

 **Geo<sup>3</sup>T<sup>2</sup>**  
April 9-10, 2015 

*Geotechnical, Geophysical,  
Geoenvironmental Engineering  
Technology Transfer  
Conference & Expo*

# 3D GPR Imaging to Map Subsurface Voids

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April 9, 2015



# US321 Sinkhole Project



Site Location

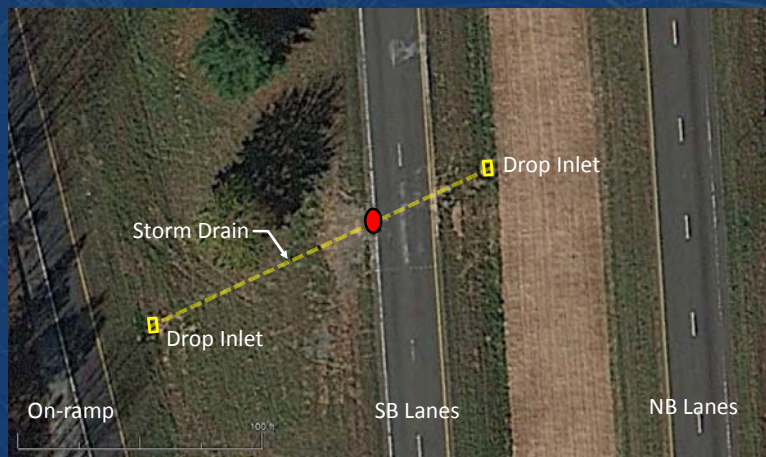


## Project Timeline

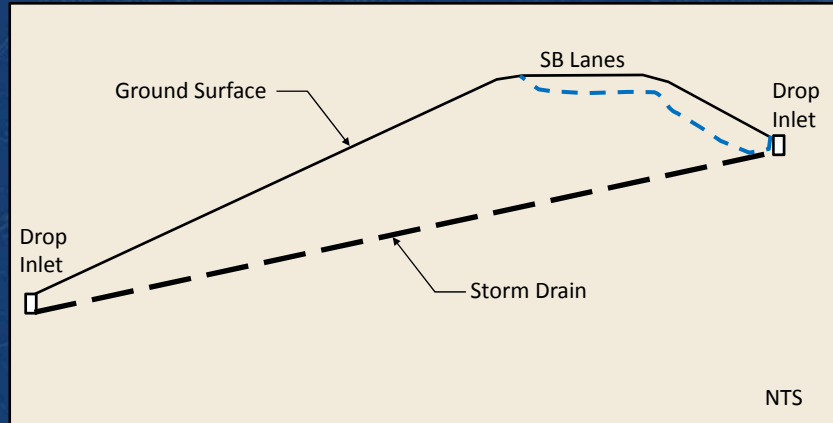
- August ??, 2013 – Sinkhole develops on edge of pavement on outside SB lane.
- August ??, 2013 – NCDOT excavates and places flowable fill on both sides of SB lanes.
- August 16, 2013 – ESP performs GPR study to map voids beneath the pavement
- August 23 & 26, 2013 – NCDOT drills and grouts voids. Places about 250 bags of grout.
- May 9, 2014 – ESP performs post-repair GPR study to map remnant voids



## Sinkhole and Storm Drain Location



## Schematic (looking N)



## Study Area



# GPR Studies

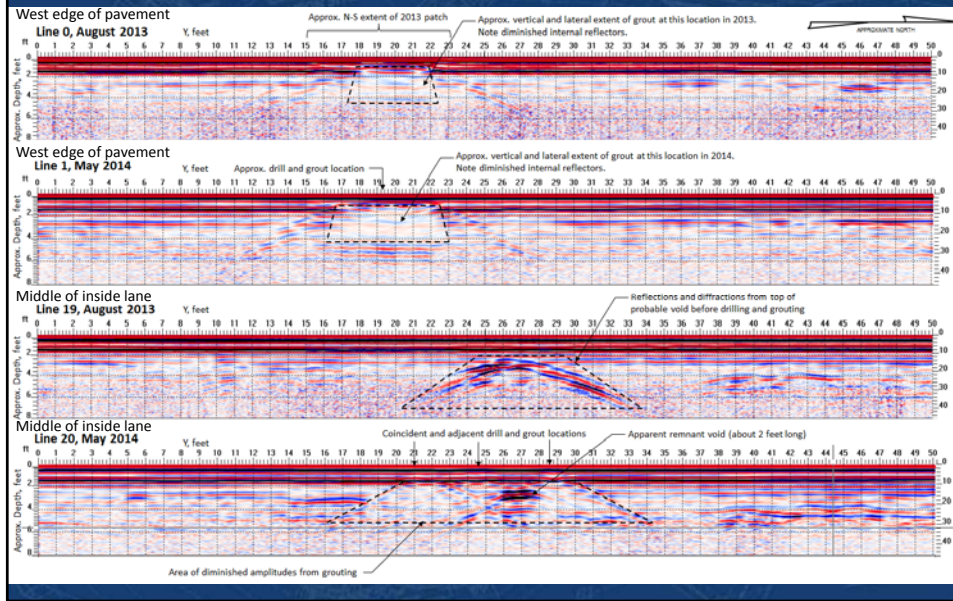
250 Mhz Antenna, 50'x24/26' Grid, 1-Foot Line Spacing



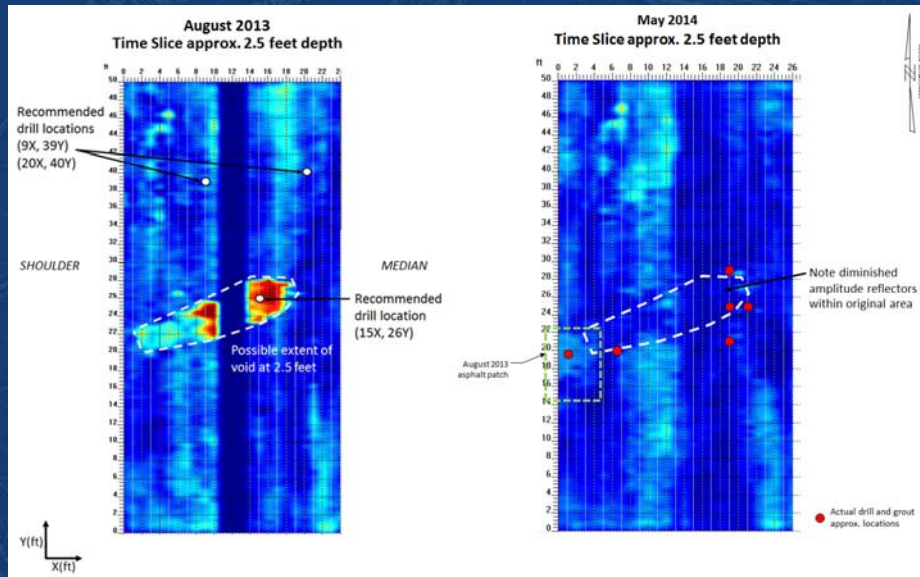
# GPR Data Comparison



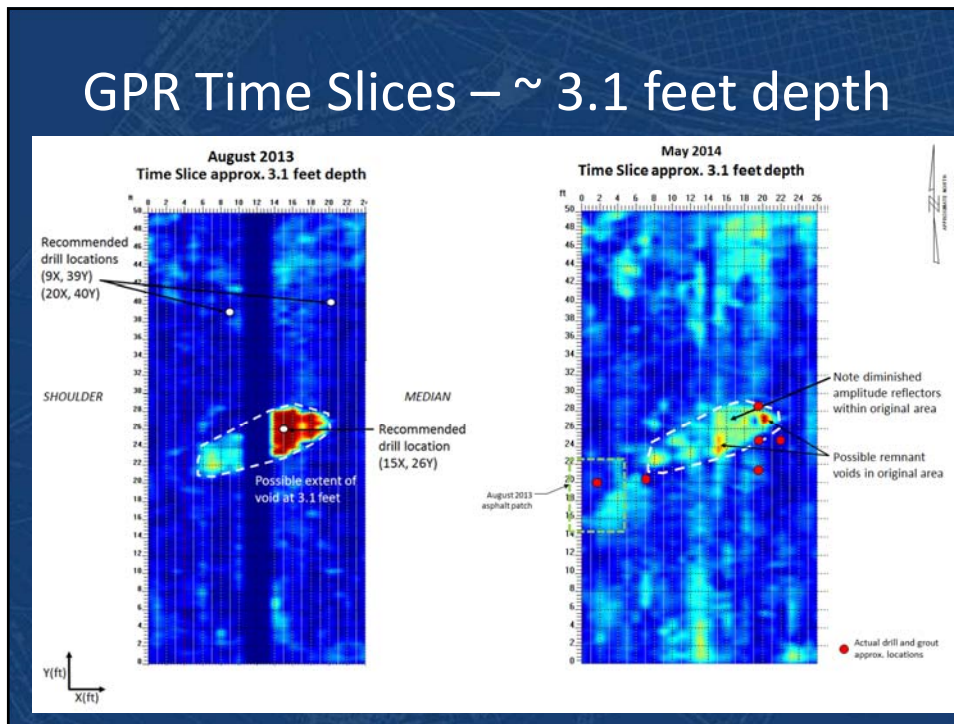
# 2013 vs 2014 GPR Cross-Sections



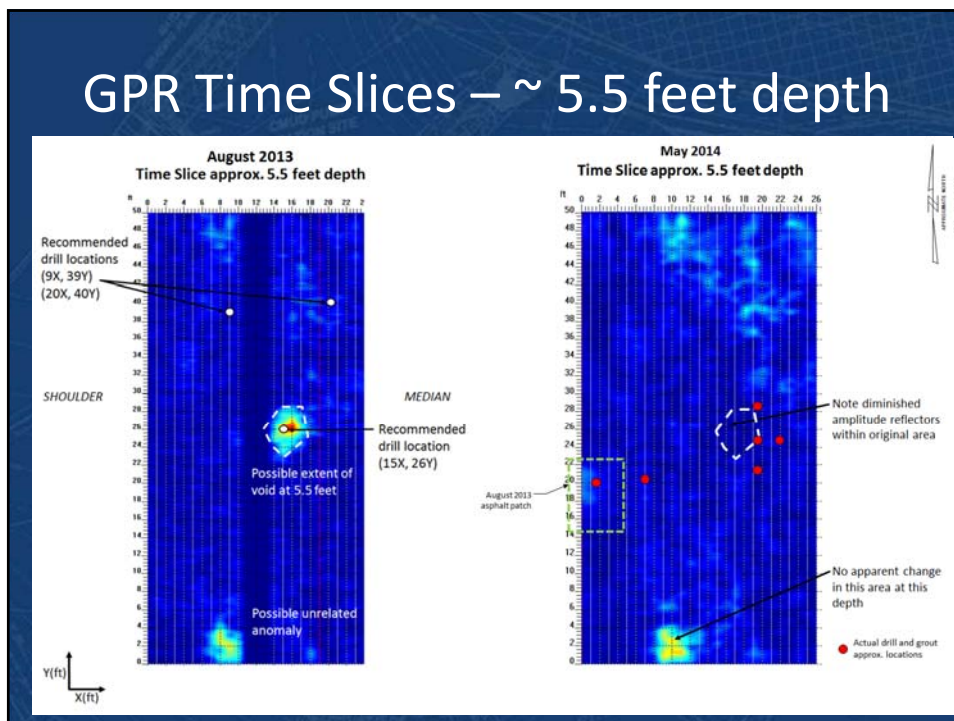
# GPR Time Slices – ~ 2.5 feet depth



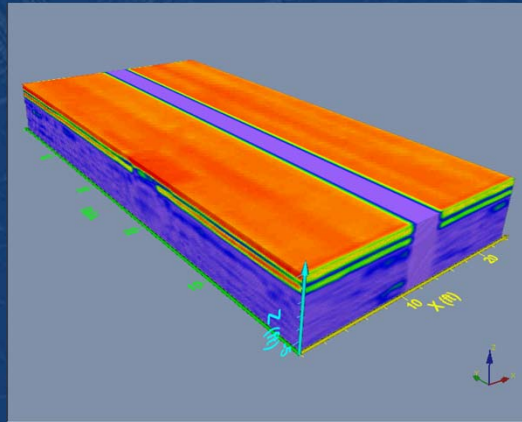
## GPR Time Slices – ~ 3.1 feet depth



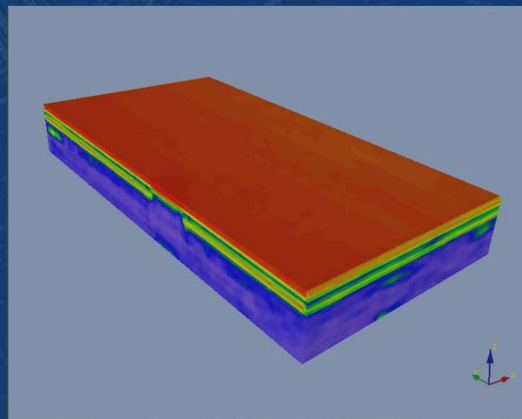
## GPR Time Slices – ~ 5.5 feet depth



## 2013 GPR 3D Volume



## 2014 GPR 3D Volume



## Conclusions

- 2013 GPR study identified lateral and approximate vertical extent of voids
- 2014 GPR study confirmed that the grouting program filled majority of void space
- 3D data analysis provided high confidence deliverables in less time than 2D analysis
- Deliverables were readily understandable by others.



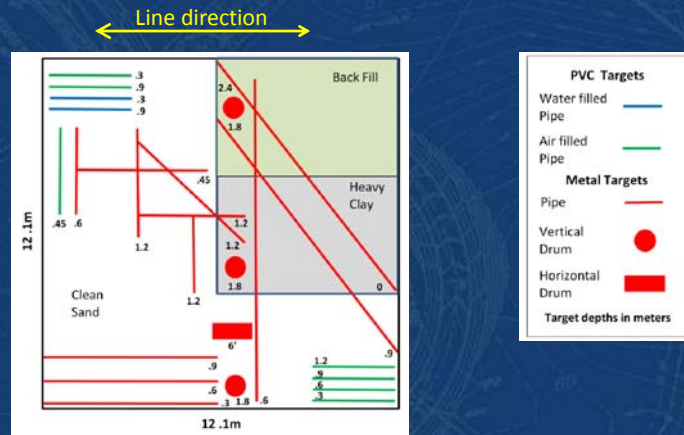
# THANK YOU





## 2008 GSSI 3D GPR Study

- 400 MHz antenna, 2 inch spacing



<http://www.geophysical.com/Documentation/WhitePapers/IWAGPR2009-Robertsetal.pdf>

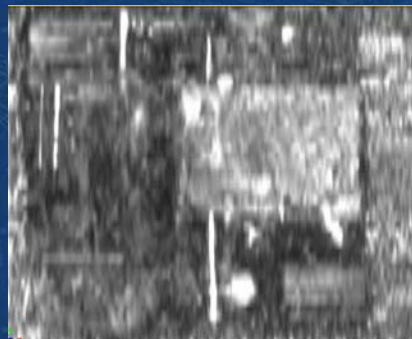
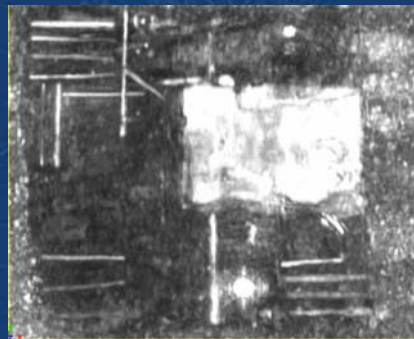


## 2008 GSSI Study

- Time/Depth Slice about 2.25 feet depth

0.05m (2in) line spacing

0.3m (12in) line spacing



← Line direction →

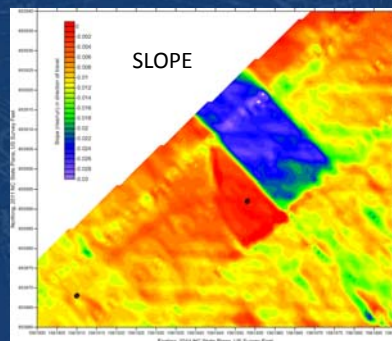
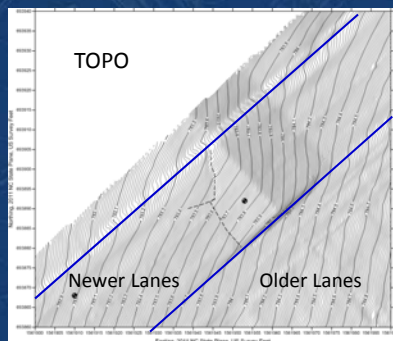
<http://www.geophysical.com/Documentation/WhitePapers/IWAGPR2009-Robertsetal.pdf>



# I-85 Salisbury Settlement Study

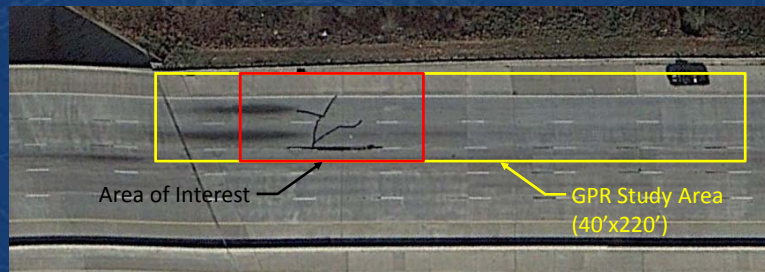


# Mobile LiDAR Scanning

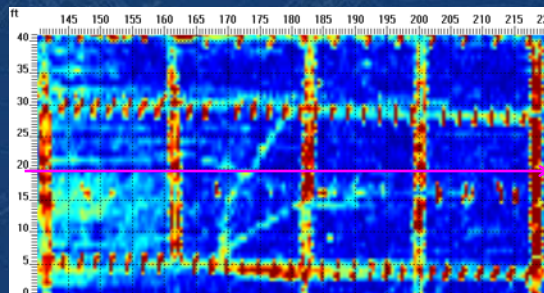


## 3D GPR Study

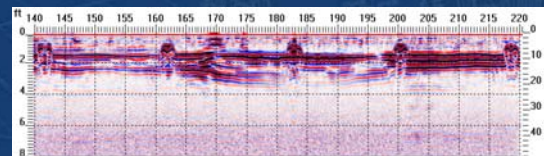
- GPR Imaging with 250 and 500 MHz antennas
  - One-foot line spacing
  - Positioning grid established with tape measure



## 500 MHz data, ~1 foot depth



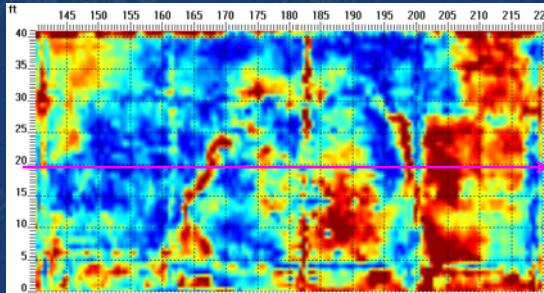
Plan View



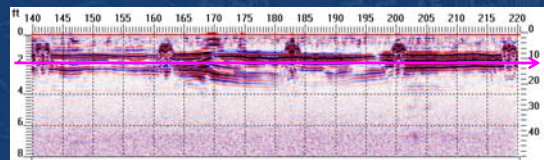
Cross-Section



## 500 MHz Data, ~2 feet depth



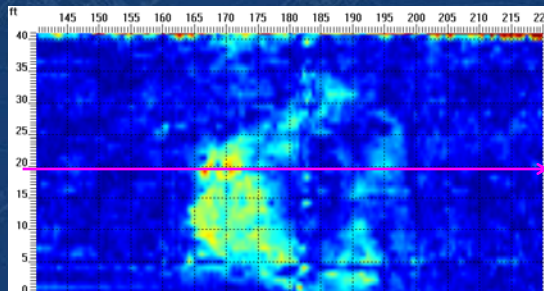
Plan View



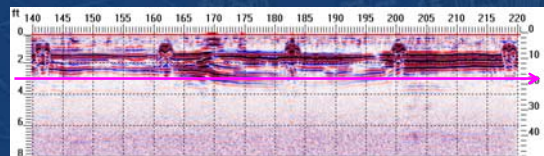
Cross-Section



## 500 MHz data, ~3 feet depth



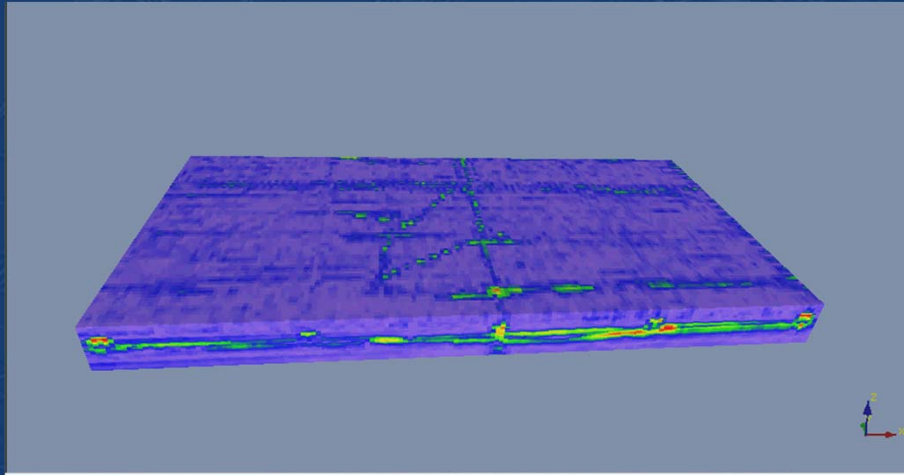
Plan View



Cross-Section



## 500 MHz 3D Volume



## 500 MHz data 3D Volume

