New Minnesota Landfill Siting Rules

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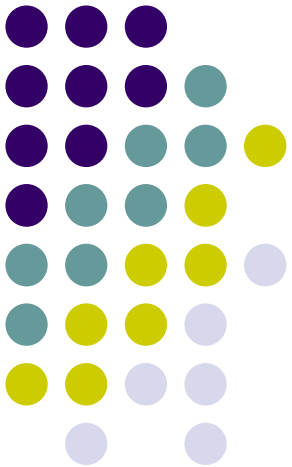
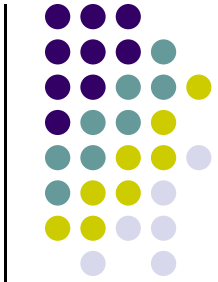
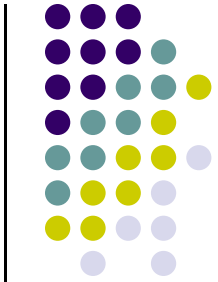


Legislation



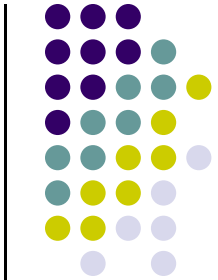
- Originally passed in 2008:
  "The rules for the disposal of solid waste shall include site-specific criteria to prohibit solid waste disposal based on the area's sensitivity to groundwater contamination, including site-specific testing.
- Labeled as FASIT for Financial Assurance and SITing

What is Groundwater Sensitivity?



- Sensitivity to *contamination*
- Factors:
  - Hydraulic conductivity, gradient
  - Adsorption, Cation Exchange Capacity
  - Preferential flow paths
  - Depth to water table, confining layers
- DNR (1990) determined that time of travel was best surrogate for groundwater sensitivity
- Fast vs. Slow
  - Fast – Easy to detect and remediate releases
  - Slow – Limit impacted area and resources
- Doesn't Rule 7035.2815 (Phased Hydrologic Evaluation) already cover this?

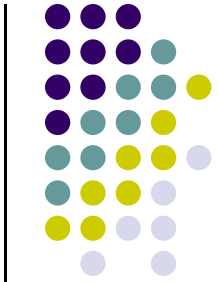
Legislation



- Amended in 2010:
  "The rules shall provide criteria for locating landfills based on a site's sensitivity to groundwater contamination. Sensitivity to contamination is based on the predicted minimum time of travel of groundwater contaminants from the solid waste to the compliance boundary."

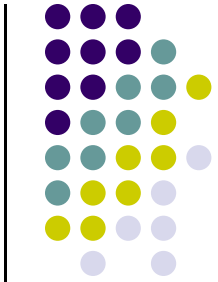
- How do we predict travel time in karst?

Legislative Intent



- “The rules shall prohibit landfills in areas where karst is likely to develop. The rules shall specify testable or otherwise objective thresholds for these criteria.”
- Exceptions:
  - Facilities permitted before January 1, 2011
  - Facilities that accept construction and demolition debris or inert materials
  - Permit by Rule landfills

New rules have four parts



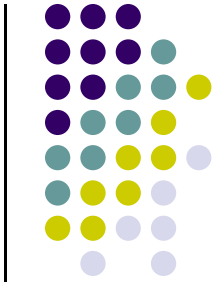
- Part A: Groundwater travel time
- Part B: Monitoring and release response
- Part C: Lateral distance to karst (200 ft)
- Part D: Vertical distance to carbonate bedrock (50 ft)

- New rules [Administrative Rules 7001.3111] published in 2012

Rule Part A, B

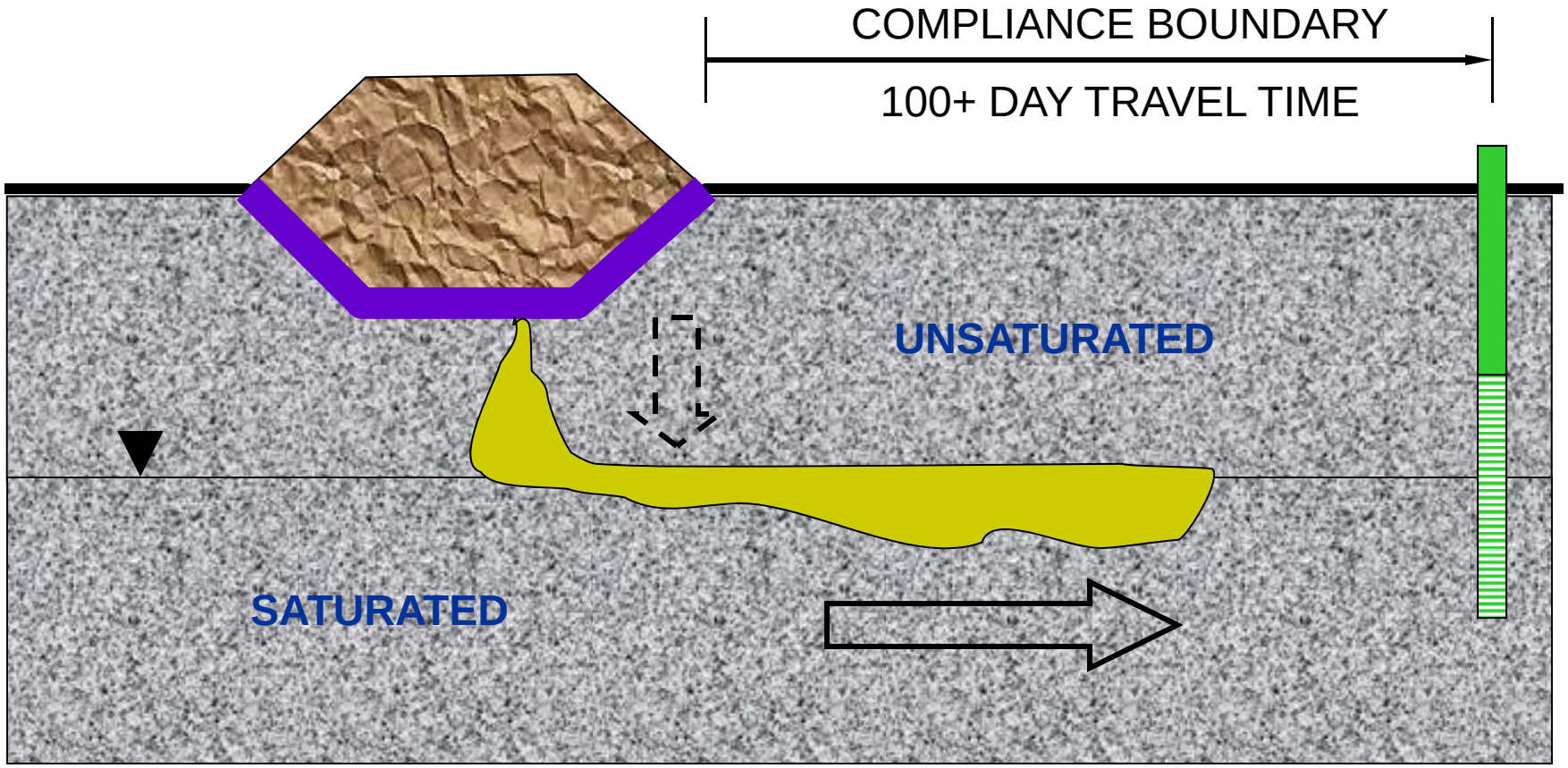
- Site must meet Part A or Part B
- A. The predicted minimum time of travel of groundwater contaminants from the proposed landfill's base grade to an approvable compliance boundary is as least 100 days.

Rule Part A, B

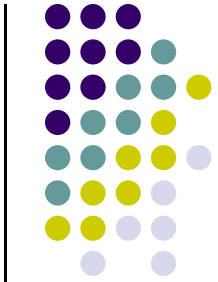


- B. Groundwater flow is known in sufficient detail to allow monitoring for potential contaminant releases, and site and groundwater conditions would allow the owner/operator sufficient space and time to implement corrective actions to prevent contaminants released from the landfill from exceeding applicable standards at a compliance boundary.

Landfill Conceptual Model

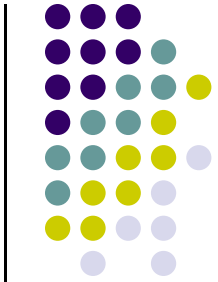


Groundwater Speed Limit



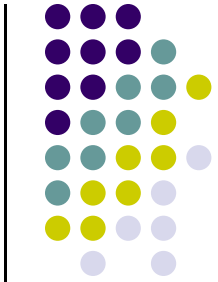
- Avoid areas with rapid and unpredictable flow
- Previous limit was 1 meter/day in fastest aquifer below site
- All agreed that unsaturated flow should be considered
- Measurement methods not specified

Why 100 days?



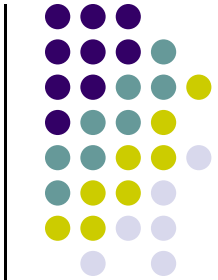
- Compliance well monitoring required quarterly (91 days)
- Landfill release model
- Seems workable
- *Landfill liner is not included in travel time*

Effect of Landfills on Karst



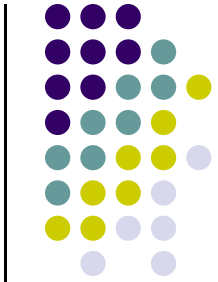
- Karst surfaces are in dynamic equilibrium
  - Altering that equilibrium can and does create changes
    - Increased loading
    - Decreased infiltration. Lowering of water table?
    - Changes in chemistry
  - Any or all of the above can induce sudden changes, which can be catastrophic
- Changes can be rapid (hours) and slow (centuries) and siting and design must consider both time frames

Regulation Part C and D



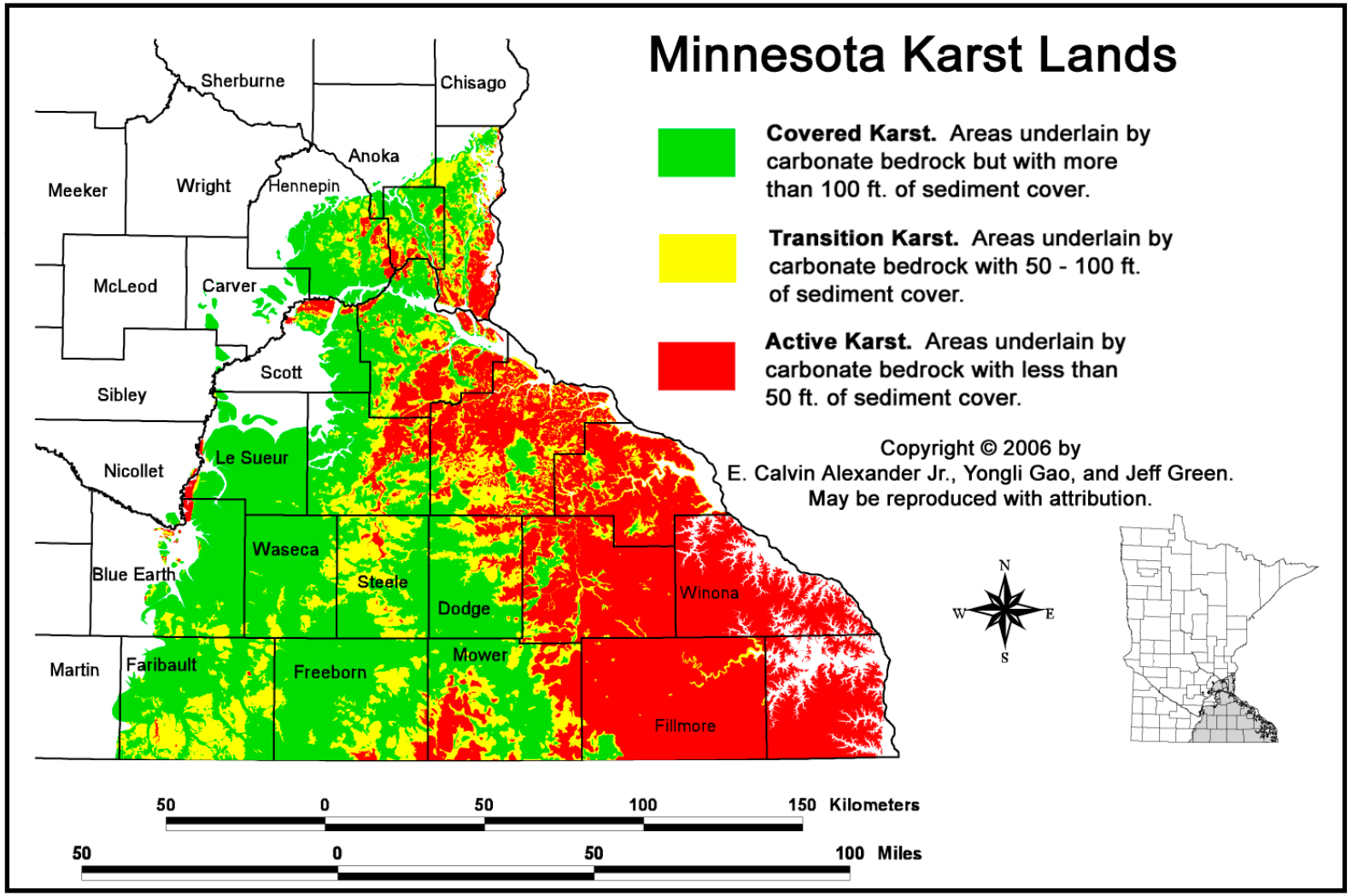
- C. No karst exists within 200 feet laterally of the proposed waste fill area.
- D. At sites where carbonate bedrock exists, either of the following conditions are met within the area of the compliance boundary:
  1. More than 50 feet of undisturbed, unconsolidated overburden has been maintained prior to construction of the landfill so that karst is not likely to develop.
  2. Based on the site evaluation in subpart 2, employing field techniques approved by the commissioner, the commissioner finds that karst is not likely to develop and the site will support the proposed landfill structure.
- Must meet C and D

(D first)
Why 50 feet vertically?

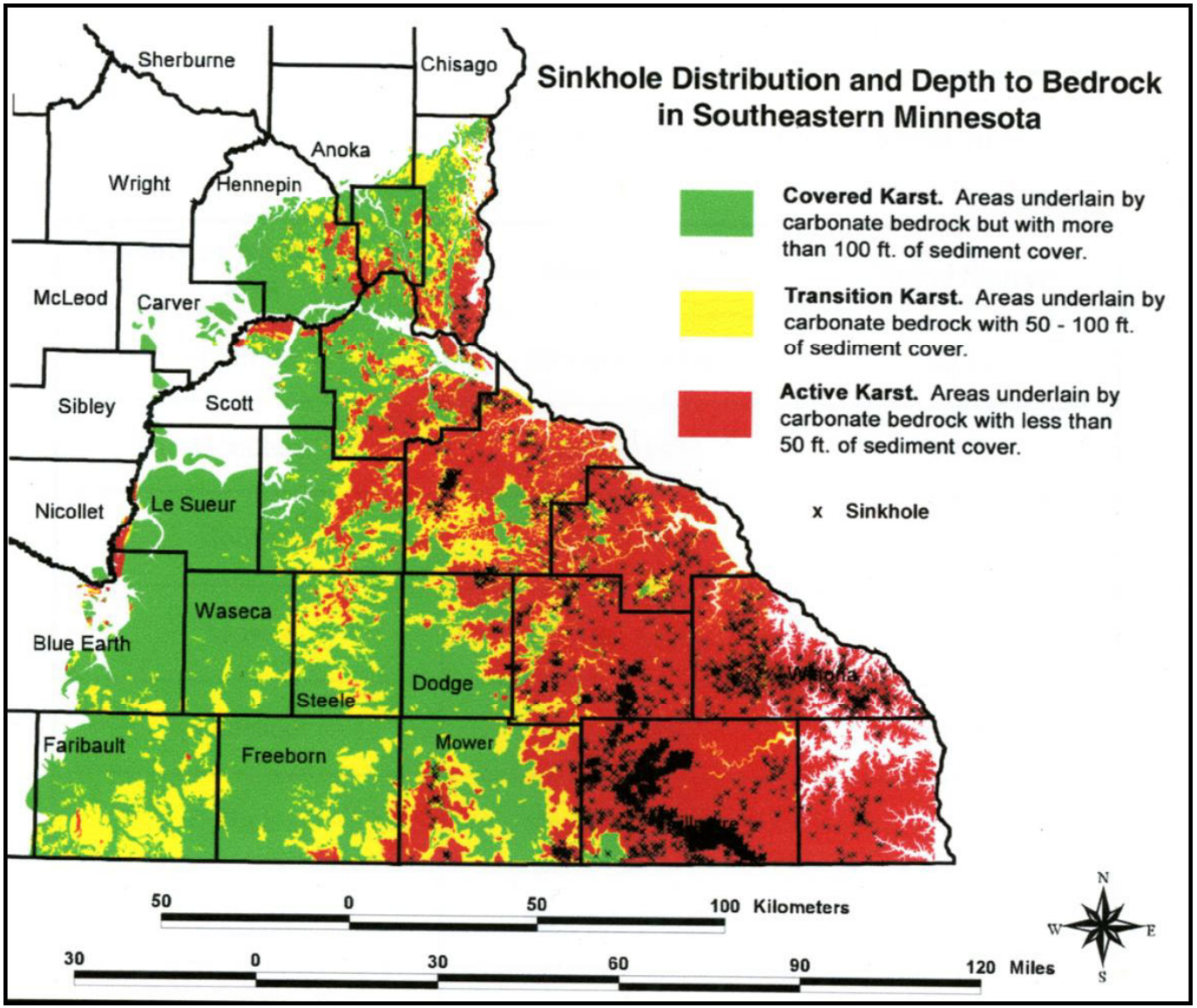


- Used term “carbonate bedrock” rather than “limestone” or “soluble bedrock”
- Over 90% of the karst features mapped in Minnesota are found in areas with <50 ft of overburden above bedrock
- Depth to bedrock mapping completed with 25 foot contour intervals
- Every county in Minnesota has areas that meet these criteria.

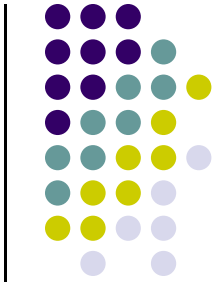
Karst Areas Map + Sinkholes



Karst Areas Map + Sinkholes

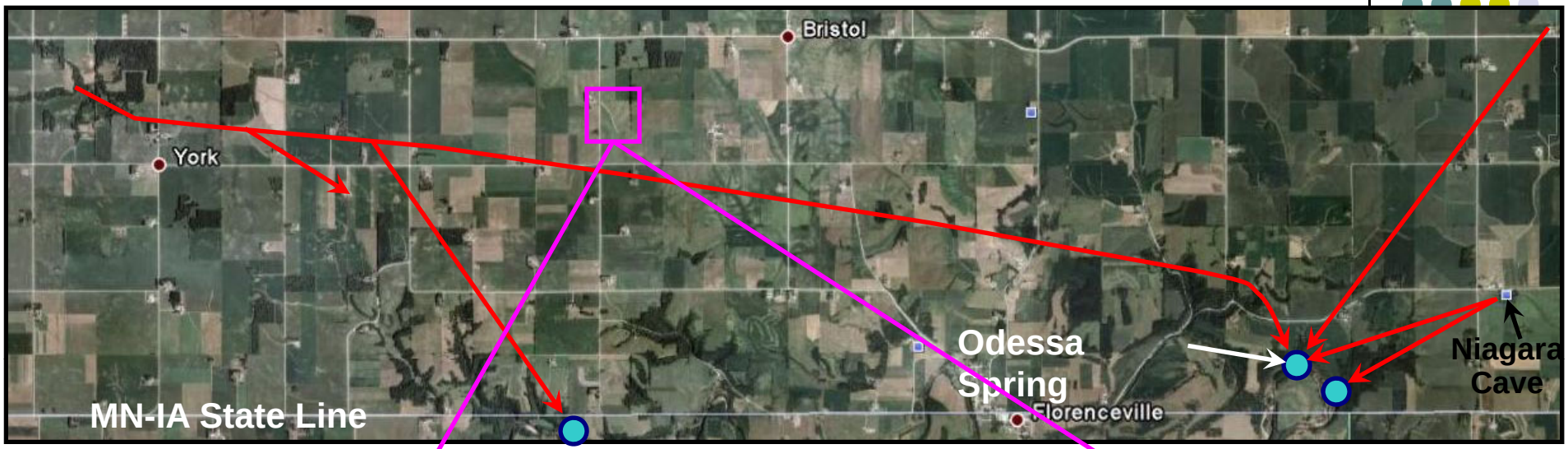


(Next C)
Why 200 feet laterally?



- Workable compromise.
- What is a karst feature?
- Where are the edges?

York Blind Valley/Odessa Spring



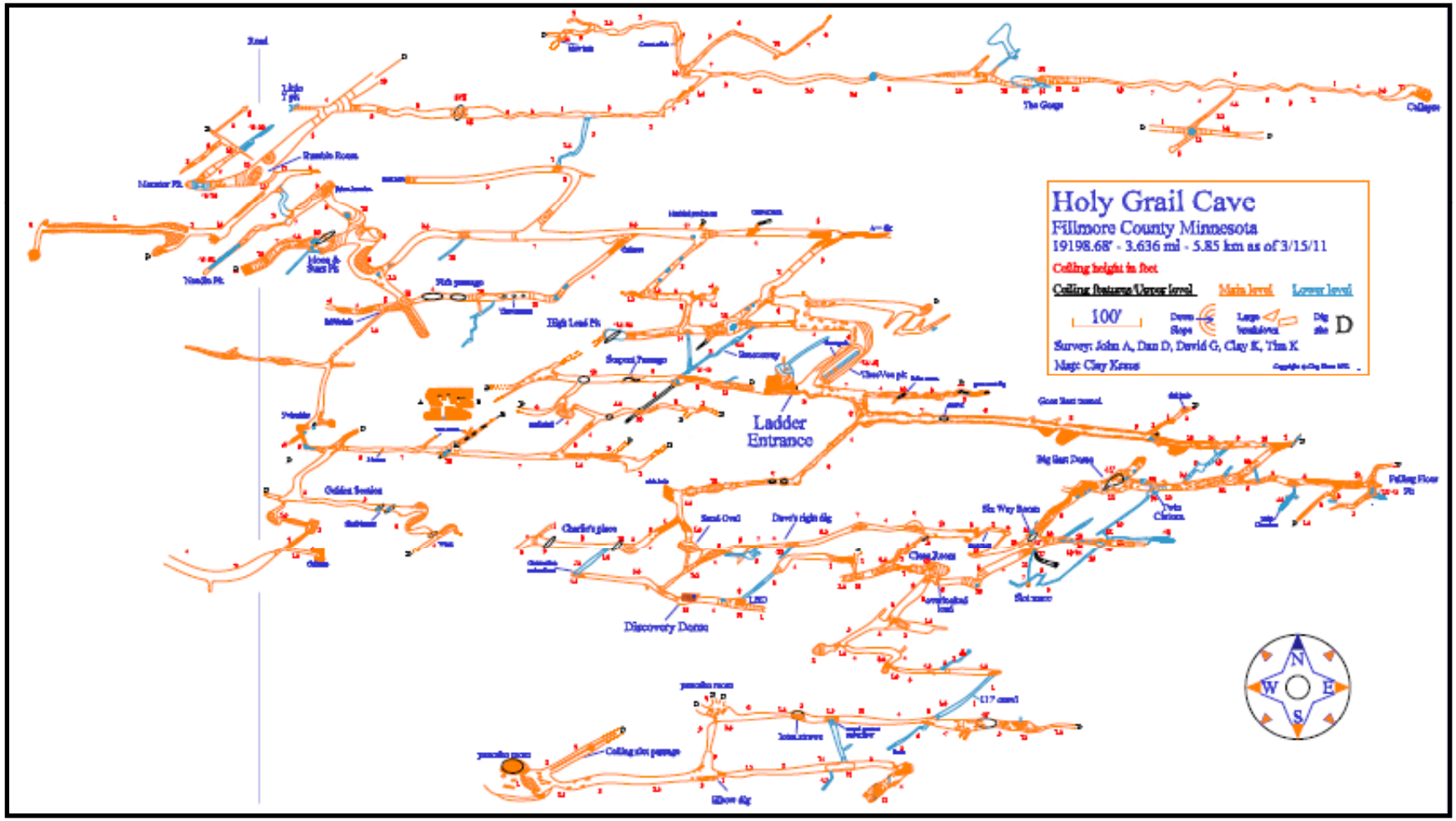
Sinkhole MN23:D5061
Holy Grail Cave

Holy Grail Cave Entrace Pit

Passage in Holy Grail Cave

Sinkhole – from the bottom

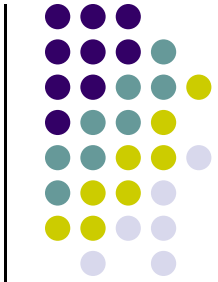
Holy Grail Cave Map



The absence of a sinkhole is not proof that the carbonate below is not karst.

- Before 8 June 2008 there would have been no surface karst features visible in this image.
- Now the only visible features are artificial, the top of a 30 inch shaft and a filled, “fixed”, sinkhole.
- This 40 acres is karst.
- The lawyers for a developer might disagree.

Unresolved questions



- What does “likely to develop” mean?
- Who is qualified to make these determinations?
- What field techniques are applicable?
- How much data is enough?