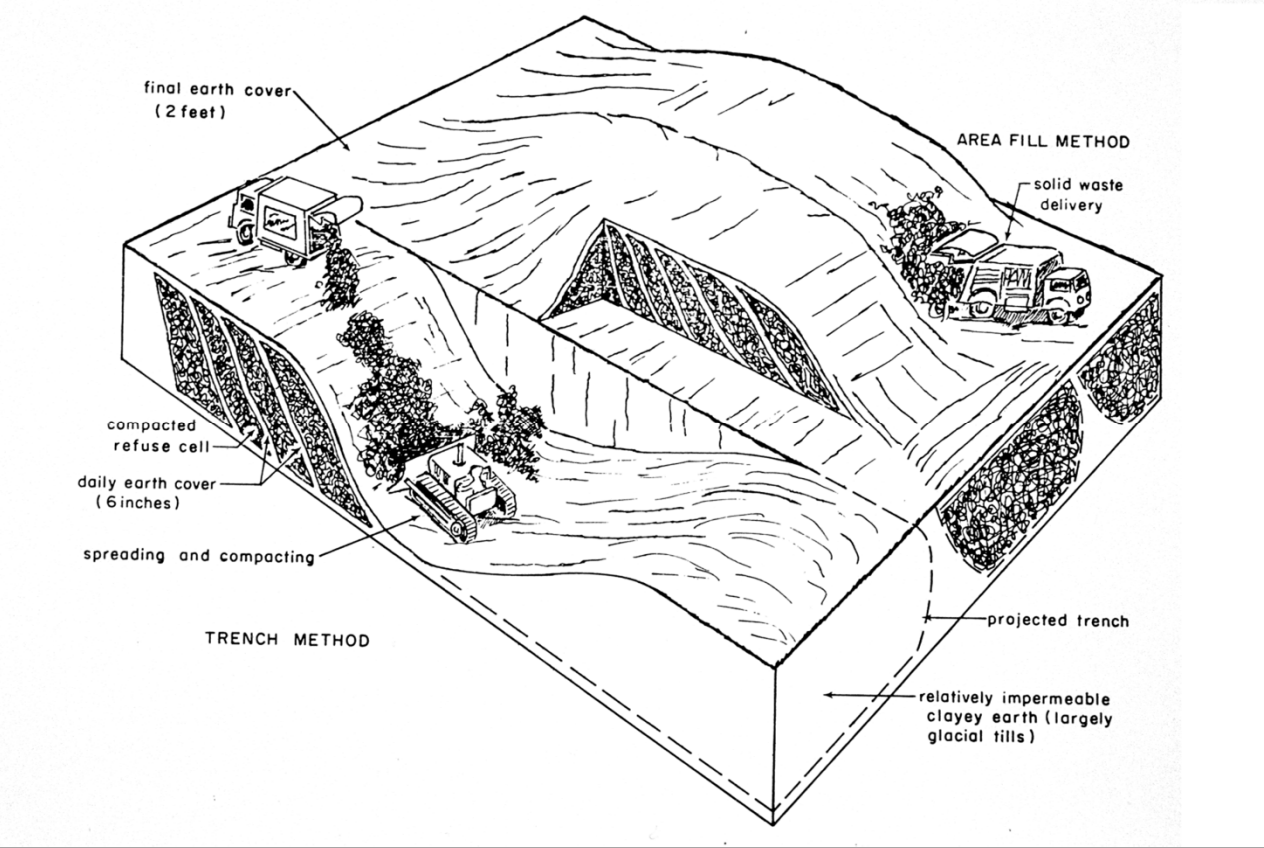
# *Illinois' Legacy Landfills, and Implications for Mahomet Aquifer Groundwater Resources*





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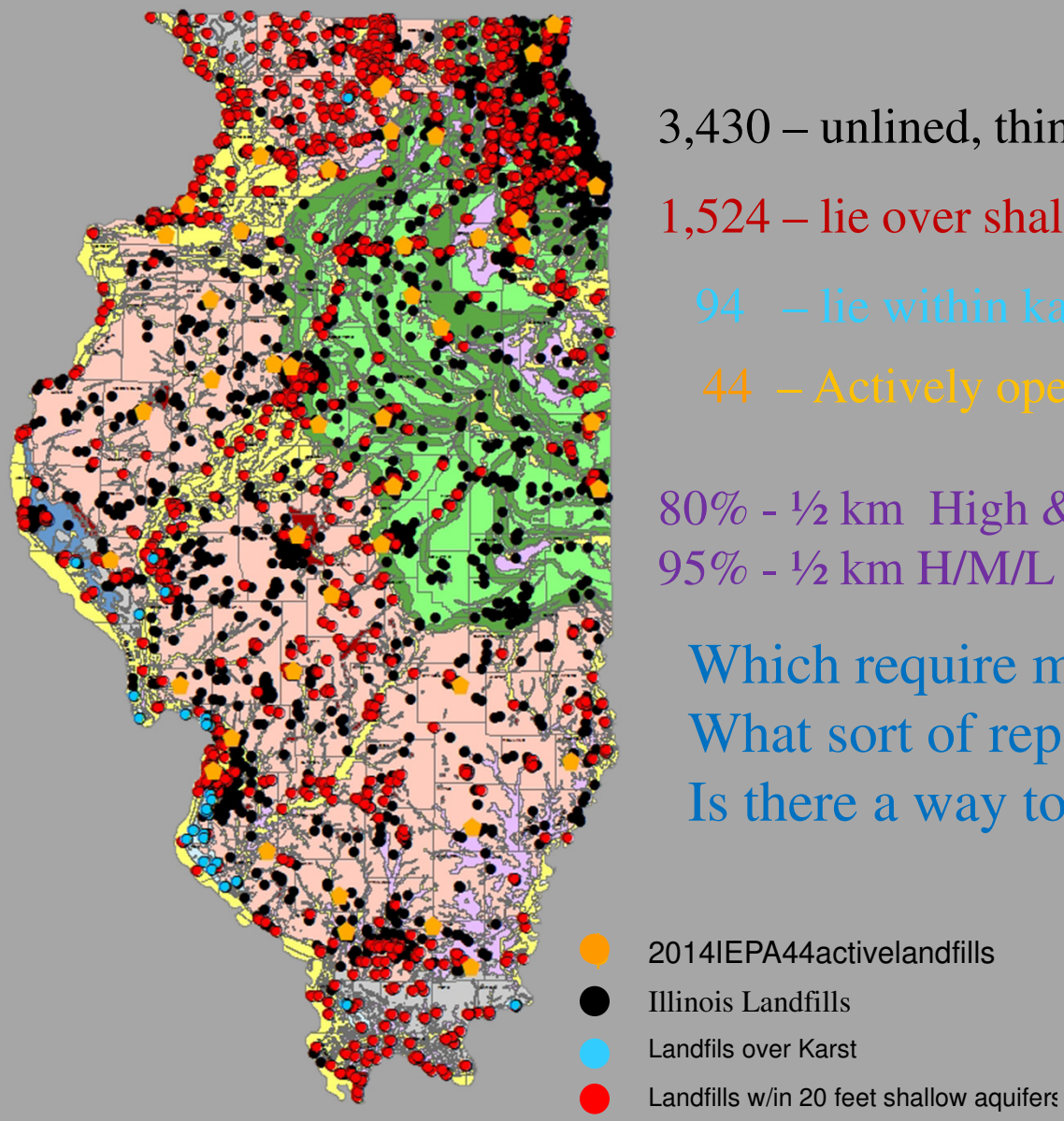
Applied Geo-Imaging Solutions, Inc.

Champaign County Board


Mahomet Aquifer Protection Task Force
Rantoul, IL
August 6, 2018

# What is the condition of 3,430 landfills in Illinois?




3,430 – unlined, thin covered landfills

1,524 – lie over shallow aquifers w/in 20' surface

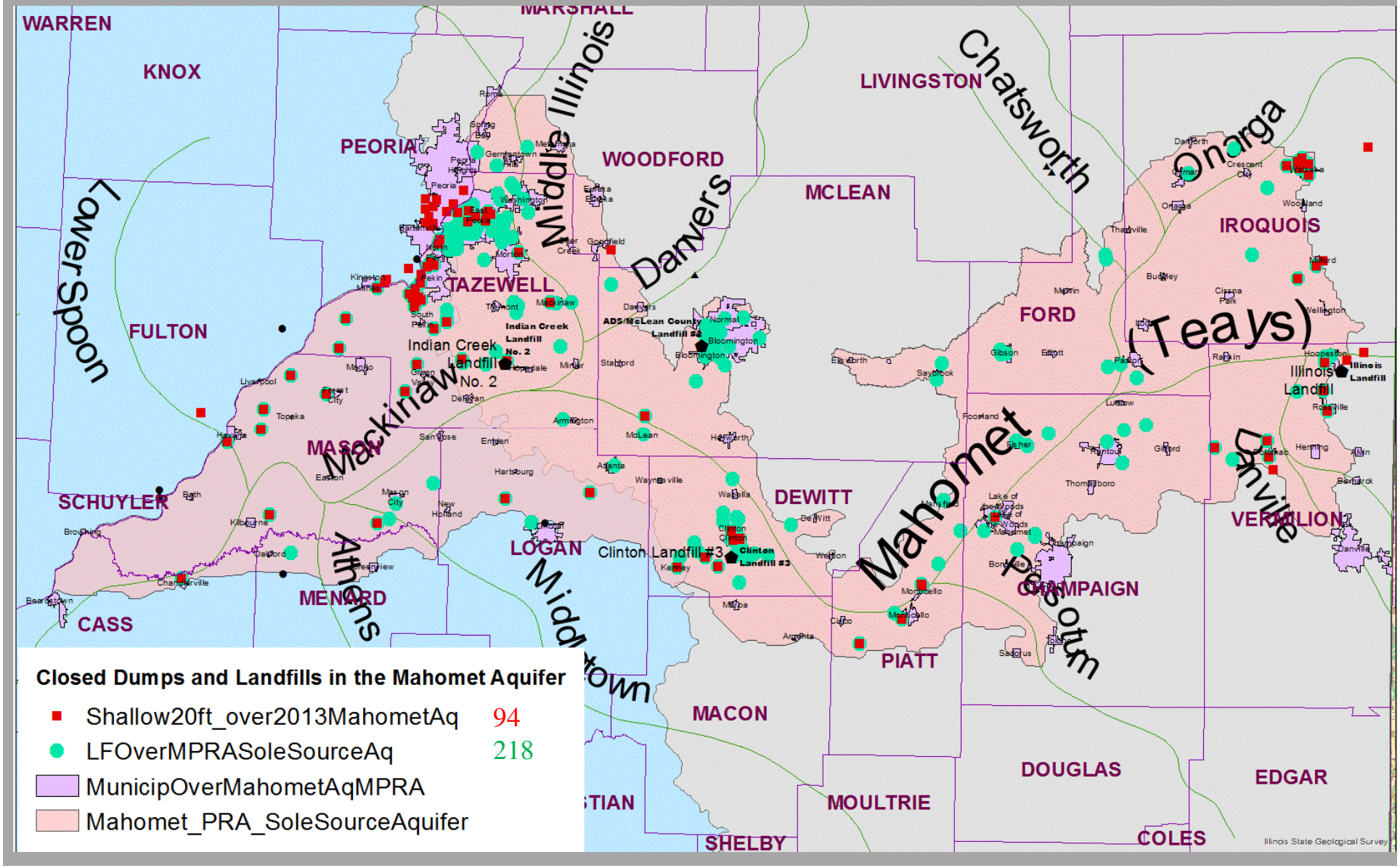
94 – lie within karst areas

44 – Actively operating landfills

80% - ½ km High & Medium Intensity Development
95% - ½ km H/M/L Intensity Development

Which require maintenance, remedial action?
What sort of repair? When – now or later?
Is there a way to use technology to help?

# East Central Illinois – Mahomet Aquifer



# Why are Old Landfills Important?

"Dry Tomb" design philosophy

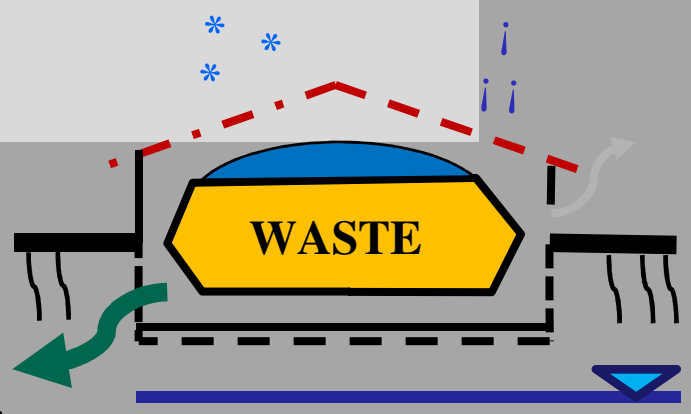
- Isolate wastes from ecosystem,
- Infiltration (leaky roof) = gas & leachate,
  - ~50% of precipitation infiltrates landfill cover,
- Added head pushes leachate > sides and bottom,
- Contaminated fluids degrades water/air quality,
- Cover is only part accessible from surface.

$4,000,000 to re-cover a landfill.
Spot repairs are less expensive.

~36 inches of rain falls on Illinois / year. What happens to that rainfall?

# Where does leachate go?

- Fluids travel laterally or vertically or both.
  - Shallow aquifers recharge streams.
  - Migration between aquifers?
  - Gas, liquids likely differ in composition over time.
- Not a problem – until it is.
  - Nobody really looks for trouble unless stream or well contamination is discovered.
- So, is this a problem?
  - Expendable aquifers?
  - Future water needs?




Some communities already facing water shortage.

# Postclosure Monitoring Strategies

- Passive – what is currently being performed.
  - Monitoring wells
  - Field “walkover” inspections
- Active – sustainable asset management
  - Remote sensing technology, “aerial traverse”
  - Focused field inspection for preventive maintenance
  - GIS-based sustainable asset management

# Flaws of “walkover traverses’

- Entire landfill will NOT be traversed in 1 hour.
- Human perception is obscured by vegetation.
- Observations skewed by season, rainfall, access.
- Paper tracking and memory.
- Is there a better way?

# Postclosure Maintenance Strategies

- Passive – what is currently being performed.
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- Active – sustainable asset management
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  - Focused field inspection for preventive maintenance
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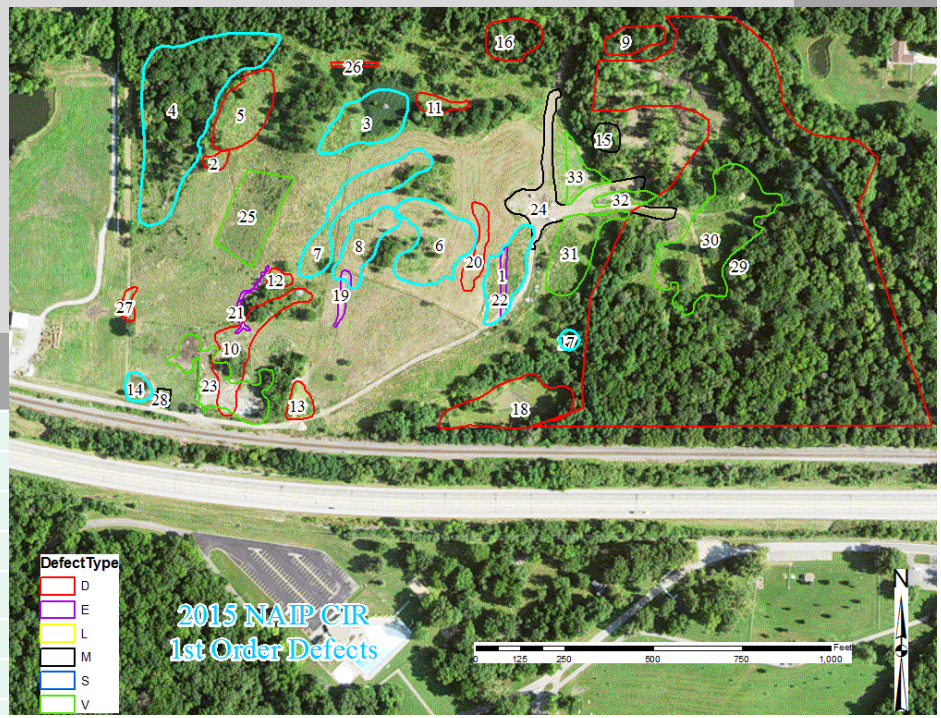
# Advantages of “aerial traverses’

- Synoptic perspective – “bird’s eye view.”
- Performed in office prior to onsite visit.
  - Image-based record of features
  - Compare changes
  - Virtual revisits
  - Focused inspections




| Id | DefectType | Look4 |
|---|---|---|
| 1 | Landslide | Persistent wet spot, veg anomaly |
| 3 | Depression | Persistent wet spot & depression, FeO |
| 4 | Depression | Low area, asperities, seeps on wooded fill? |
| 6 | Depression | Asperites atop crest, FeO |
| 7 | Depression | Asperites along contour, drain? |
| 8 | Depression | Asperities on flank, low slope, drain? |

# Defects and Features of Interest Developed in Landfill Covers

Depressions, wet spots

Leachate seep

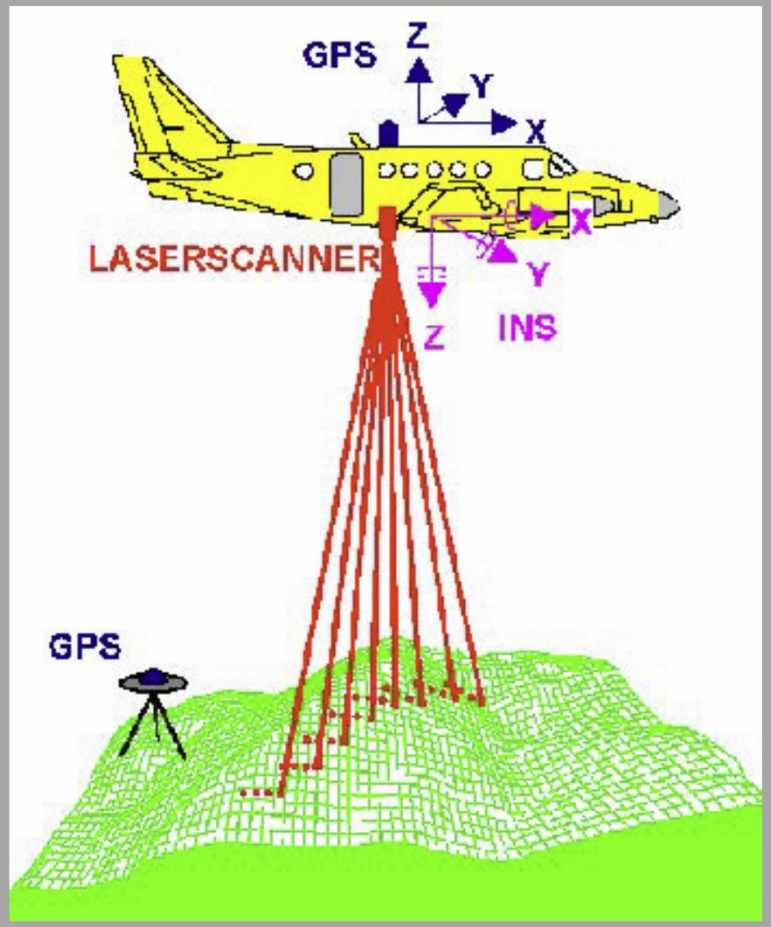
Erosion

# Improved Postclosure Monitoring Sustainable Asset Management

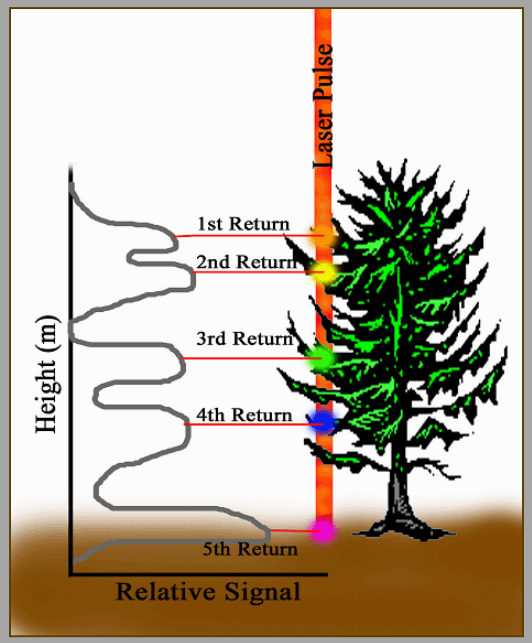
"aerial traverse"

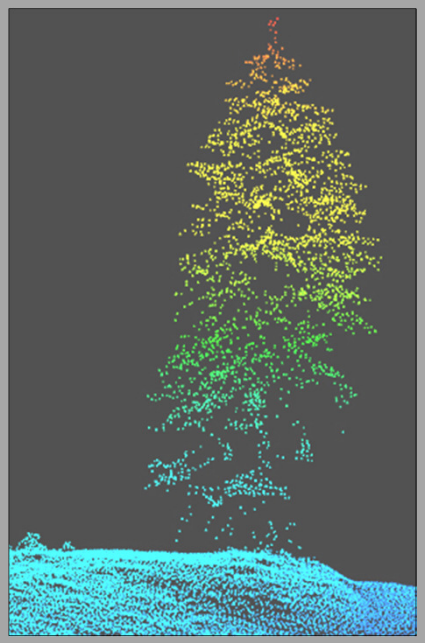
- LiDAR → Surface topography
- Aerial Photography → Feature detection
- Focused walkover reconnaissance
- GIS/CAD + measurements + field notes

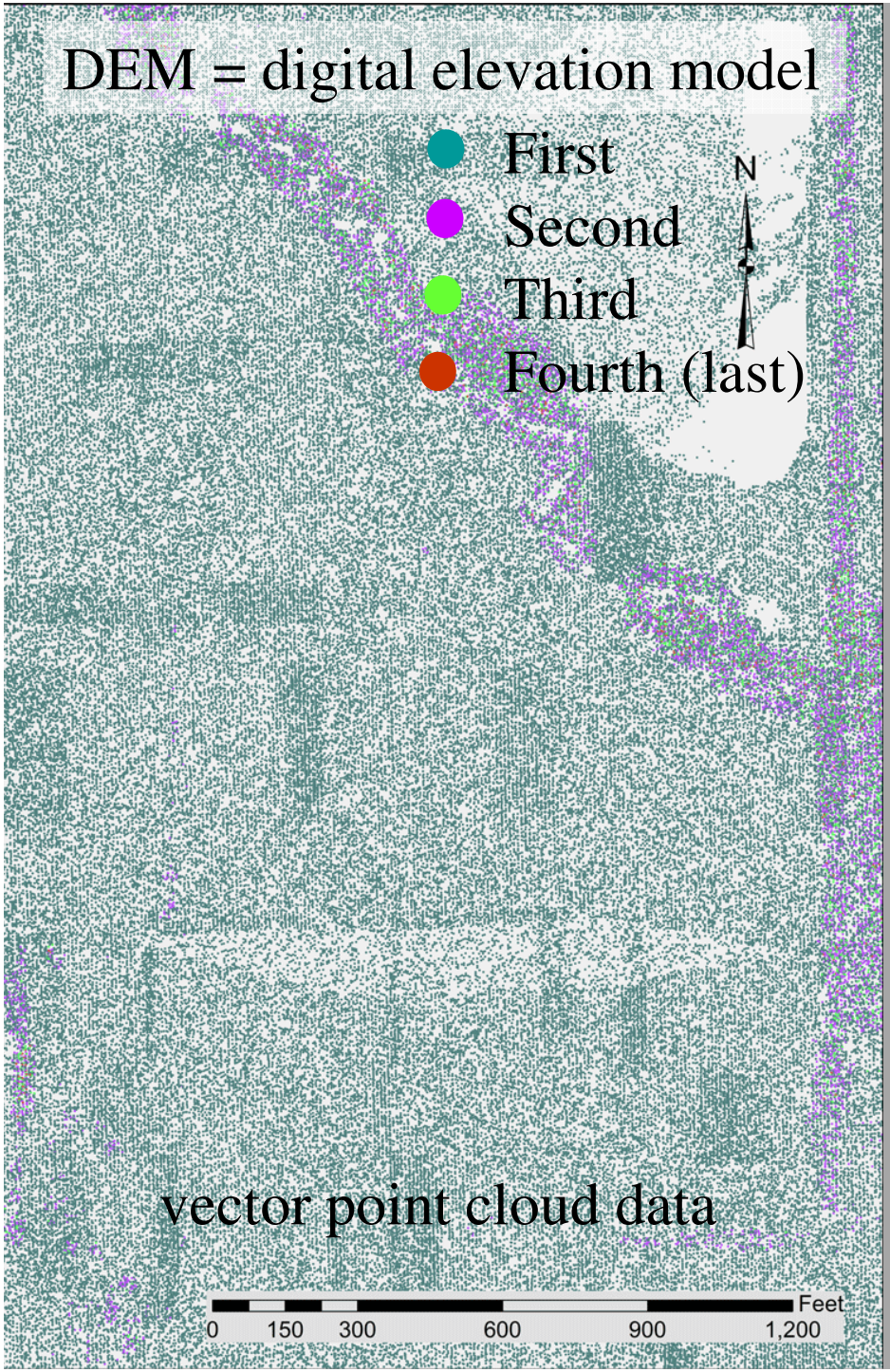
# LiDAR or lidar
# Light Detection And Ranging

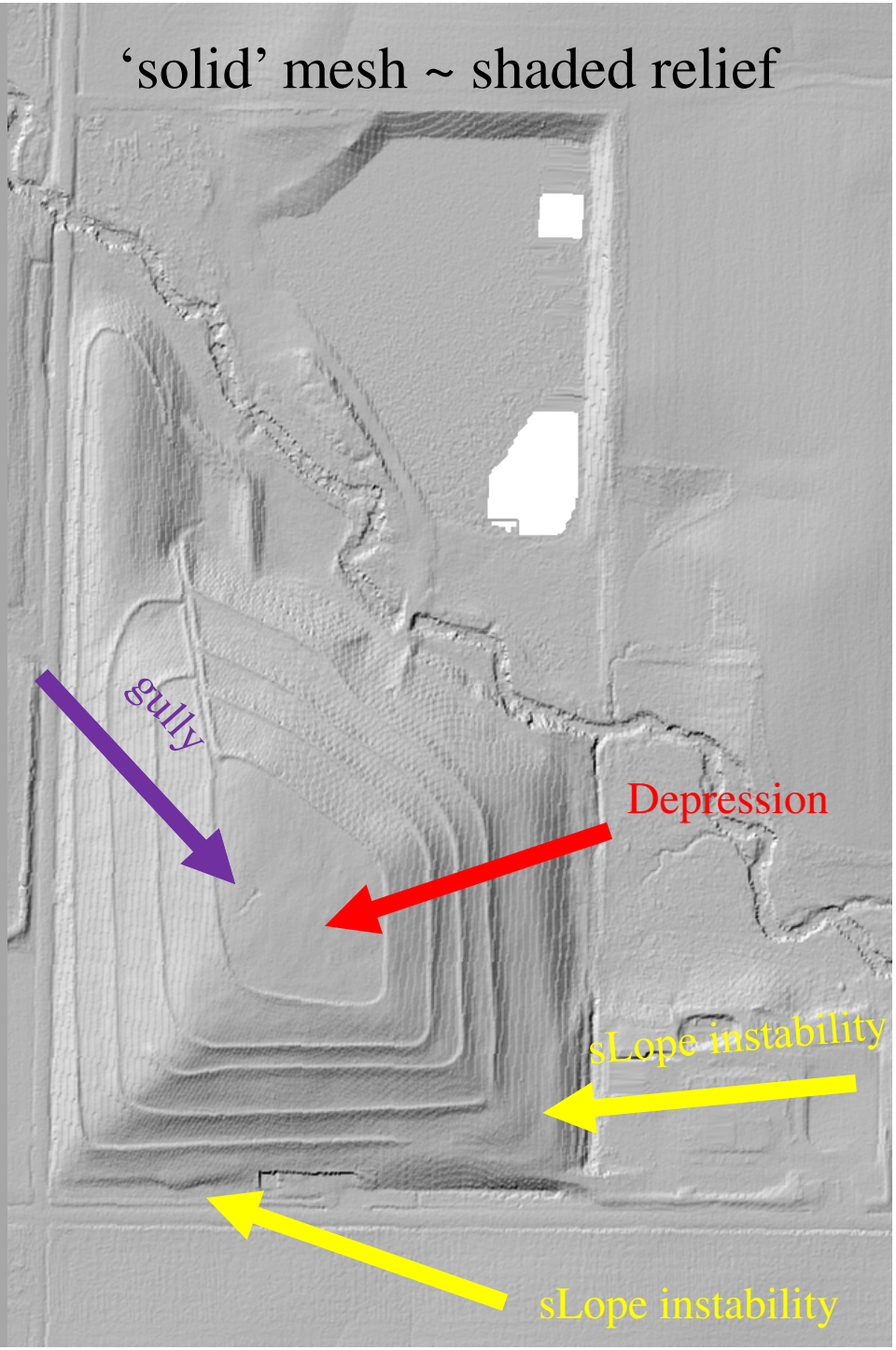


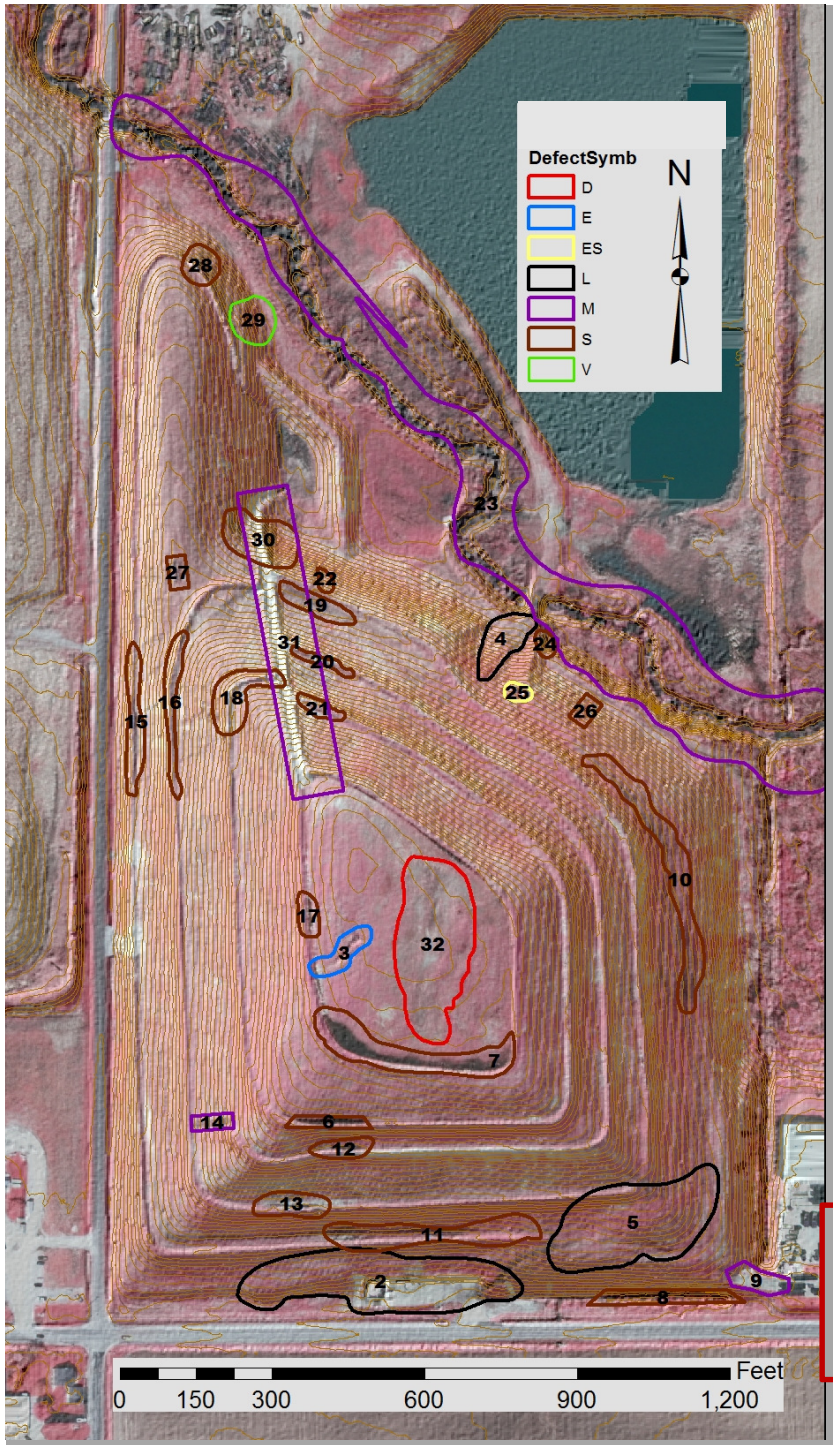

Pulse is measured 5 times.
Used to make topographic maps.

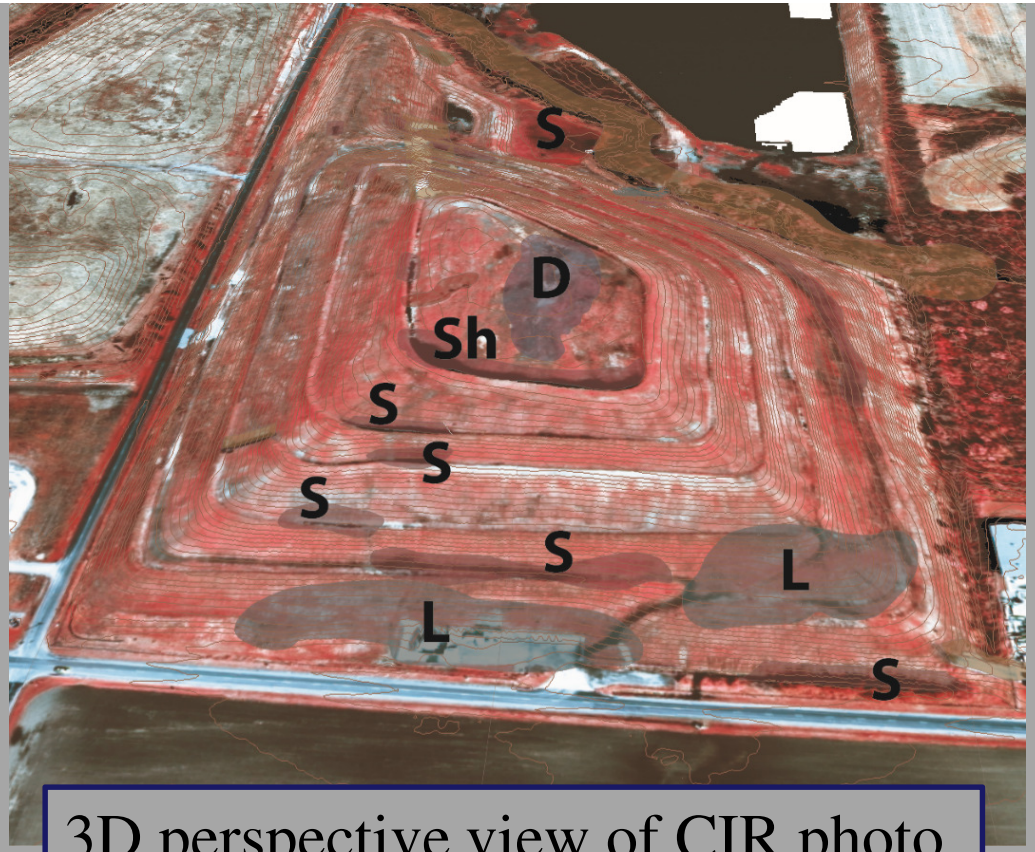



DEM = digital elevation model
First
Second
Third
Fourth (last)
N
vector point cloud data
Feet
0
150
300
600
900
1,200


'solid' mesh ~ shaded relief
gully
Depression
sLope instability
sLope instability




3D perspective view of CIR photo draped over LiDAR with contours aids in defect identification.

2D view of CIR photo with contours and interpretations.

# Improved Postclosure Monitoring Sustainable Asset Management

"aerial traverse"

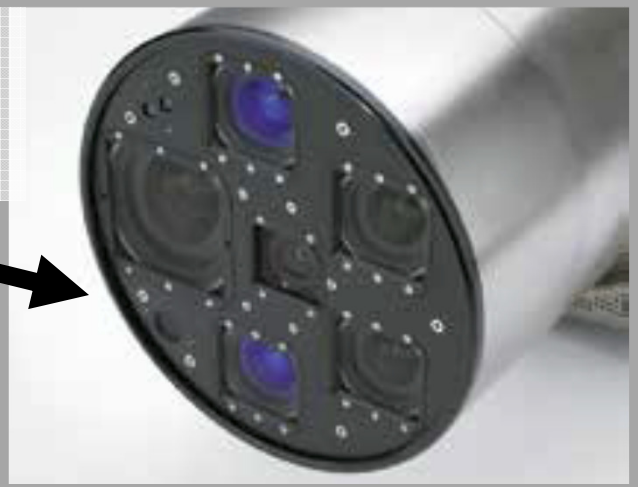
- LiDAR → Surface topography
- **Aerial Photography → Feature detection**
- Focused walkover reconnaissance
- GIS/CAD + measurements + field notes

# Digital Aerial Photography

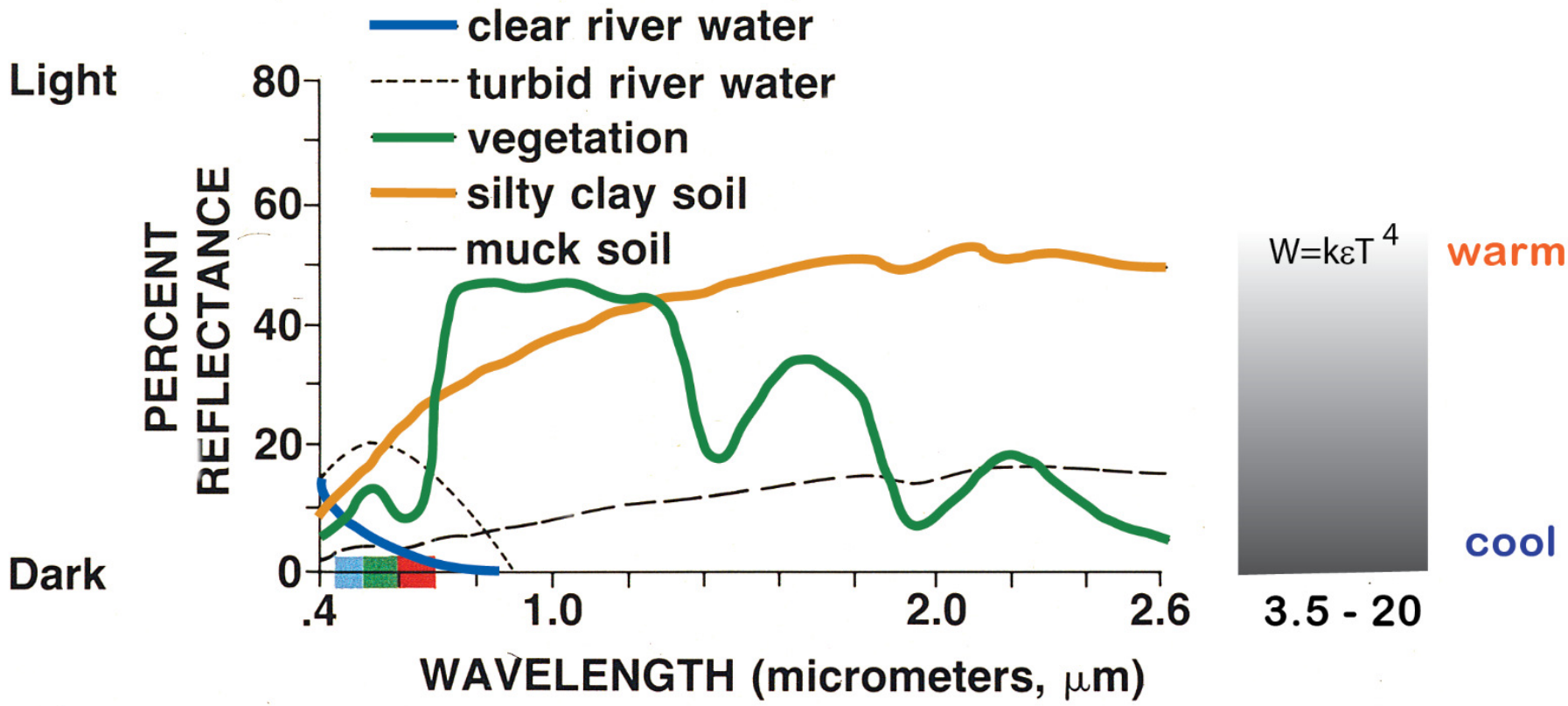
- Digital Mapping Camera
  - 4 bands = VNIR = blue, green, red, near infrared
  - Orthophotography – radial displacement removed
  - Georeferenced - image map for GIS/CAD

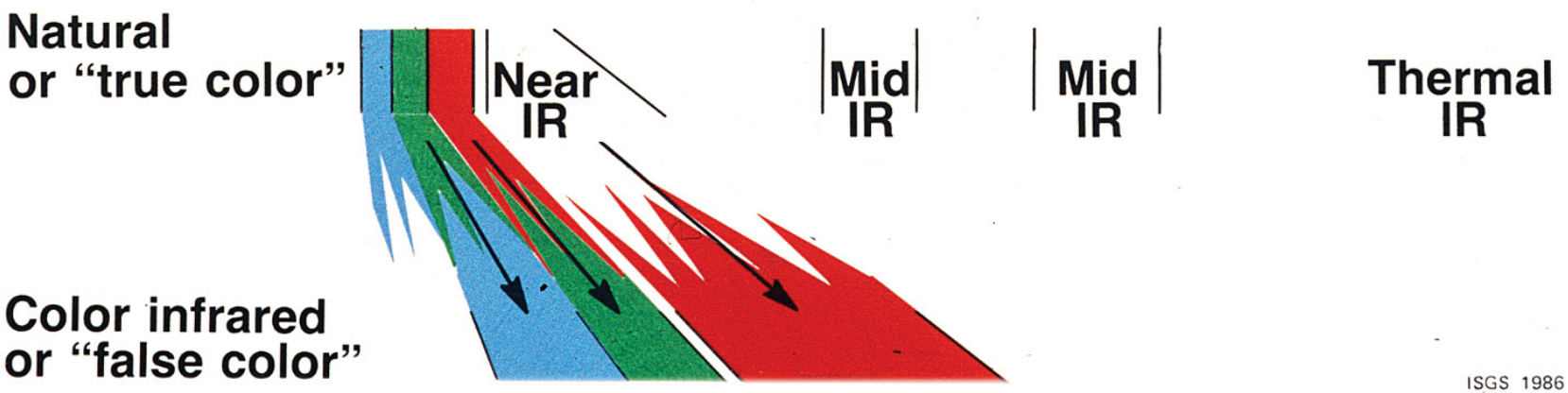
*Not calibrated*, unknown processing

VNIR – 4 band
+ Panchromatic
Boresite viewer



# COMPARISON OF TYPICAL VEGETATION, SOIL AND WATER REFLECTANCE




ISGS 1986

# Publicly-Available Aerial Imagery

- Google Earth – Good resolution, convenient,
  No adjustment or enhancement, No color infrared
- Satellite – Has RGBN, but costs $$, coarse resolution.

Better way is GIS-base + publicly available

- NAIP – National Agricultural Imagery Prog, leaf on, VNIR
- DOT – airborne lidar, leaf off, VNIR
- Counties – airborne lidar, leaf off, VNIR

Google Earth
74
Survey
Imagery Date: 5/16/2012 40°09'41.43" N 88°18'24.54" W elev

2012NAIP
Feet
0 162.5 325 650 975 1,300

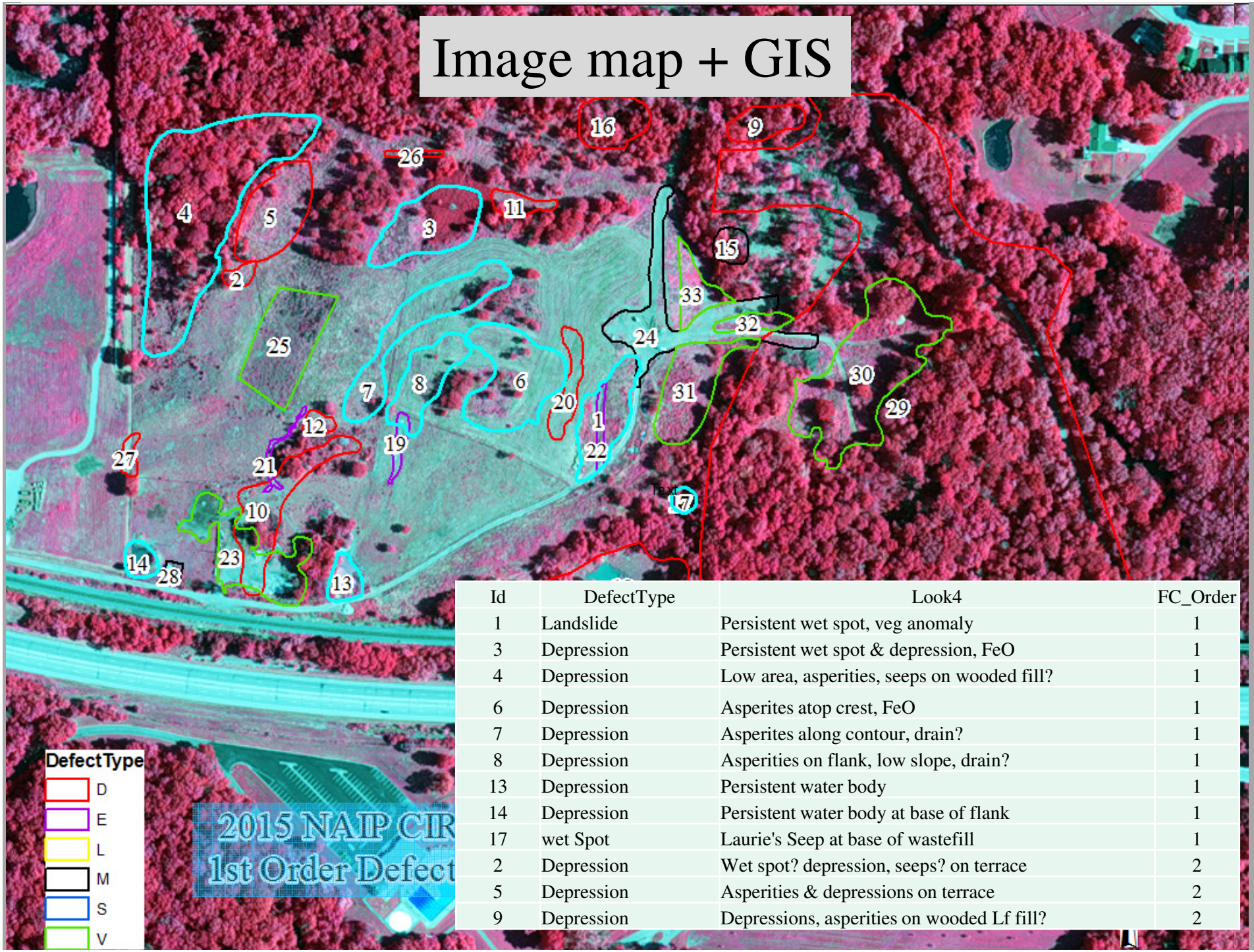
2011IDOT
Feet
0 162.5 325 650 975 1,300

# Improved Postclosure Monitoring and Custodial Care

"aerial traverse"

- LiDAR → Surface topography
- Aerial Photography → Feature detection
- **Reconnaissance map → Focused walkover**
- **GIS/CAD + measurements + field notes**

# Image map + GIS

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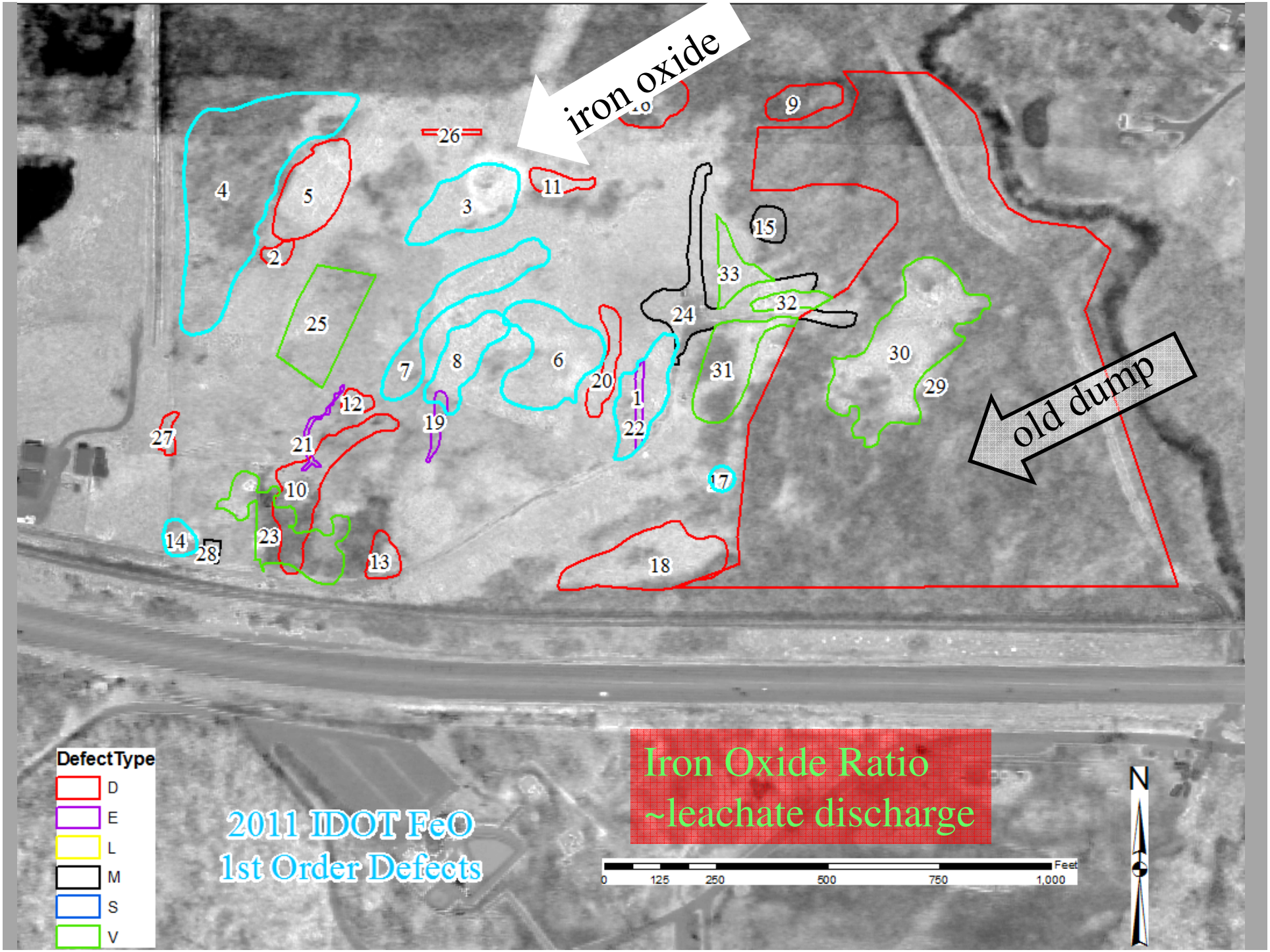
| 7 | Depression | Asperites along contour, drain? | 1 |
| 8 | Depression | Asperities on flank, low slope, drain? | 1 |
| 13 | Depression | Persistent water body | 1 |
| 14 | Depression | Persistent water body at base of flank | 1 |
| 17 | wet Spot | Laurie's Seep at base of wastefill | 1 |
| 2 | Depression | Wet spot? depression, seeps? on terrace | 2 |
| 5 | Depression | Asperities & depressions on terrace | 2 |
| 9 | Depression | Depressions, asperities on wooded Lf fill? | 2 |


iron oxide
old dump
Iron Oxide Ratio
~leachate discharge
2011 IDOT FeO
1st Order Defects
Defect Type
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125
250
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# Sustainable Legacy Landfill Management

- Identify, measure, check, and assess.
  - Which legacy landfills pose risk to Mahomet Aquifer?
  - Identify defects on earthen covers for field verification.
  - Prioritize maintenance and repair of defects.
- Sustainable maintenance.
  - Update training of field inspectors.
  - Collect landfill data and information into a geodatabase.
  - Subsequent use w/ Forest & Park Districts, C-Clubs.
  - Minimize deferred maintenance risk. [stitch in time]

Maintenance - Important, unglamorous.