Grid-Based Risk Modeling: A Standards Approach

OR: Saving the World One Grid Square at a Time

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SIT REP and IAP
input due today by 04:00 CDT
Next Operational Briefing
08/29/2012 @06:45 CDT

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.

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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).

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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…

OGC®
Open Geospatial Consortium, Inc.

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).

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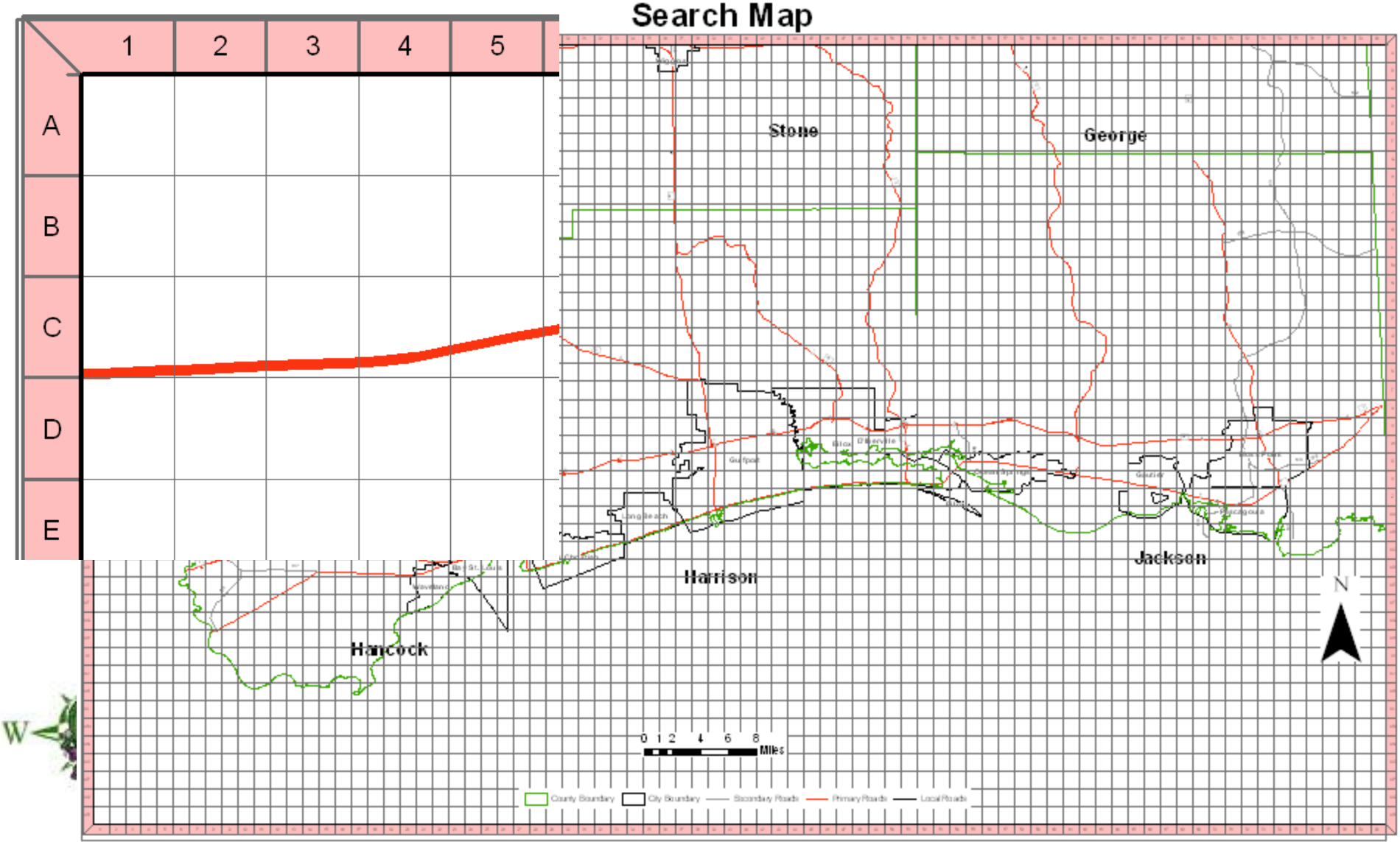
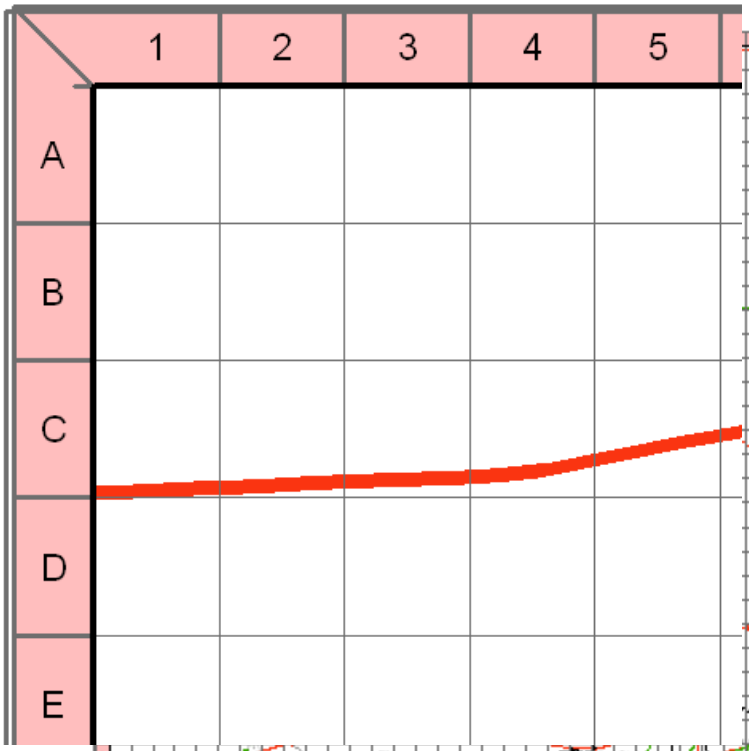
So we made 250 of these and had them laminated and sent to the field…

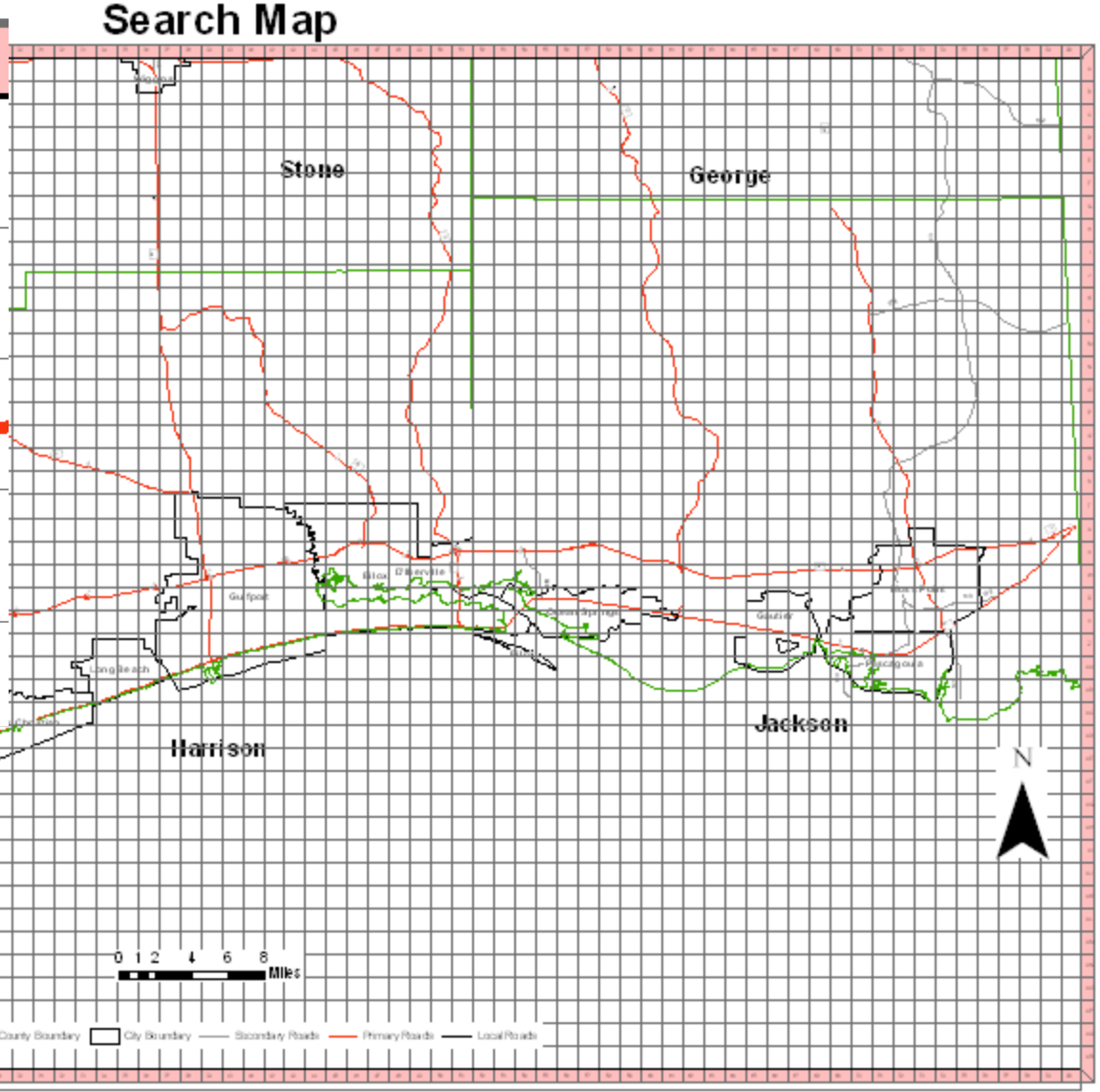


Two days later…

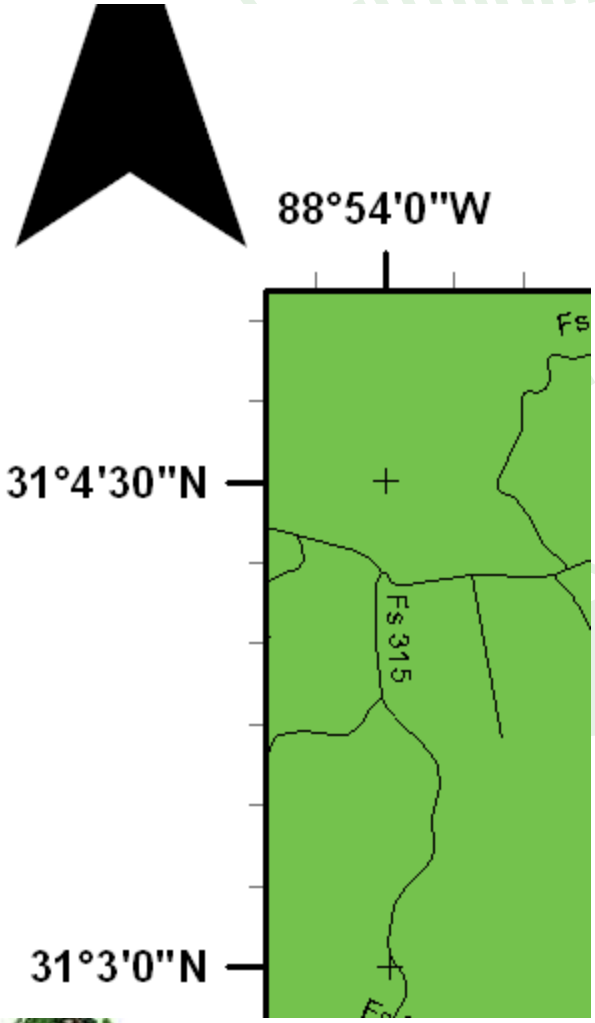
- Katrina had made landfall and the devastation exceeded most expectations
- The search area was expanded to include Stone, Lincoln, George, and Pearl River counties.
- I realized very quickly that I had screwed up. How was I to expand the map to encompass the new search area without altering the grid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

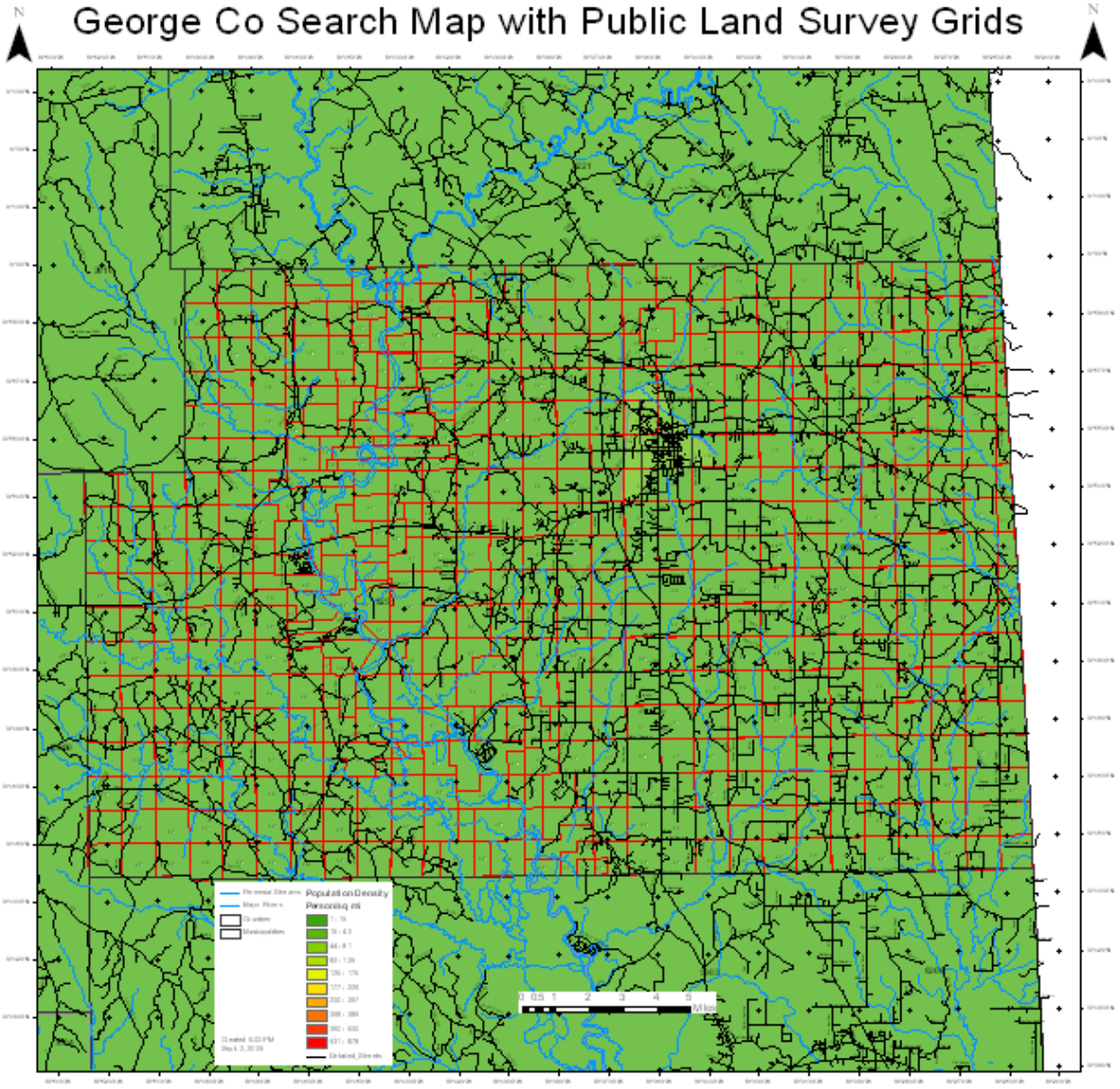
How do you expand this north and west?





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*

NTSB Report on Trooper 2 (cont'd.)

- Patrol personnel plotted coordinates using an online mapping program

- 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)

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,

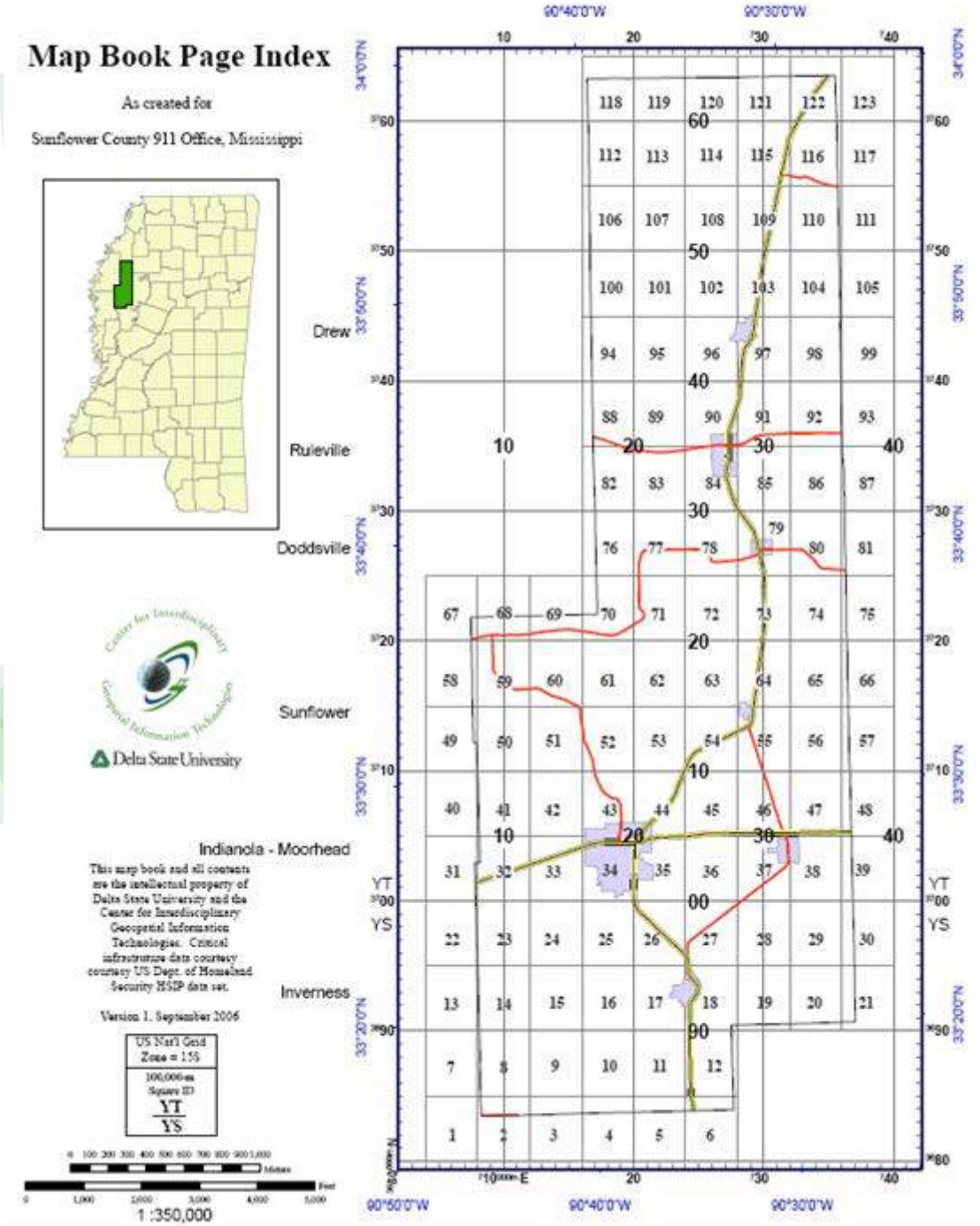
Michael K. Buckley, P.E., Director
Technical Services Division
Mitigation Directorate

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

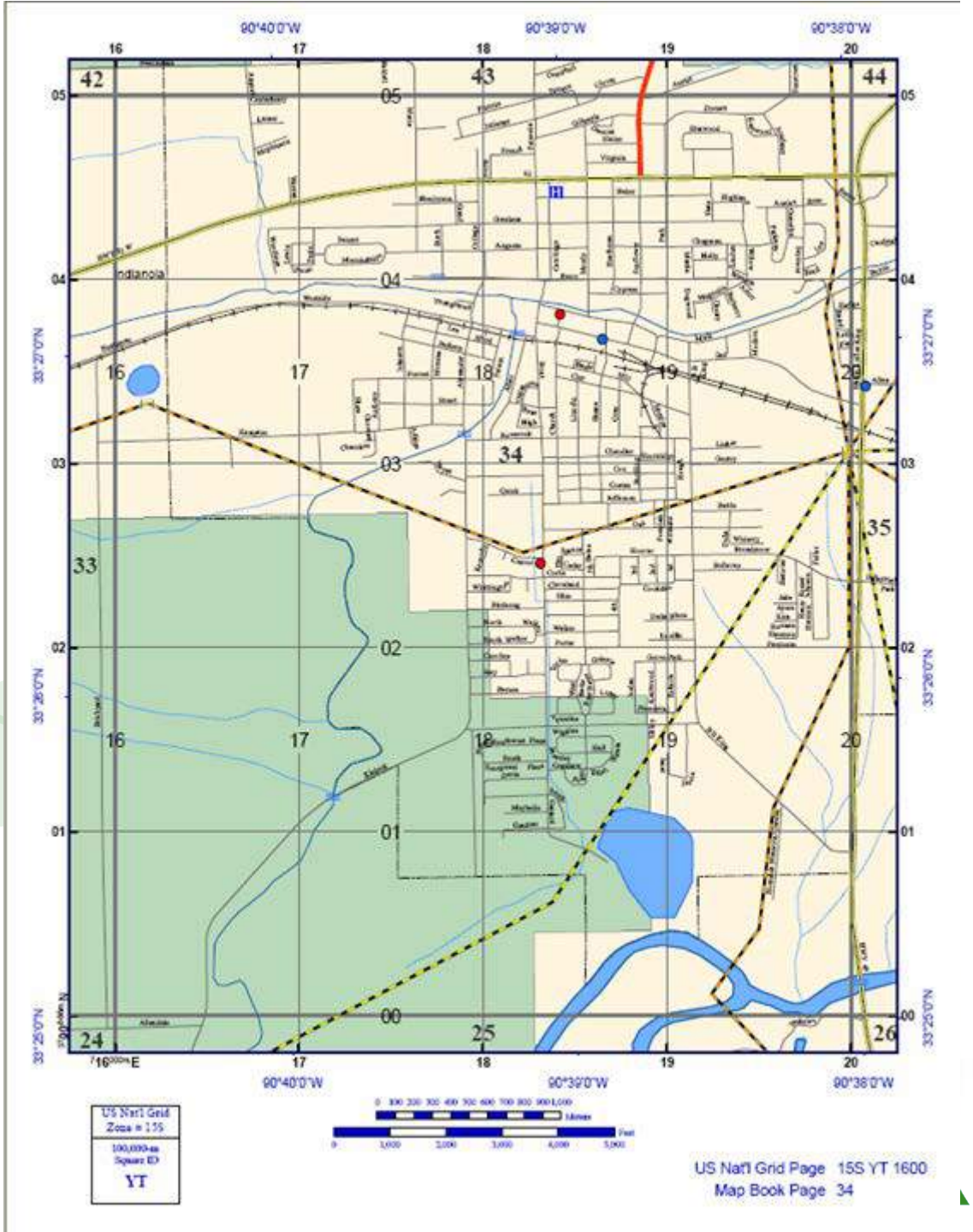
Georeference System User	USNG	Latitude/Longitude (DD-MM.mmm) (Note 1)	GARS-compatible
Land SAR Responder (Note 2)	Primary	Secondary	N/A
Aeronautical SAR Responders (Note 3)	Secondary	Primary	Tertiary
Airspace Deconfliction (Note 4)	N/A	Primary	N/A
Land SAR Responder/ Aeronautical SAR Responder Interface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

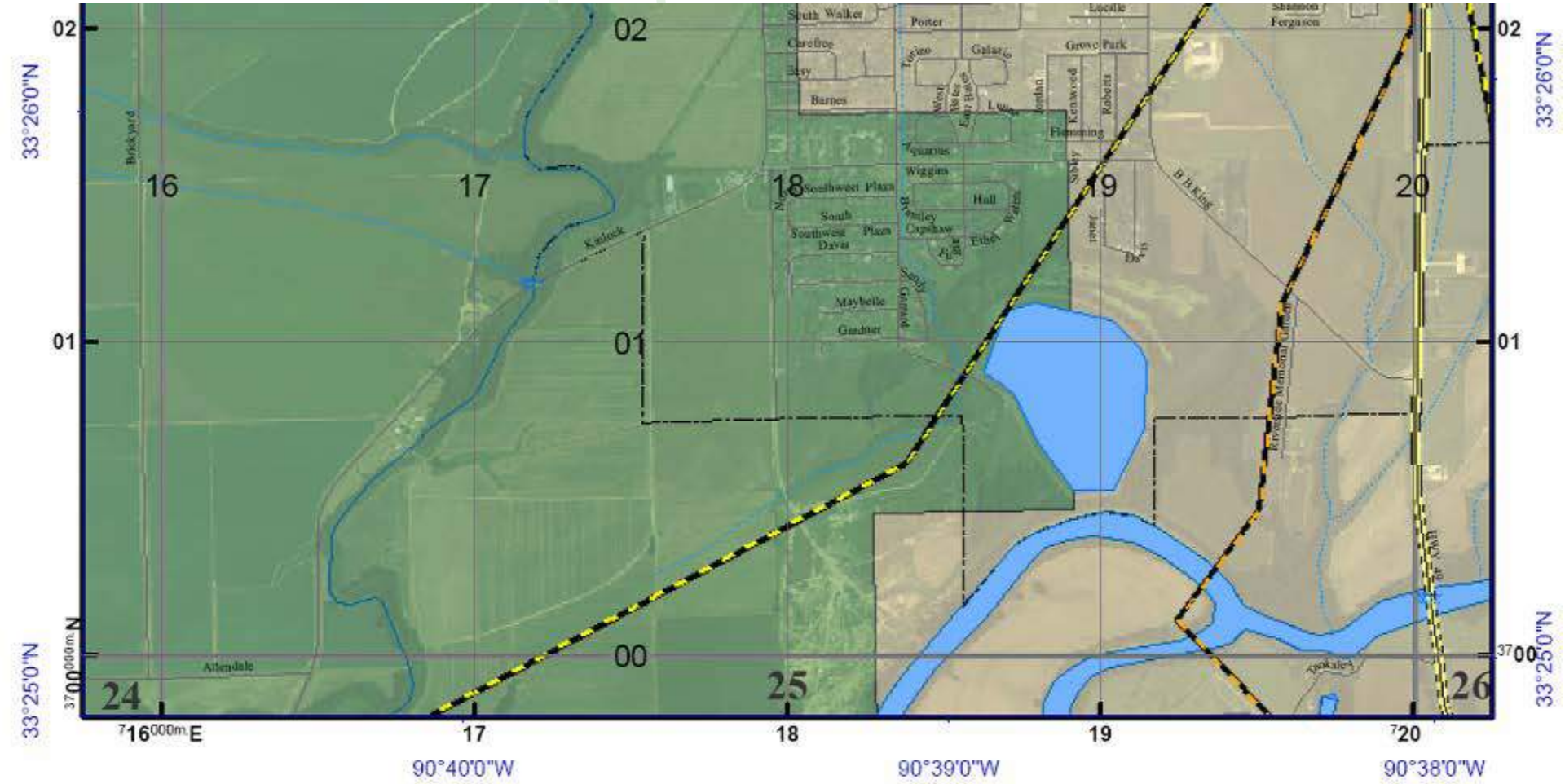
Recommended solution using US National Grid to create 1km x 1km grid squares (contact DSU for procedure as it is involved and not straight forward – especially when working at zone junctions, but still preferable to any other lat/long or other grid system.

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.



Sample USNG-based map Book page created using 4km x 5km assemblies of 1km x 1km USNG grids with layers for critical infra-structure. 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

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

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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

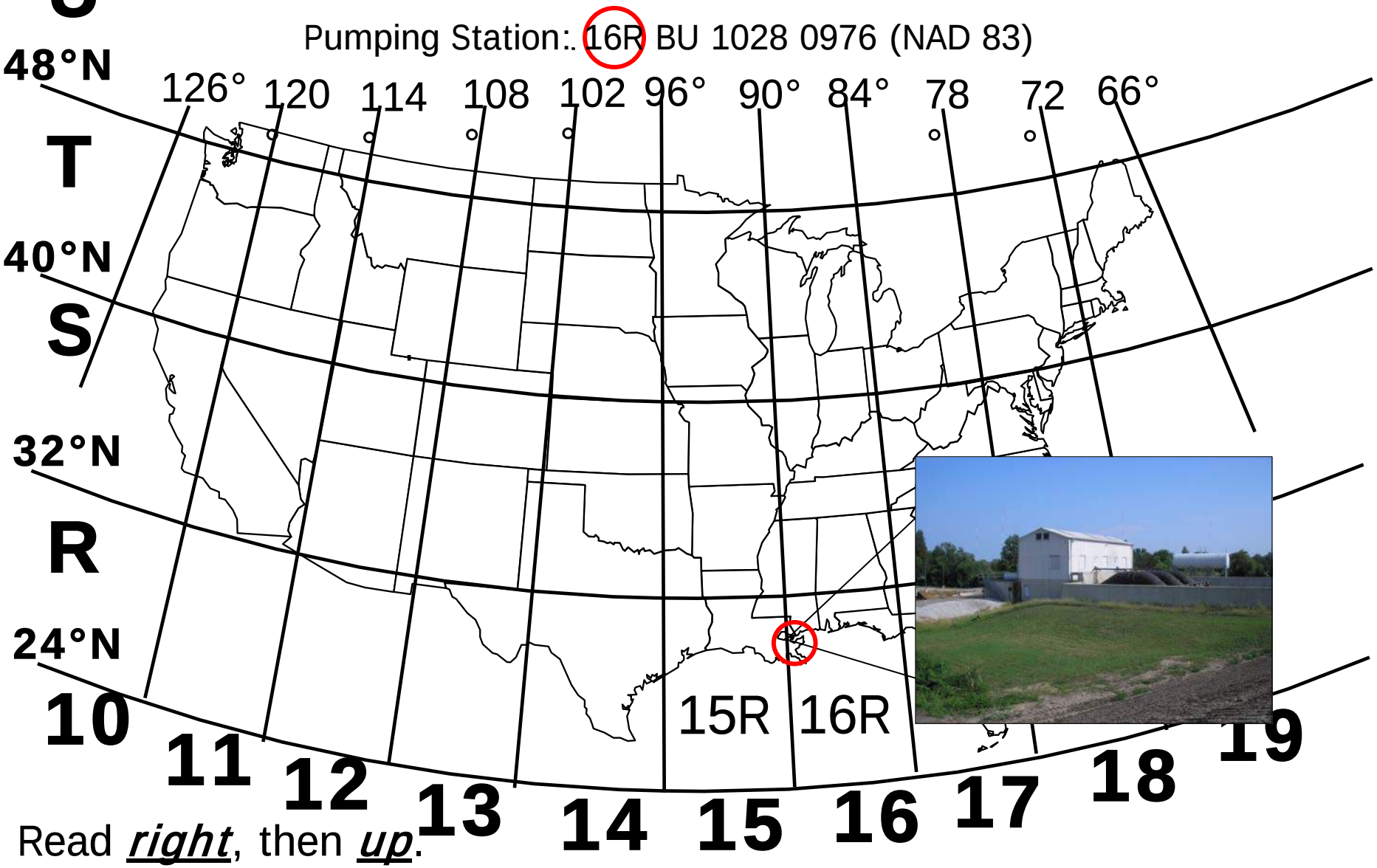
Grid Coordinates

Read *right* then *up*

How to read the USNG...

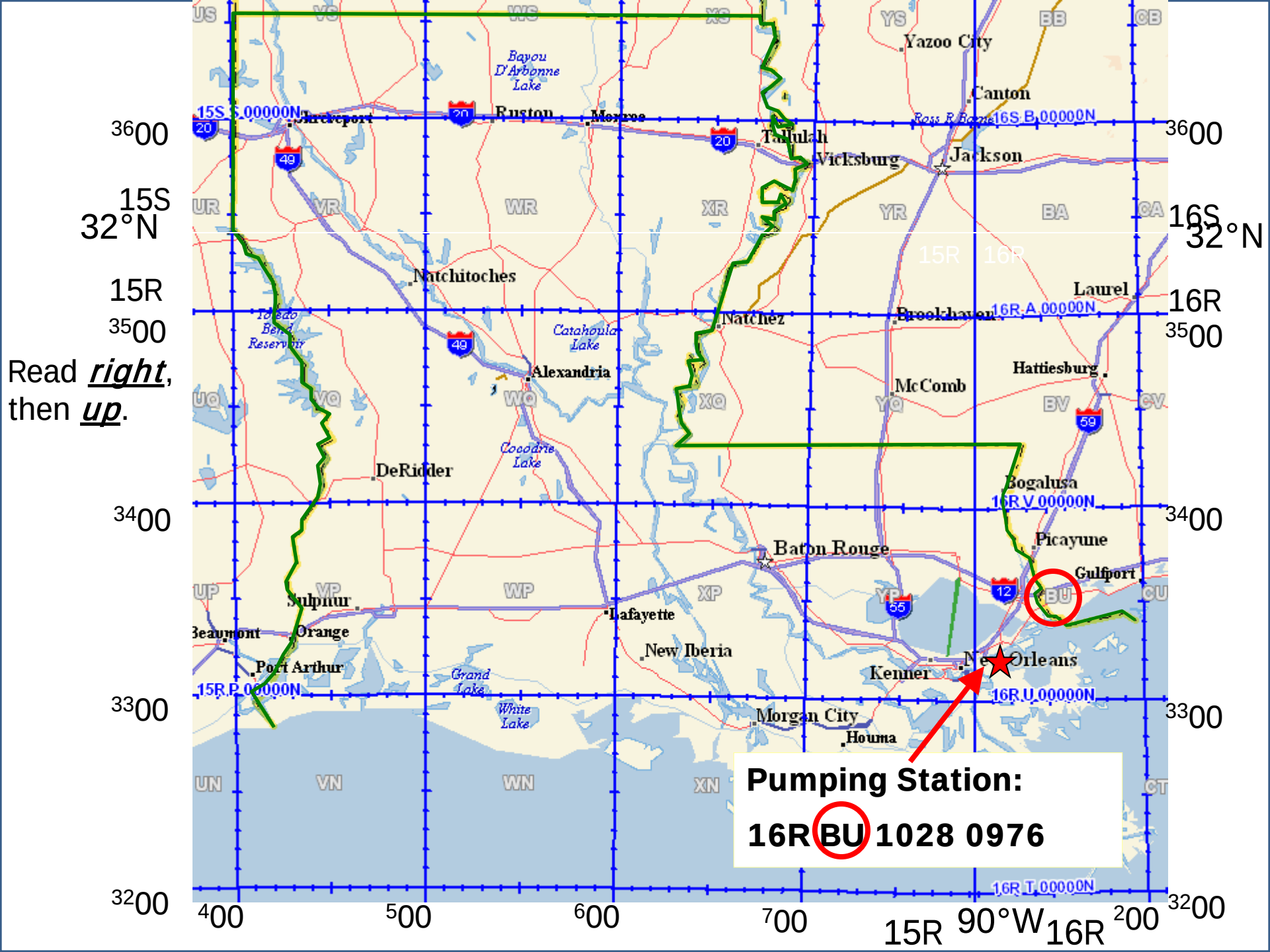
UTM / USNG Grid Zone Designations

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

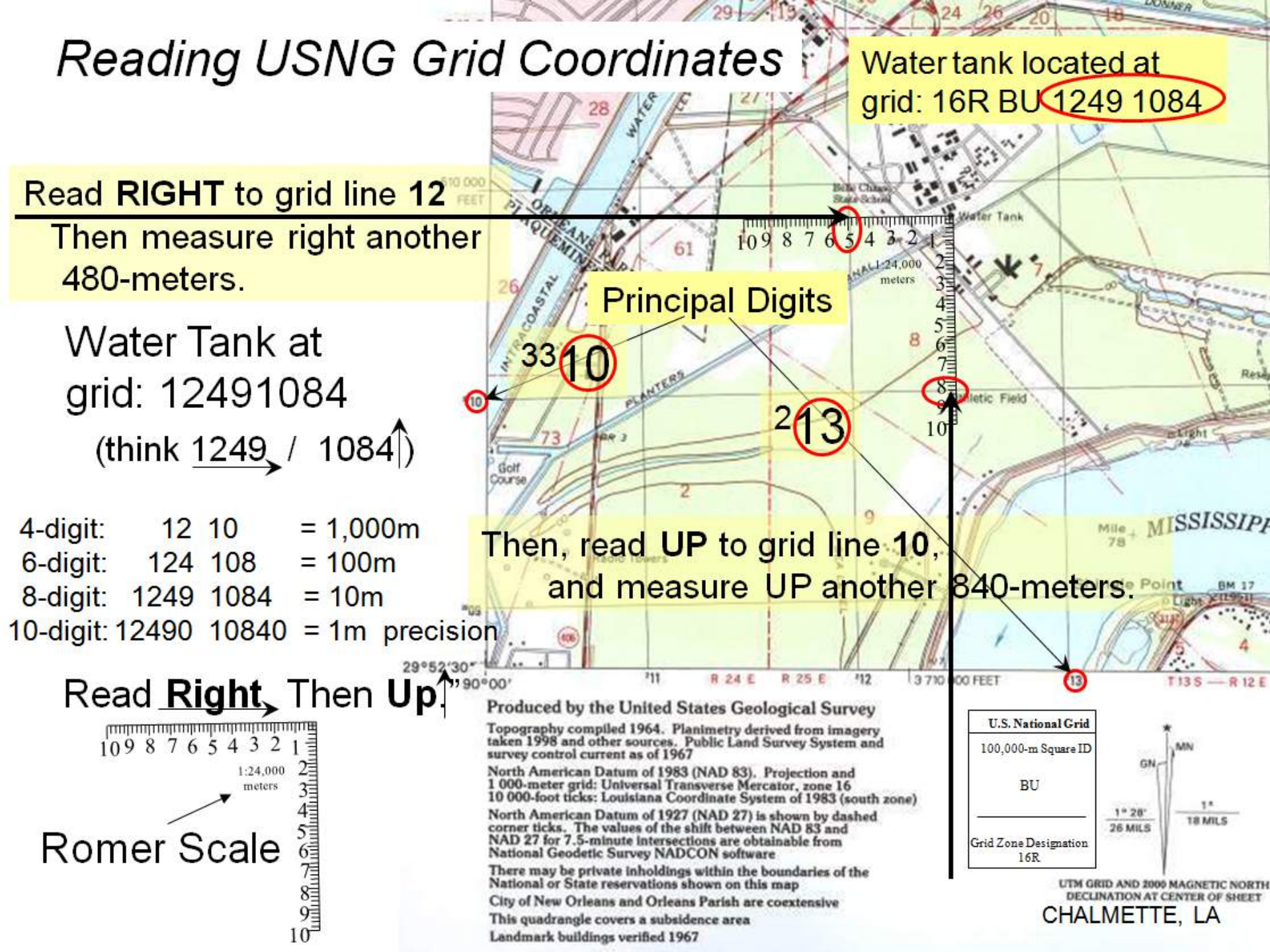


Read ***right***, then ***up***.

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

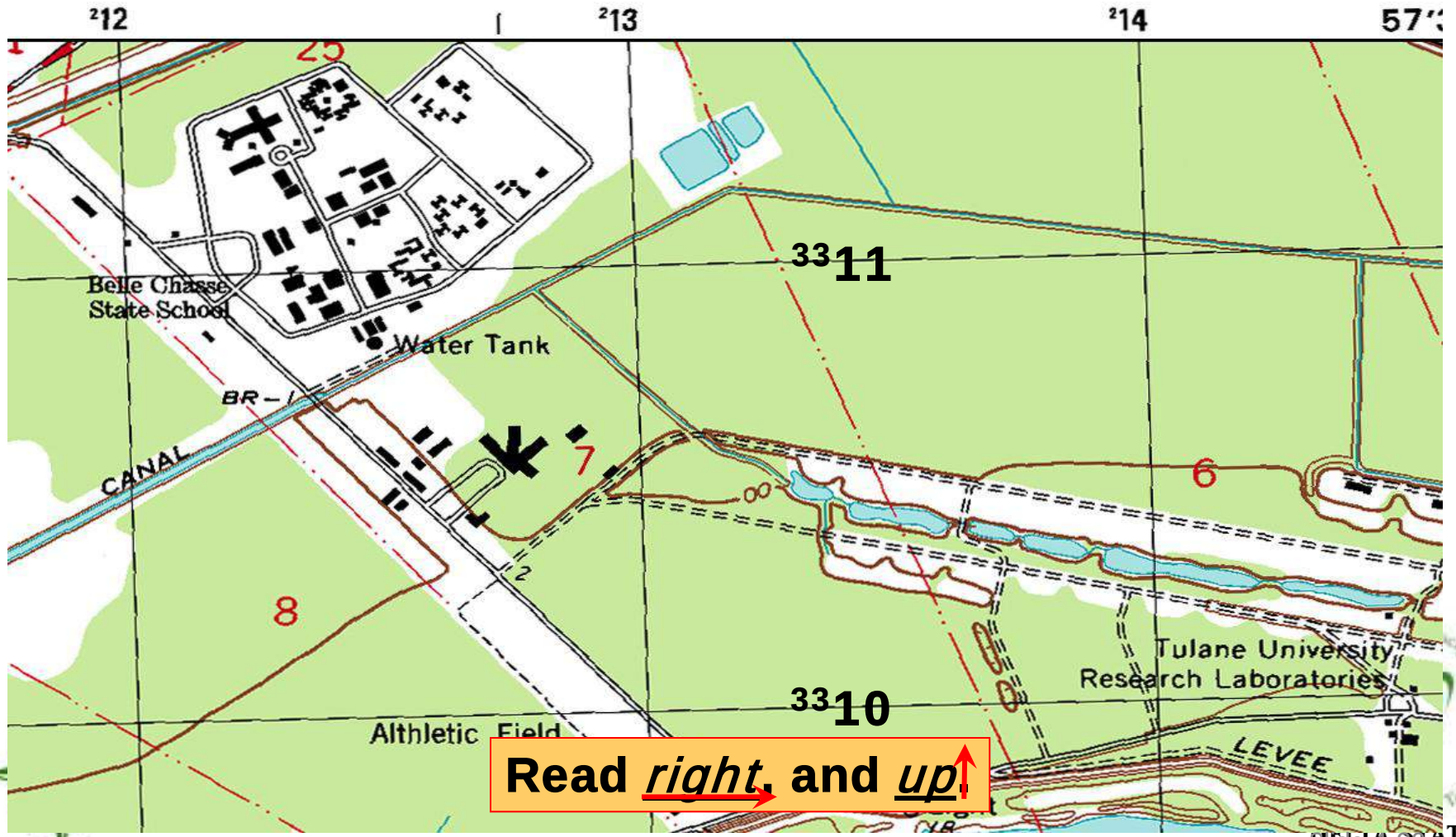


Reading USNG Grid Coordinates



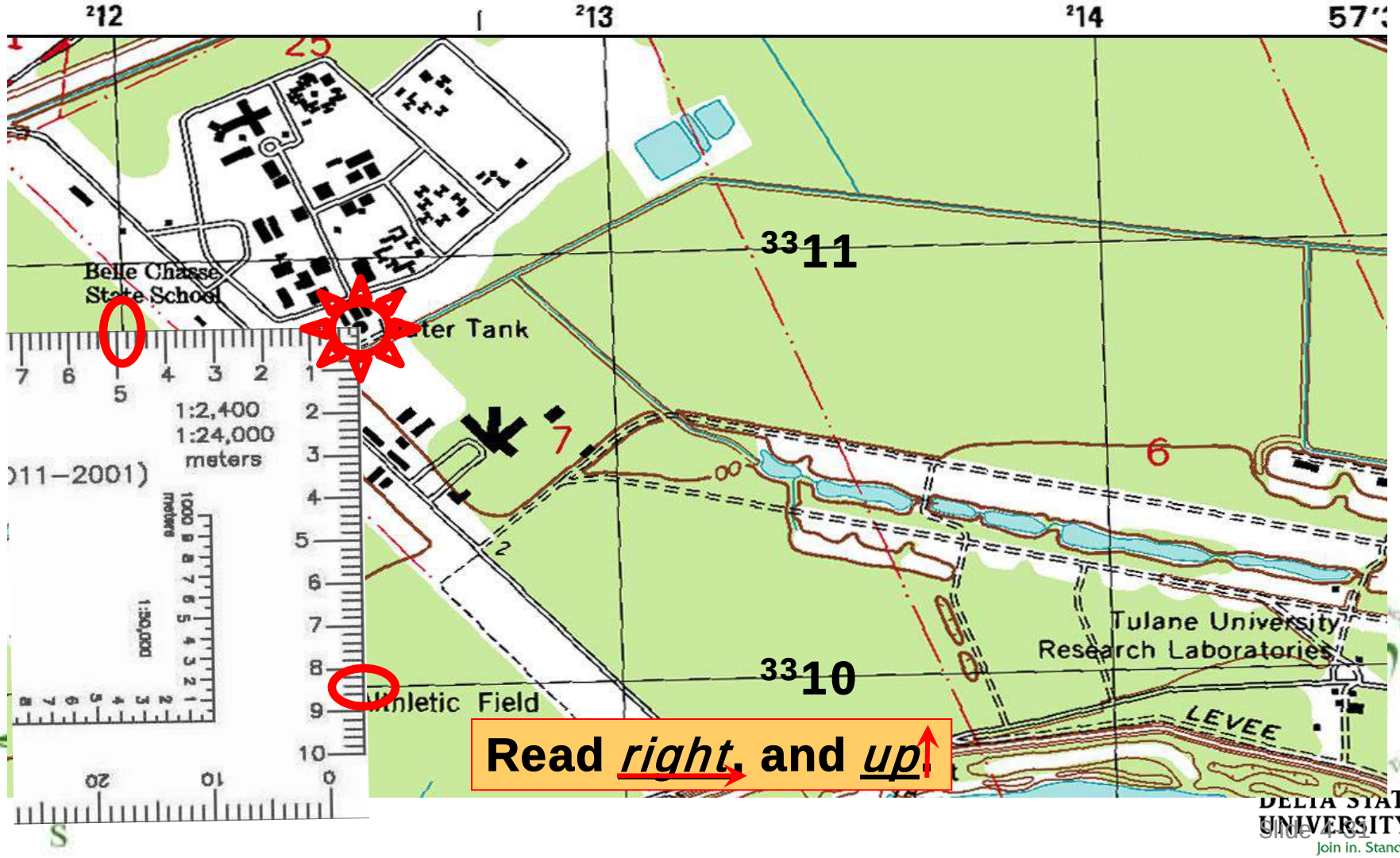
Task:

Locate the Water Tank at 1249 1084



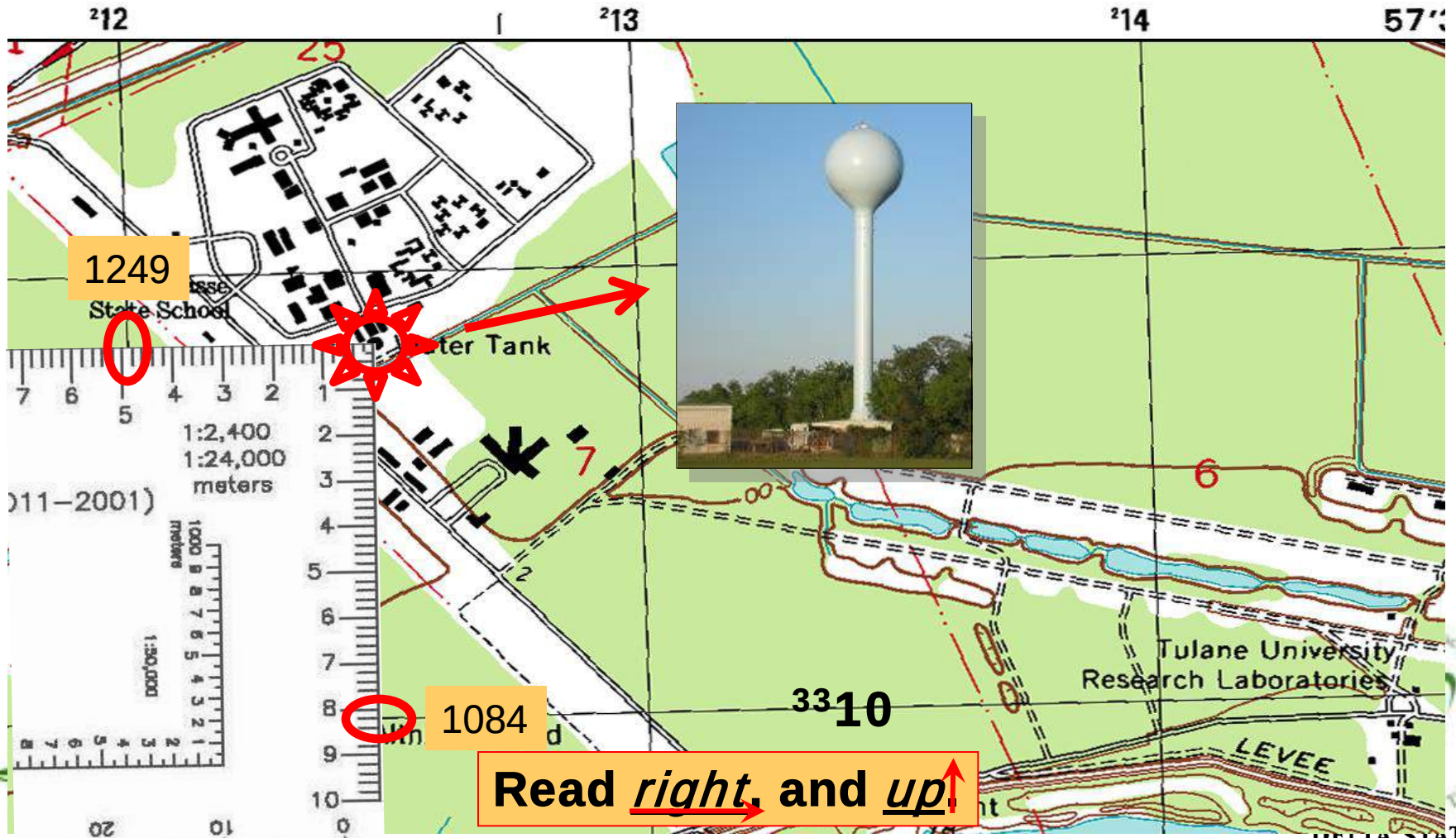
Solution

Locate the Water Tank at 1249 1084



Solution

Locate the Water Tank at 1249 1084



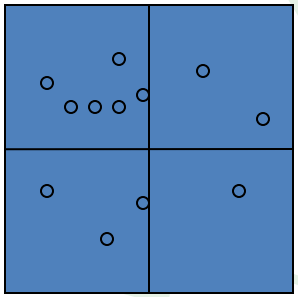
USNG as Area Management/Masking Tool

- 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 Tornados

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

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



$\lambda = 12/4 = 3$

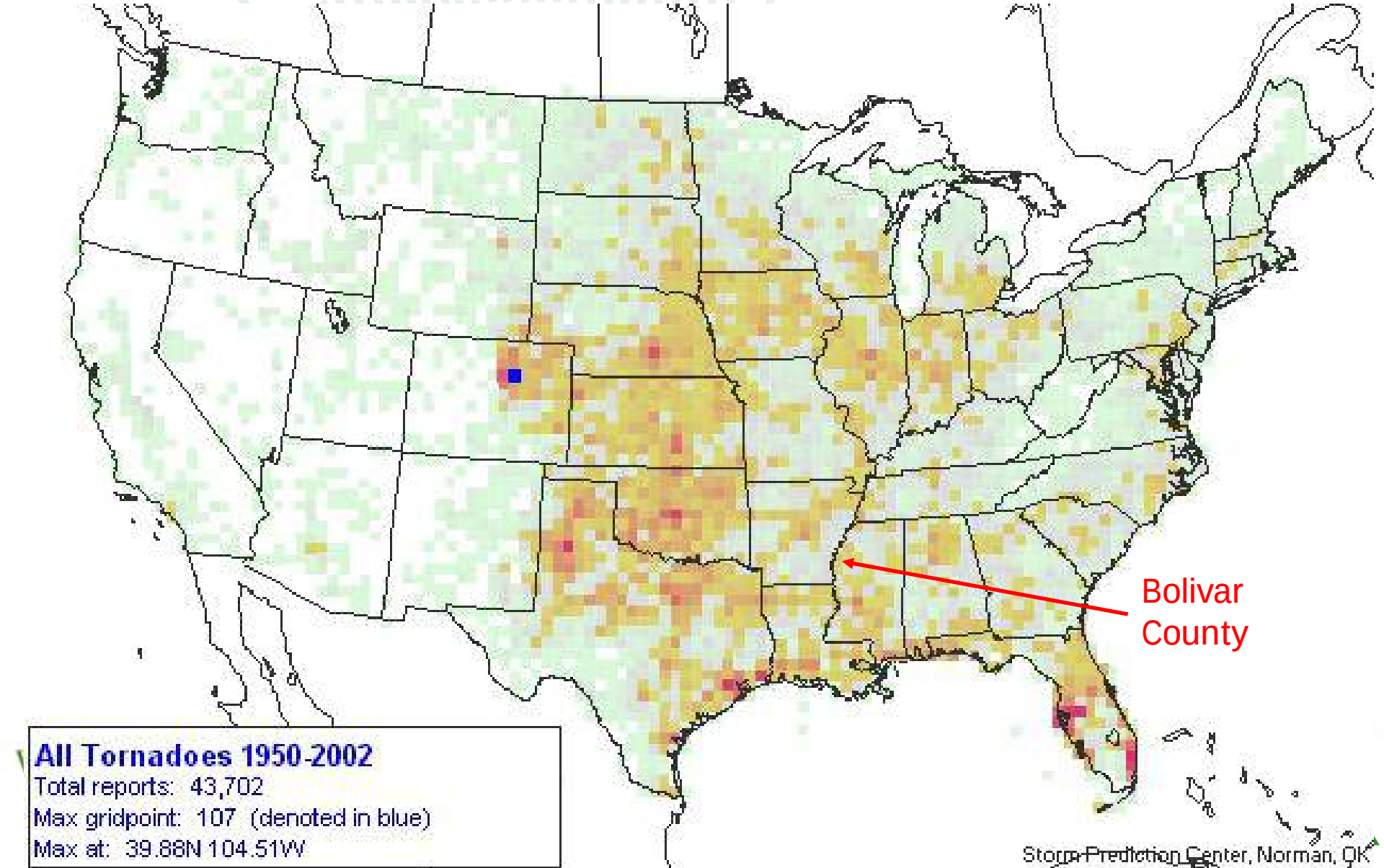
$P(5) = 2.71828^{-3} * 3^{5} / (5*4*3*2*1)$

$= 0.1008$

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

$= 0.2240$

Tornados 1950-2002

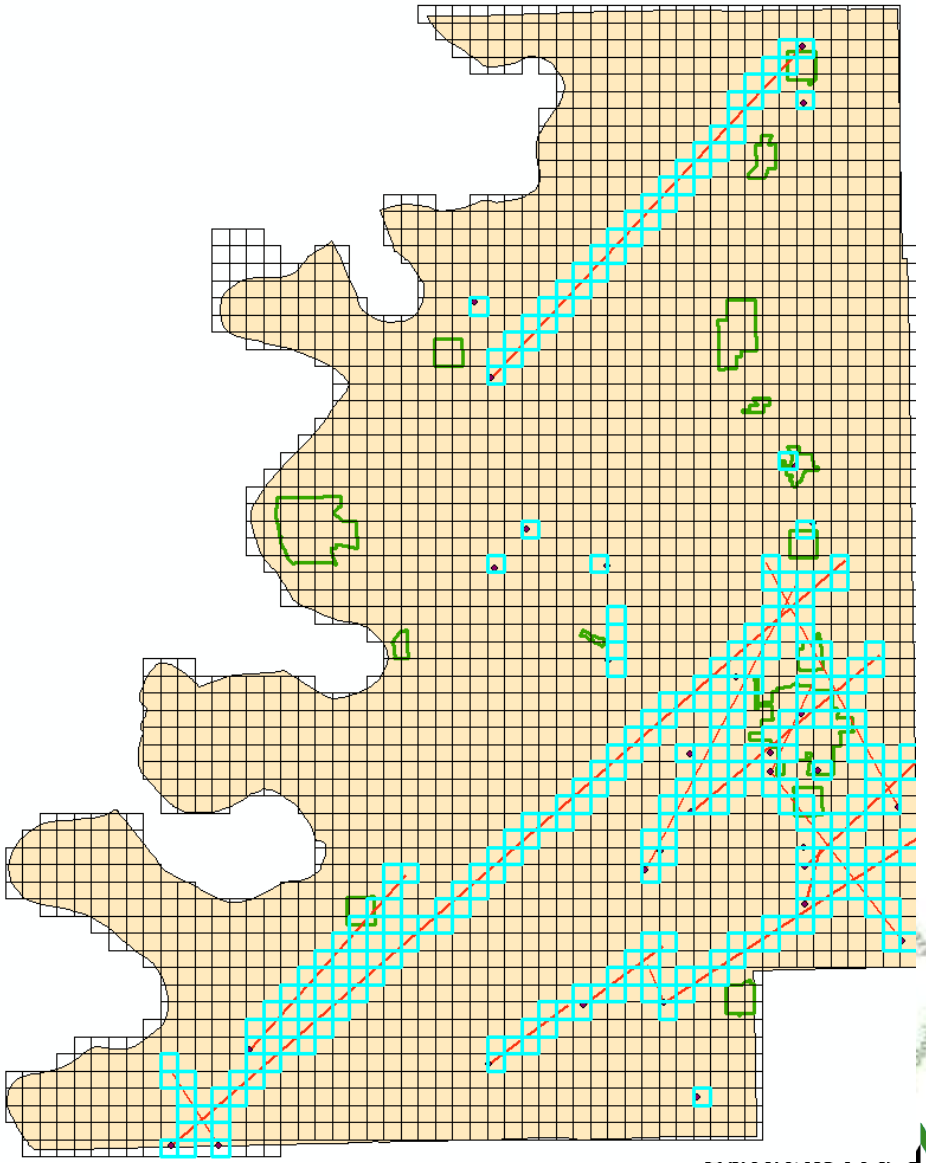


Time for a Tornado Shelter!

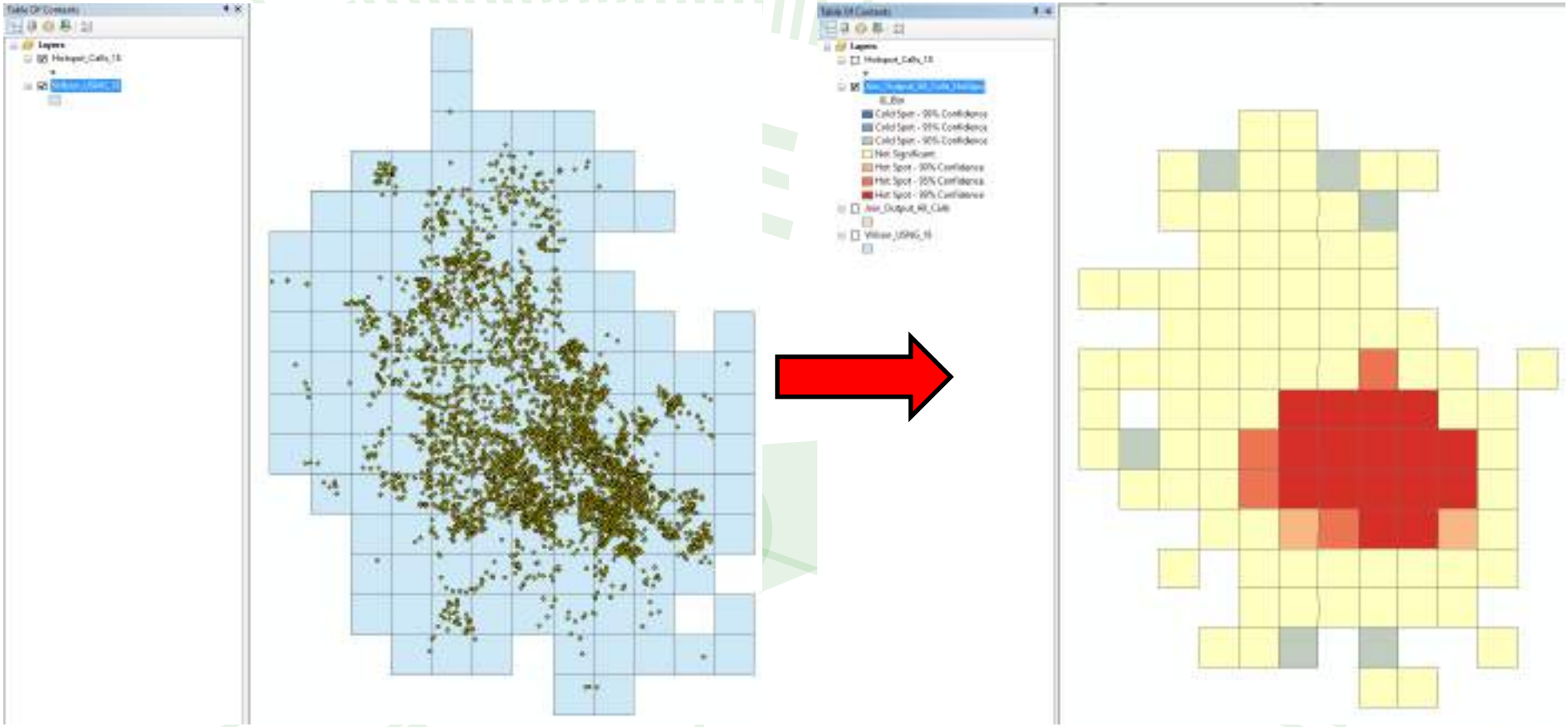
$$P(x) = \frac{e^{-\lambda}\,\lambda^{x}}{x!}$$

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

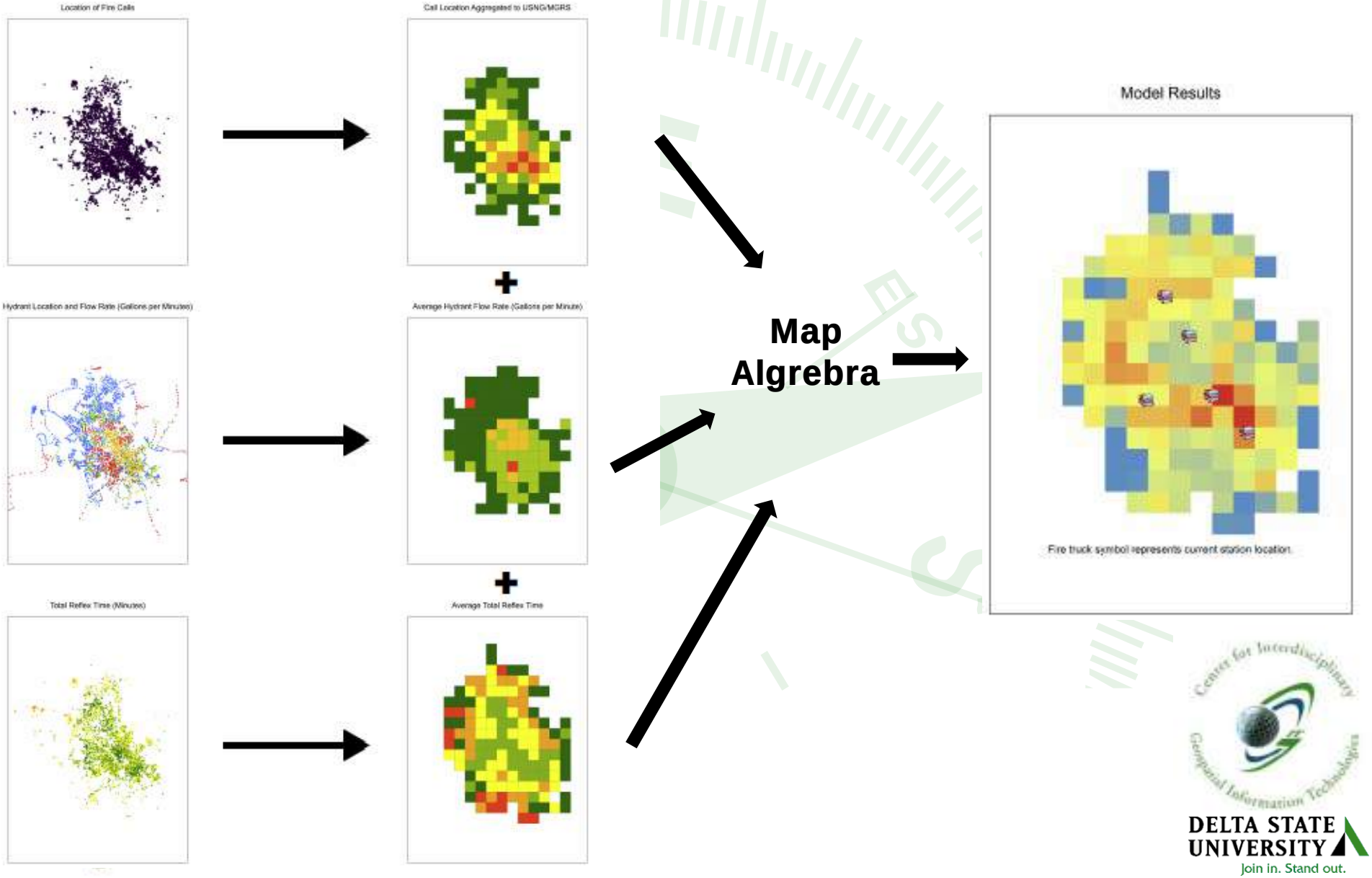
P(1) = .14



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

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