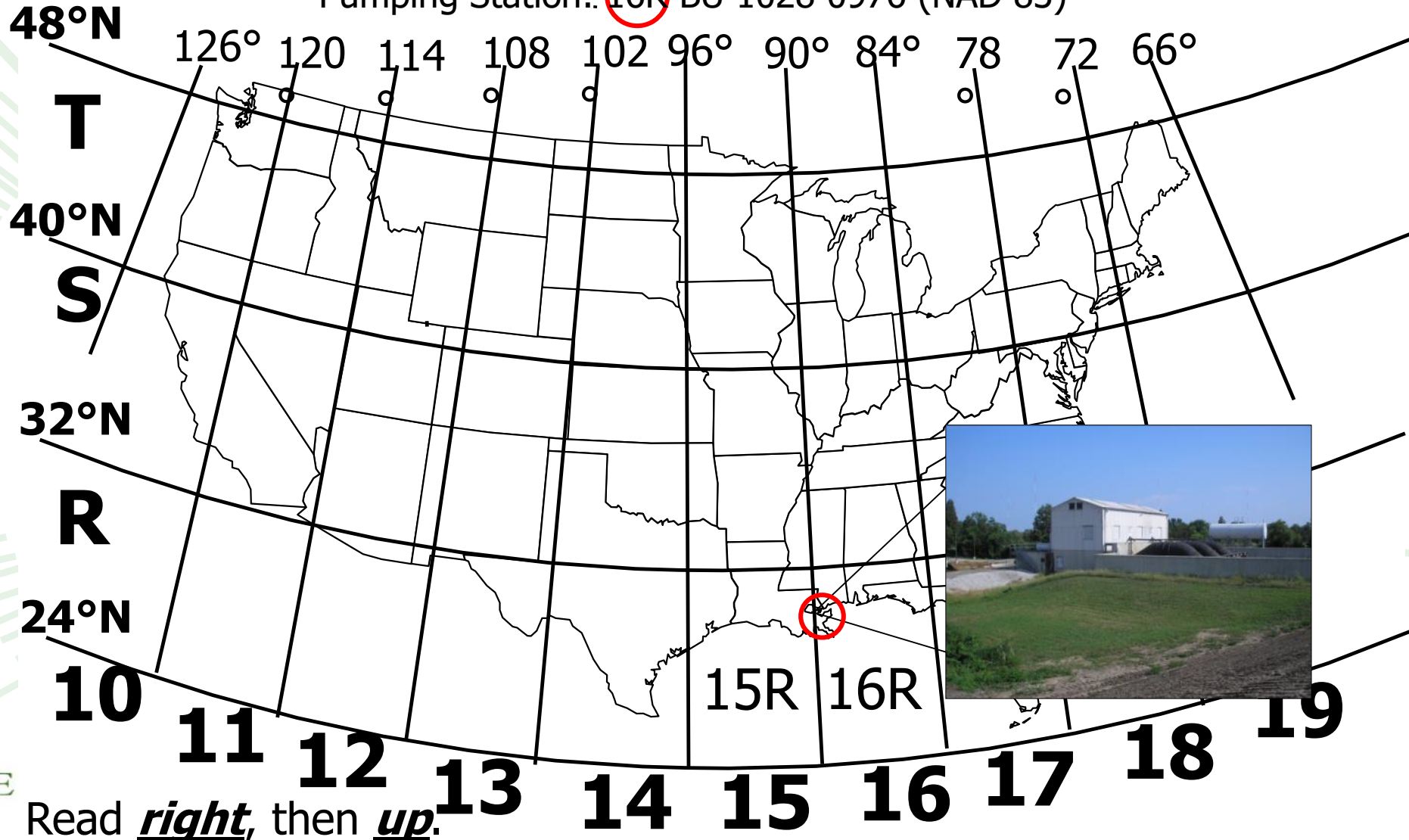
Read right then up



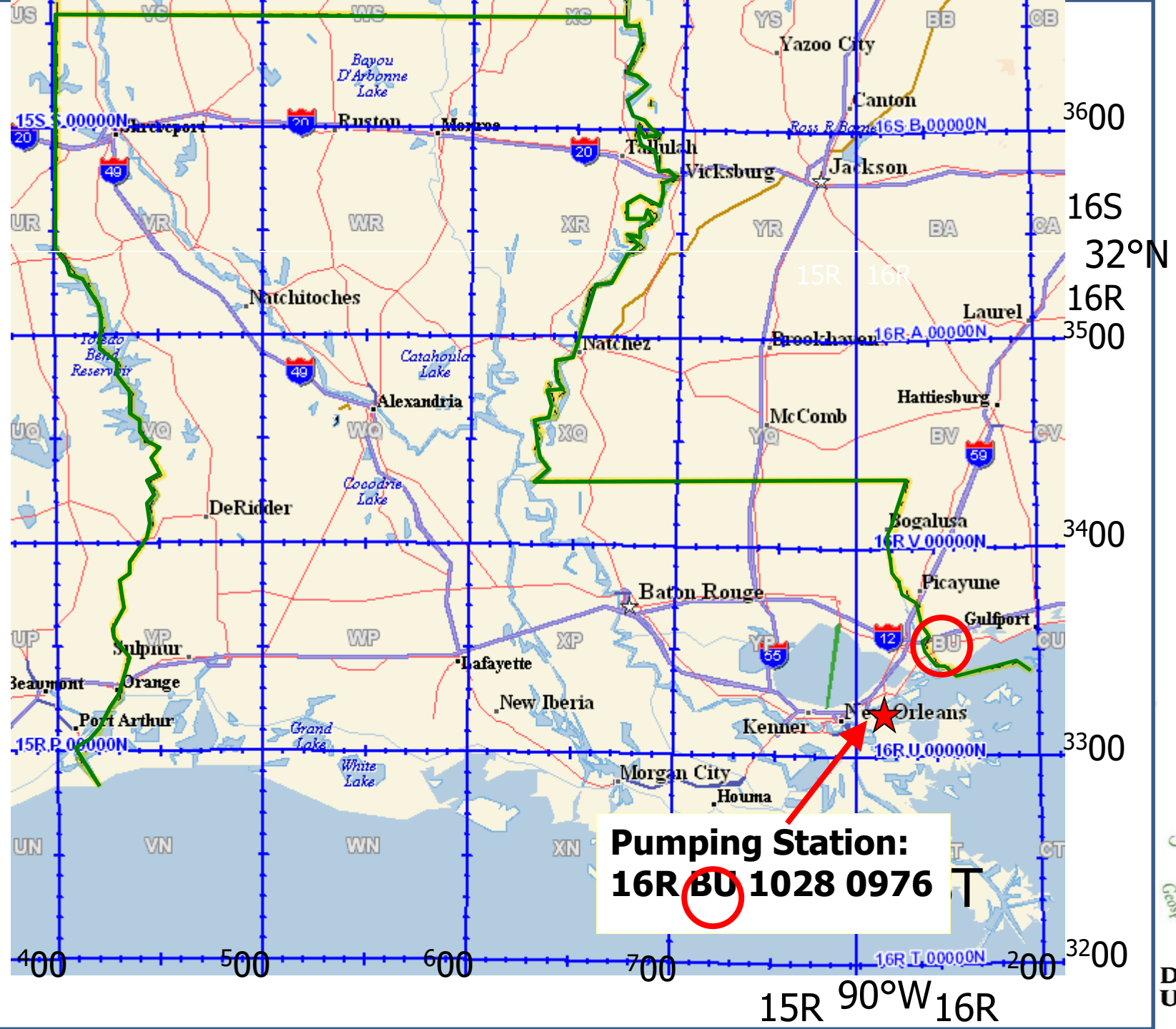
How to read the USNG...

UTM/USNG Grid Zone Designations

Pumping Station: 16R BU 1028 0976 (NAD 83)



Read **right**,
then **up**.



Reading USNG Grid Coordinates

Water tank located at
grid: 16R BU **1249 1084**

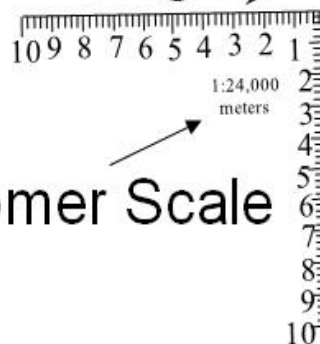
Read **RIGHT** to grid line 12
Then measure right another
480-meters.

Water Tank at
grid: 12491084
(think 1249 / 1084)

4-digit: 12 10 = 1,000m
6-digit: 124 108 = 100m
8-digit: 1249 1084 = 10m
10-digit: 12490 10840 = 1m precision

Then, read **UP** to grid line 10,
and measure UP another 840-meters.

Read **Right**, Then **Up**



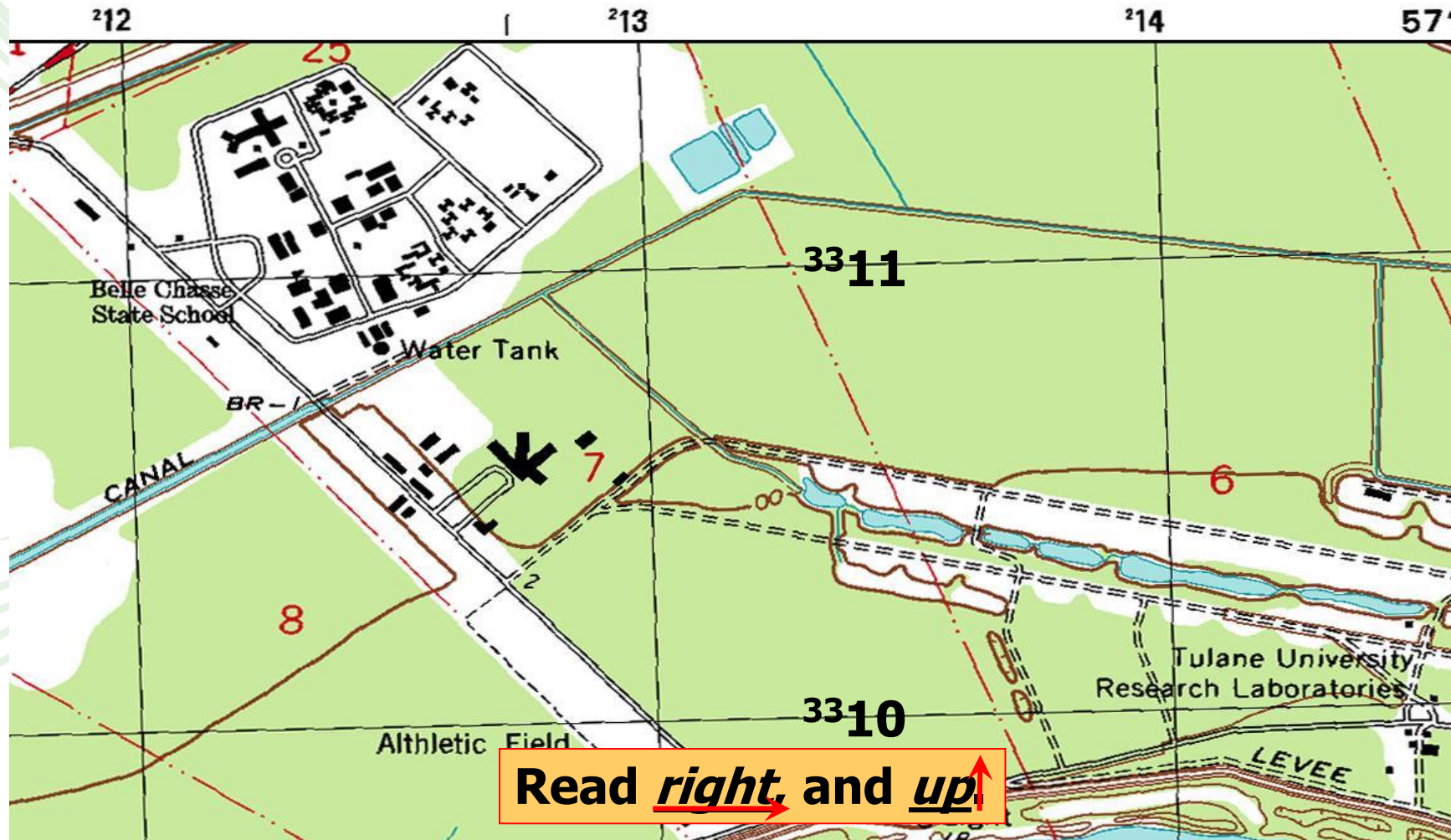
Produced by the United States Geological Survey
Topography compiled 1964. Planimetry derived from imagery taken 1998 and other sources. Public Land Survey System and survey control current as of 1967
North American Datum of 1983 (NAD 83). Projection and 1 000-meter grid: Universal Transverse Mercator, zone 16 10 000-foot ticks: Louisiana Coordinate System of 1983 (south zone)
North American Datum of 1927 (NAD 27) is shown by dashed corner ticks. The values of the shift between NAD 83 and NAD 27 for 7.5-minute intersections are obtainable from National Geodetic Survey NADCON software
There may be private inholdings within the boundaries of the National or State reservations shown on this map
City of New Orleans and Orleans Parish are coextensive
This quadrangle covers a subsidence area
Landmark buildings verified 1967

U.S. National Grid
100,000-m Square ID
BU
Grid Zone Designation
16R

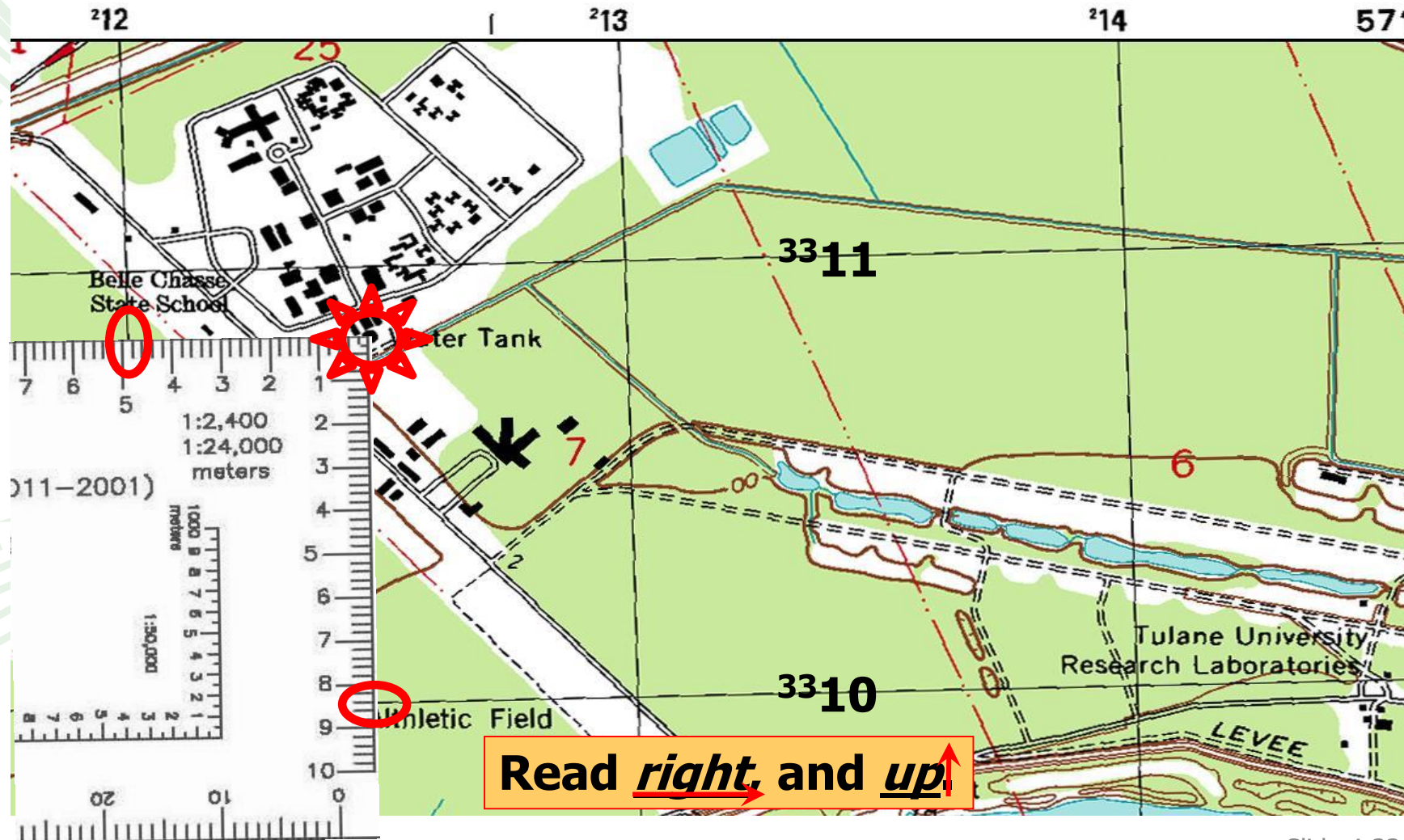
UTM GRID AND 2000 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET
CHALMETTE, LA

Task:

Locate the Water Tank at 1249 1084

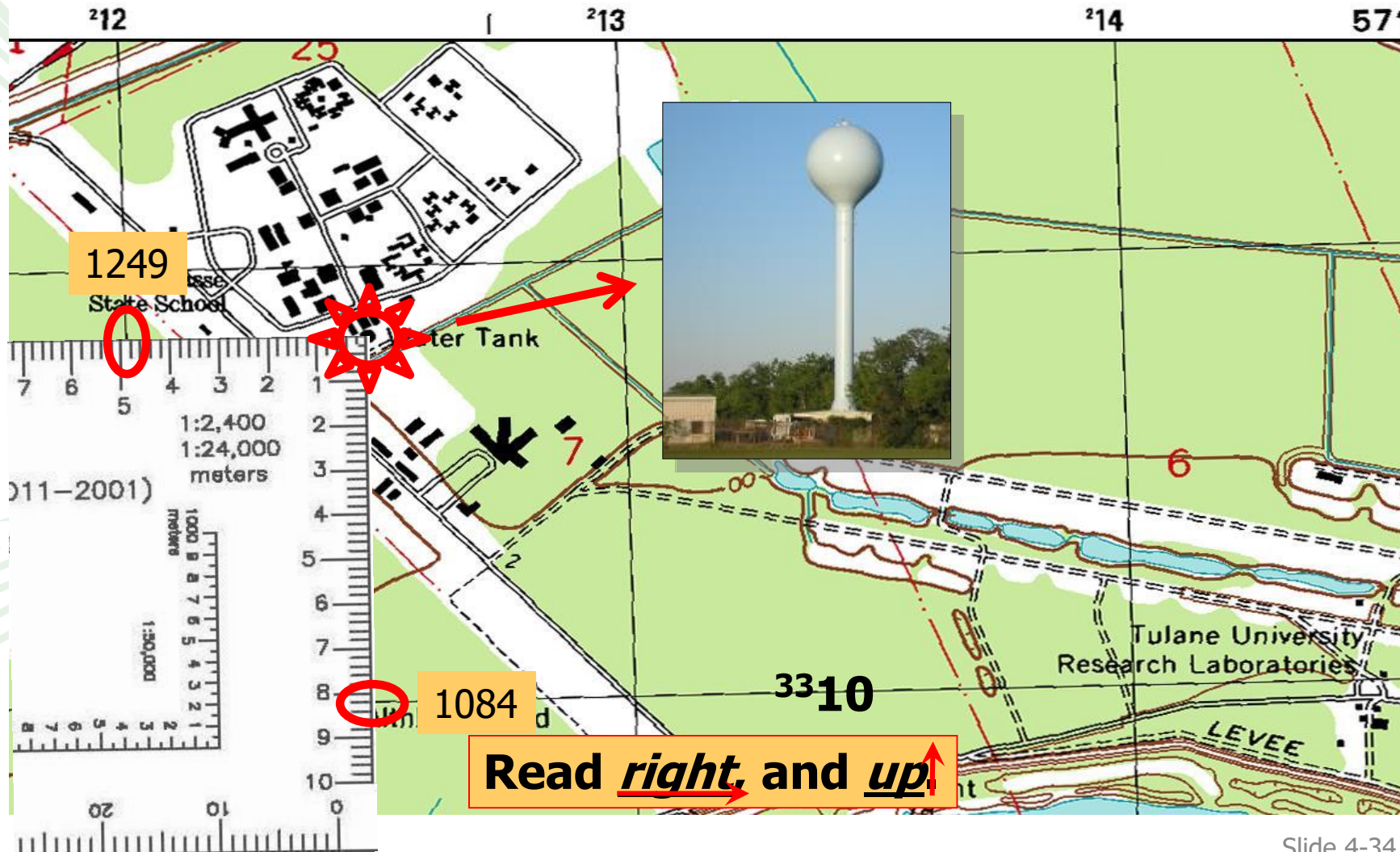


Locate the Water Tank at 1249 1084



Solution

Locate the Water Tank at 1249 1084



Slide 4-34

USNG as Area Management/Masking Tool

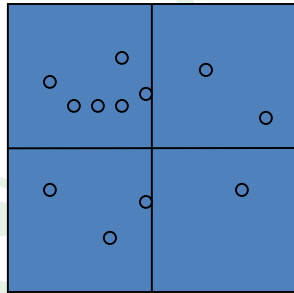
- Grid squares may be referred to by the coordinates representing the lower-left corner
- Number of digits expresses the size of the grid square
- May be used for
 - Area reference
 - Aggregator for features
 - Analysis grid



Example 1: Poisson Distribution and Tornadoes

$$P(x) = \frac{e^{-\lambda} \lambda^x}{x!}$$

where λ is the average number of things in a unit (time or area)



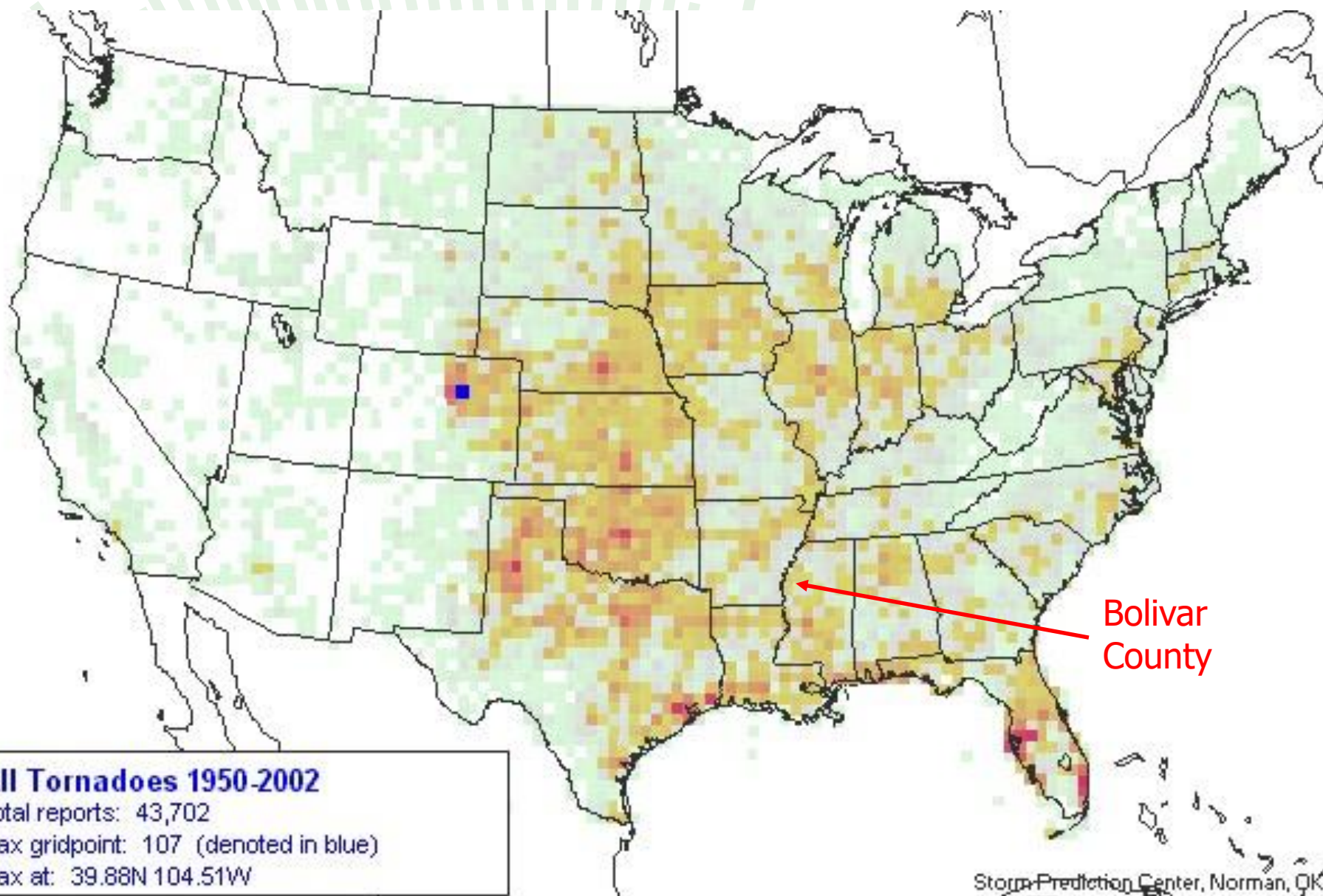
$$\lambda = 12/4 = 3$$

$$P(5) = 2.71828^{-3} 3^5 / (5 * 4 * 3 * 2 * 1) = 0.1008$$

$$P(2) = 2.71828^{-3} 3^2 / (2 * 1) = 0.2240$$



Tornados 1950-2002

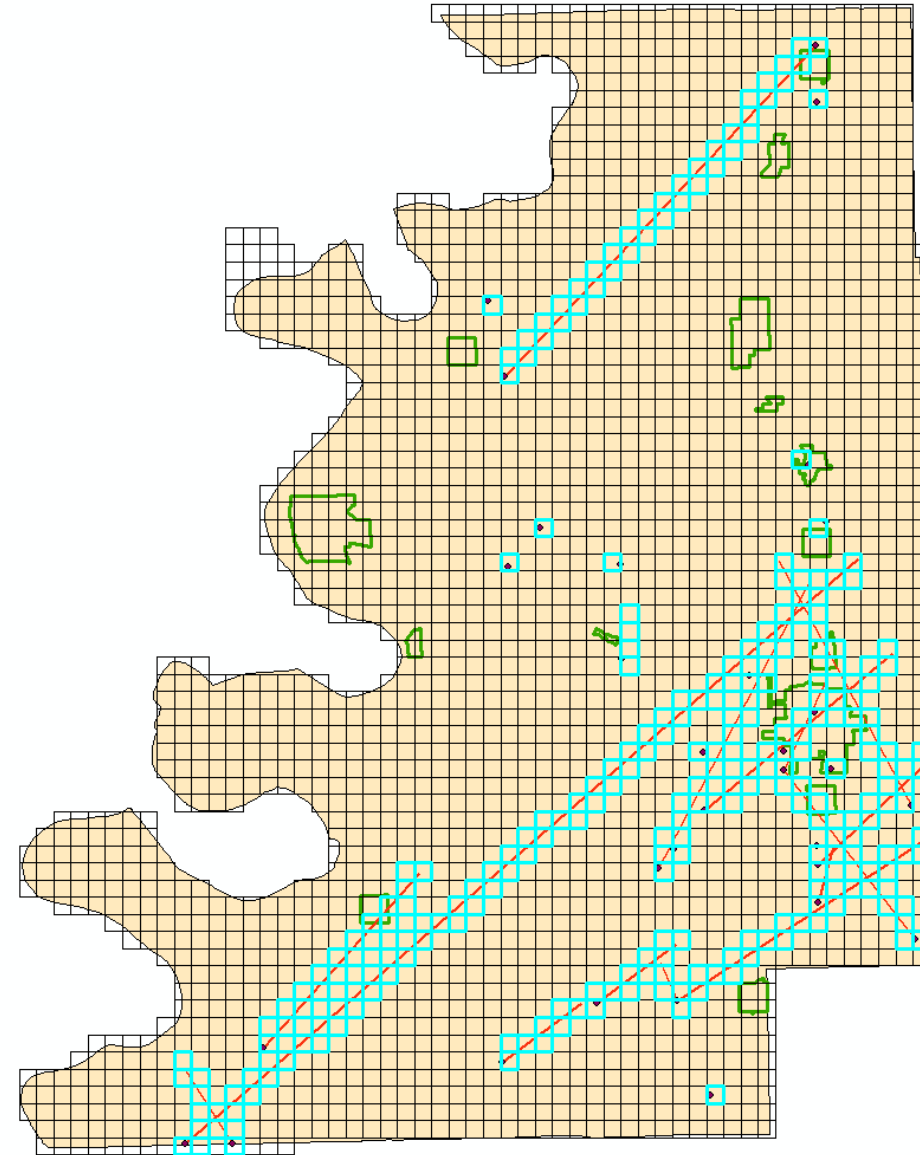


Time for a Tornado Shelter!

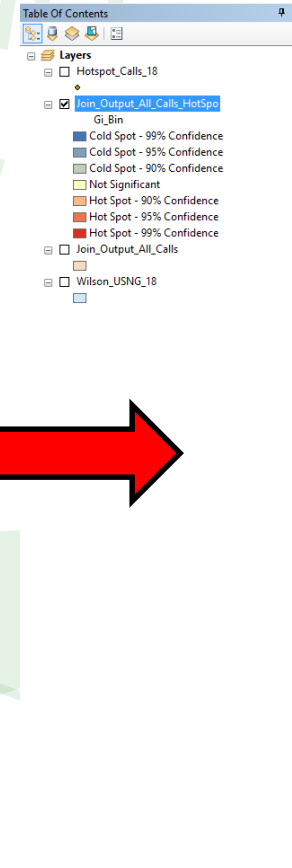
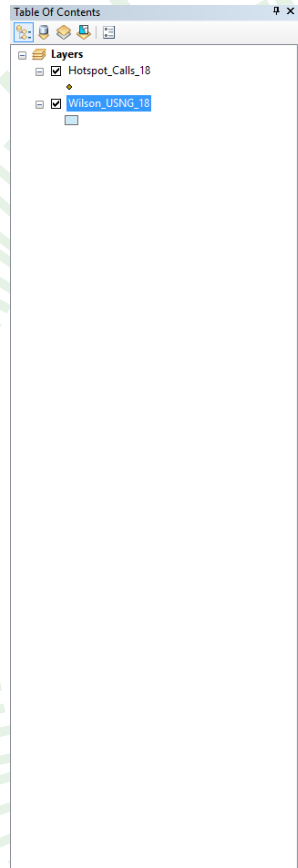
$$P(x) = \frac{e^{-\lambda} \lambda^x}{x!}$$

$$P(1) = \frac{e^{-.12} 0.12^1}{1}$$

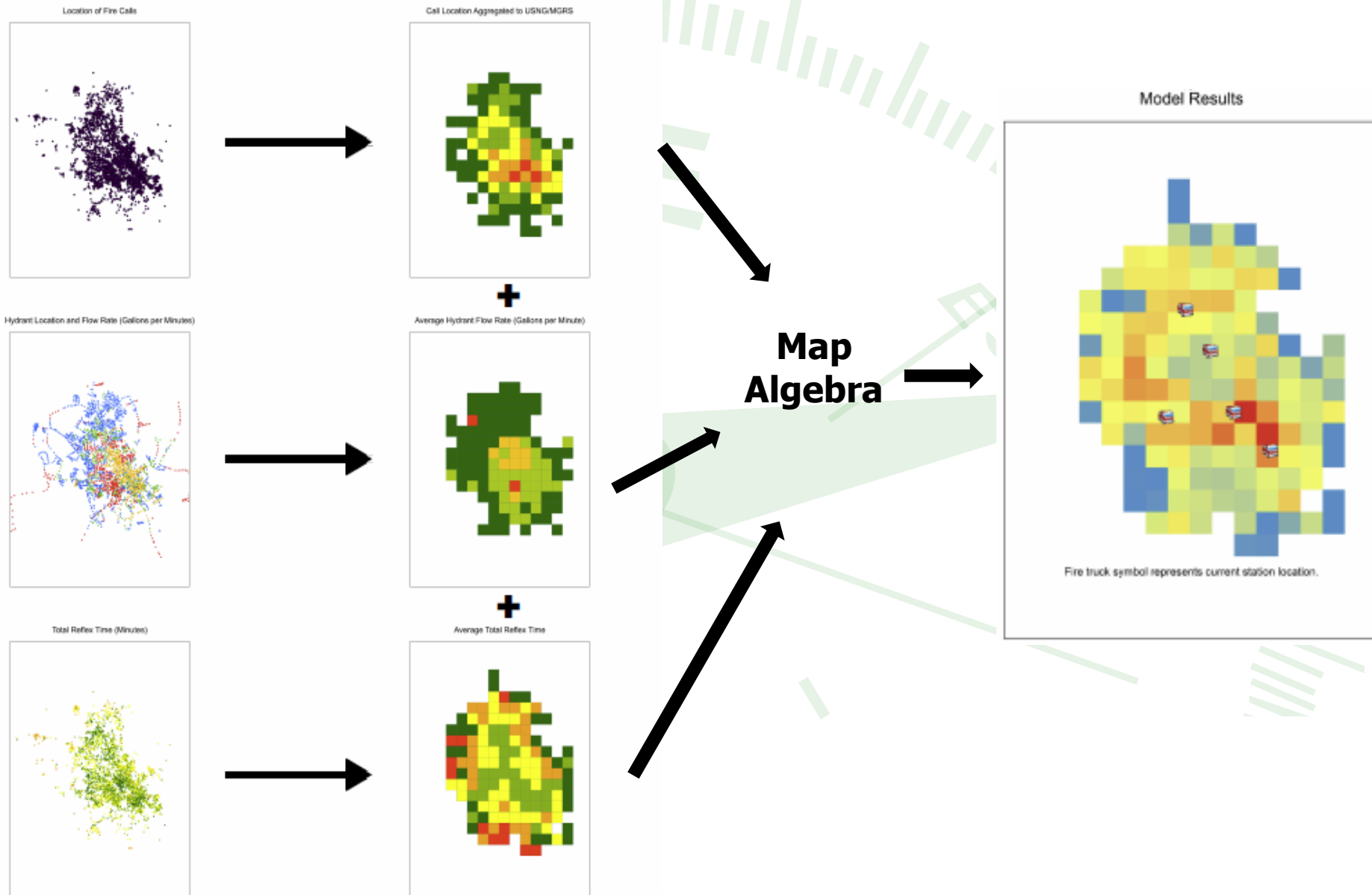
$$P(1) = .14$$



Example: Aggregation and Hotspots



Example: Risk Modeling



Bottom Line: Use Standards.

Maps for use during a crisis or an emergency are not for you. They are for those dealing with this...



Waveland, MS after Hurricane Katrina





esri

THE
SCIENCE
OF
WHERE