Southeastern
Transportation
Geotechnical
Engineering
Conference

Delineation of a Landfill Affecting Highway Performance

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ESP

ACKNOWLEDGMENTS

INFRASTRUCTURE CONSULTING & ENGINEERING

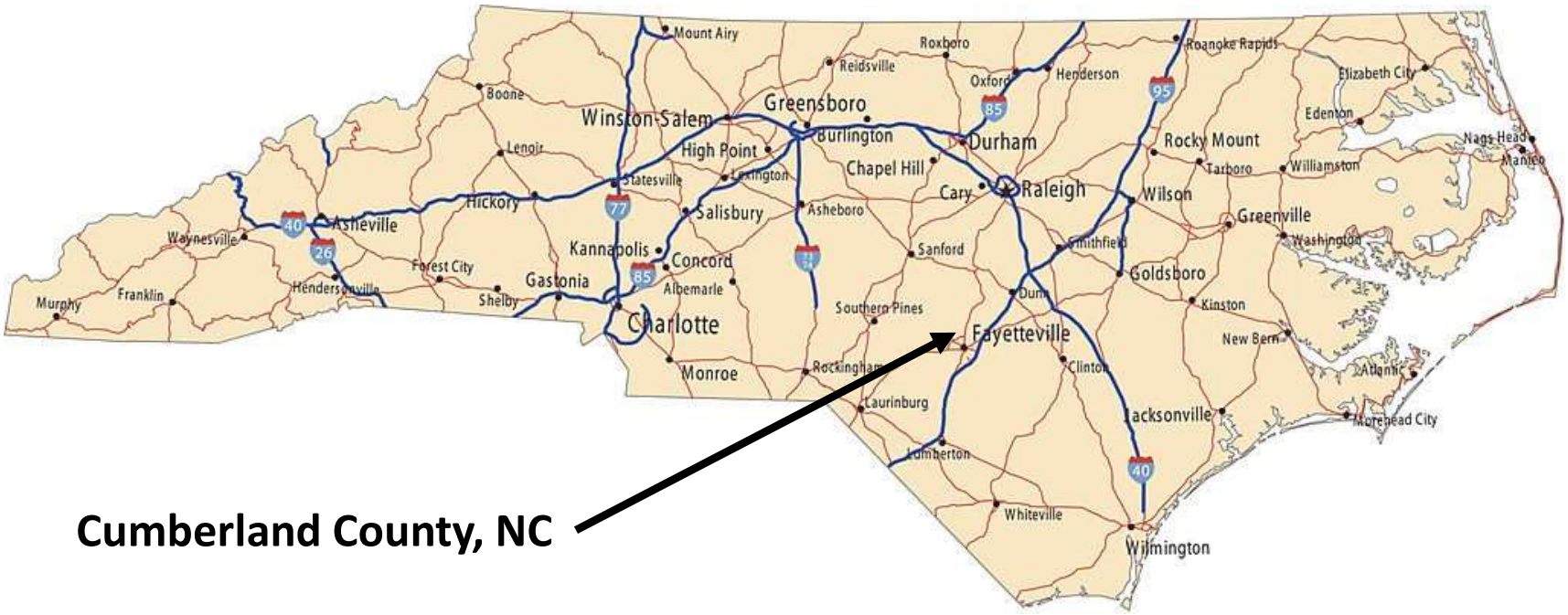
STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

ESP

OUTLINE

- Background
- Goals
- Data Collection and Results
- Discussion

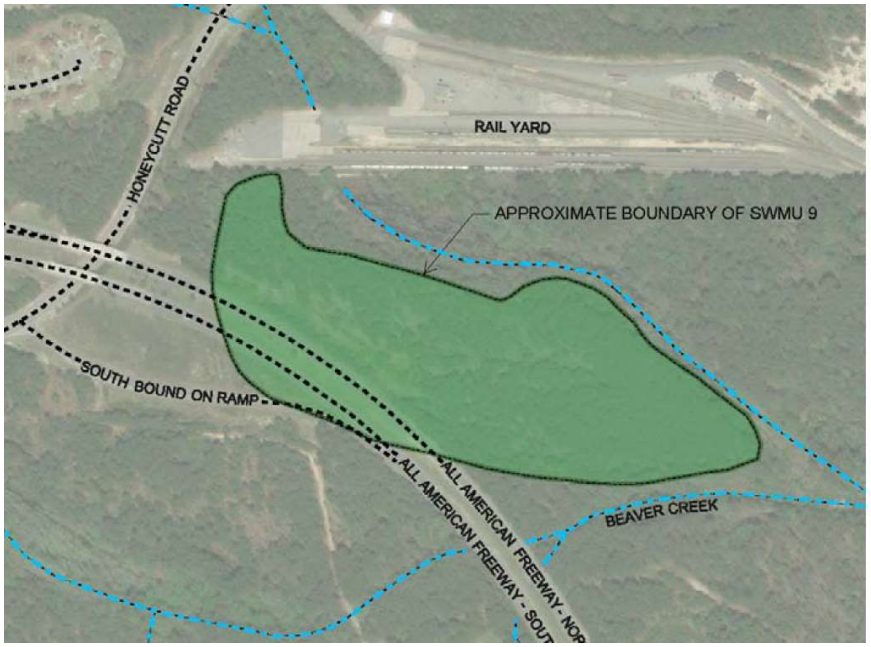
SITE LOCATION



HISTORY

- Municipal landfill operated 1970 - 1975
- Freeway constructed 1975 - 1978
- Differential settlement
- Periodic milling and paving

SITE CONDITIONS

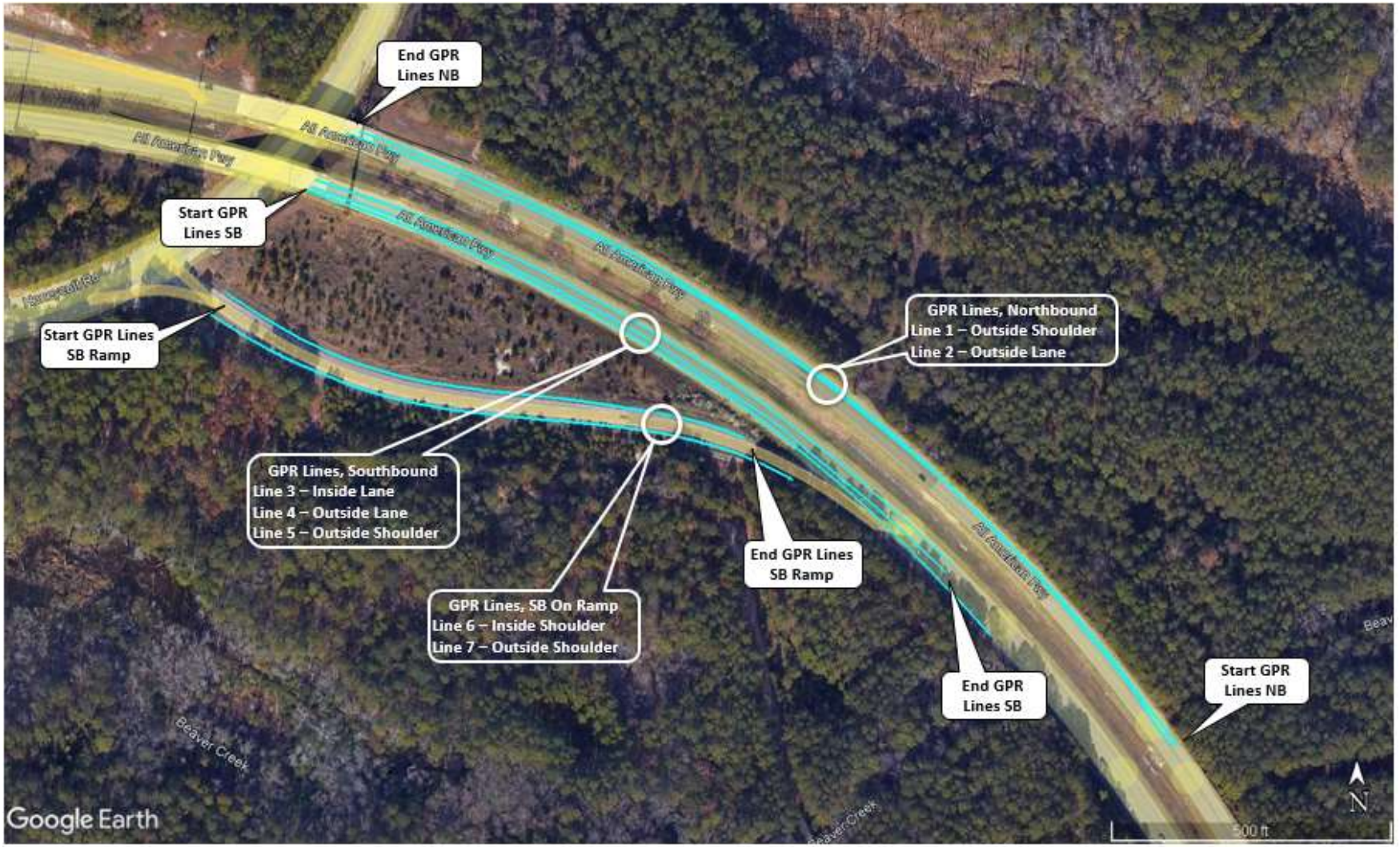


GOALS

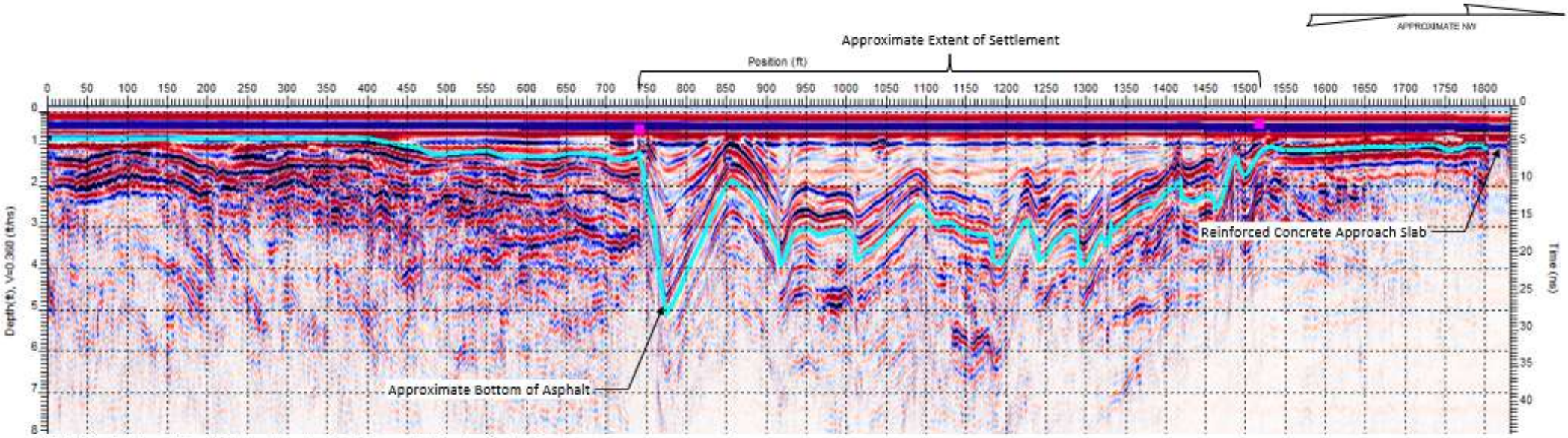
- Determine approximate thickness of the asphalt using ground-penetrating radar (GPR)
- Determine approximate lateral and vertical extents of the buried waste using electromagnetic induction (EM) and electrical resistivity imaging/induced potential (ERI/IP),

GPR DATA COLLECTION

- Sensors and Software Noggin Cart with 250 MHz antenna
- Towed behind field vehicle
- Real-time DGPS
- Approx. 10,000 linear feet of production data

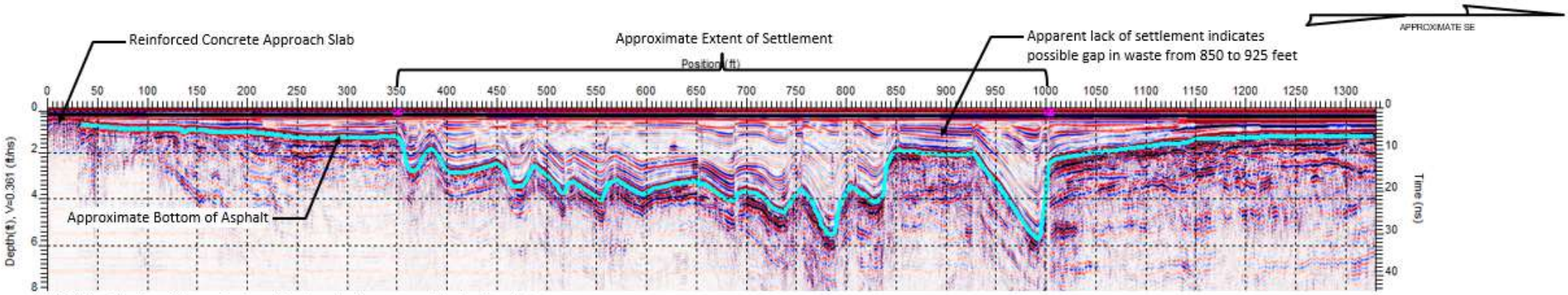

End GPR Lines NB
Start GPR Lines SB
Start GPR Lines SB Ramp
GPR Lines, Northbound
Line 1 – Outside Shoulder
Line 2 – Outside Lane
GPR Lines, Southbound
Line 3 – Inside Lane
Line 4 – Outside Lane
Line 5 – Outside Shoulder
End GPR Lines SB Ramp
GPR Lines, SB On Ramp
Line 6 – Inside Shoulder
Line 7 – Outside Shoulder
End GPR Lines SB
Start GPR Lines NB
Beaver Creek
Google Earth
N
500 ft

EXAMPLE GPR IMAGE, NORTHBOUND

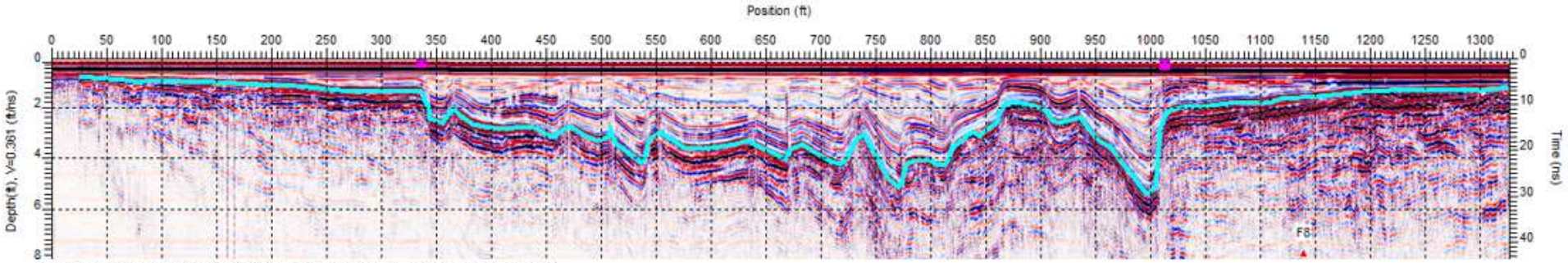


A. GPR Line G1 along NB outside shoulder showing interpreted depth of asphalt.

EXAMPLE GPR IMAGE, SOUTHBOUND



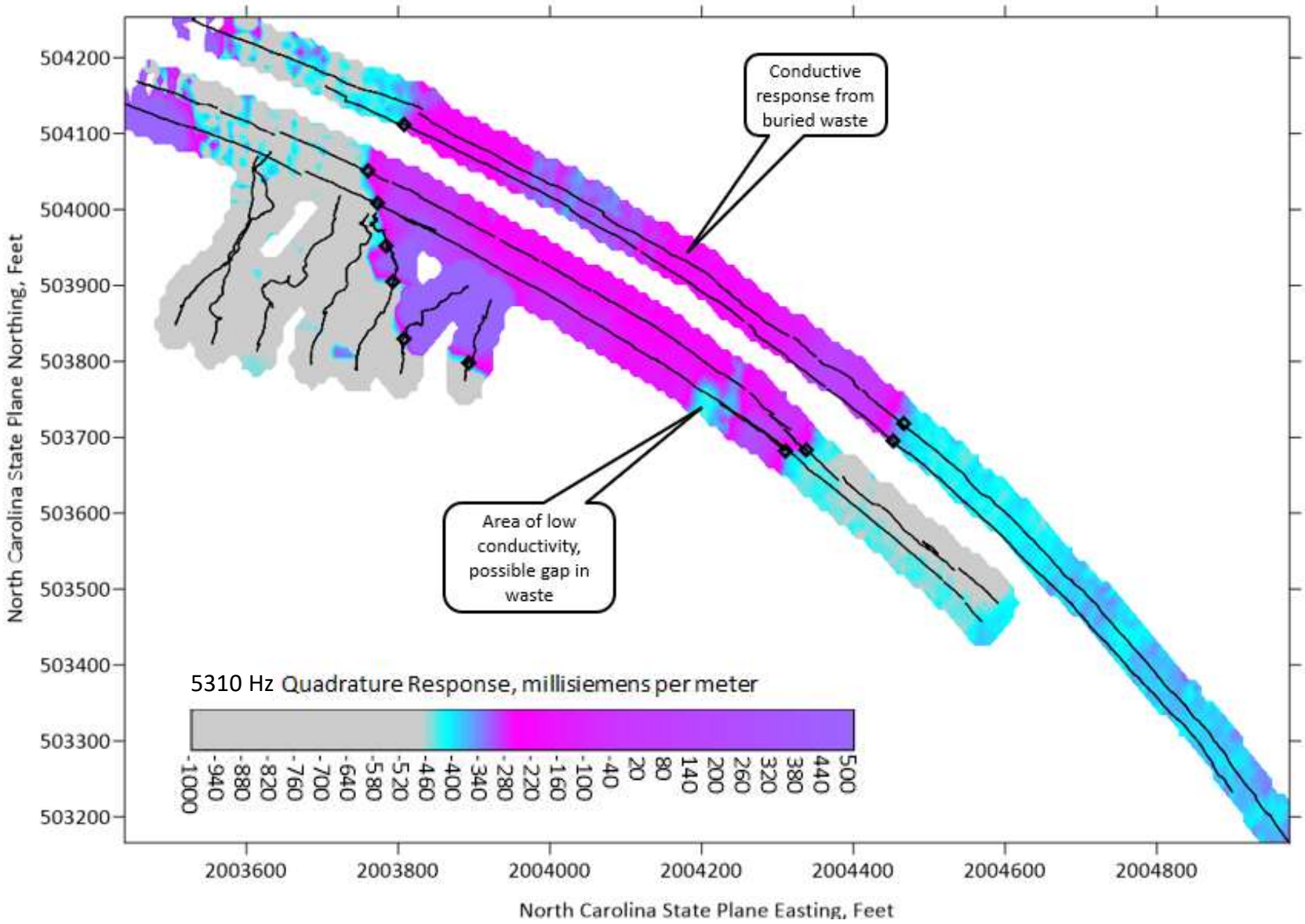
A. GPR Line G3 along NB outside shoulder showing interpreted depth of asphalt.



A. GPR Line G4 along NB outside lane showing interpreted depth of asphalt.

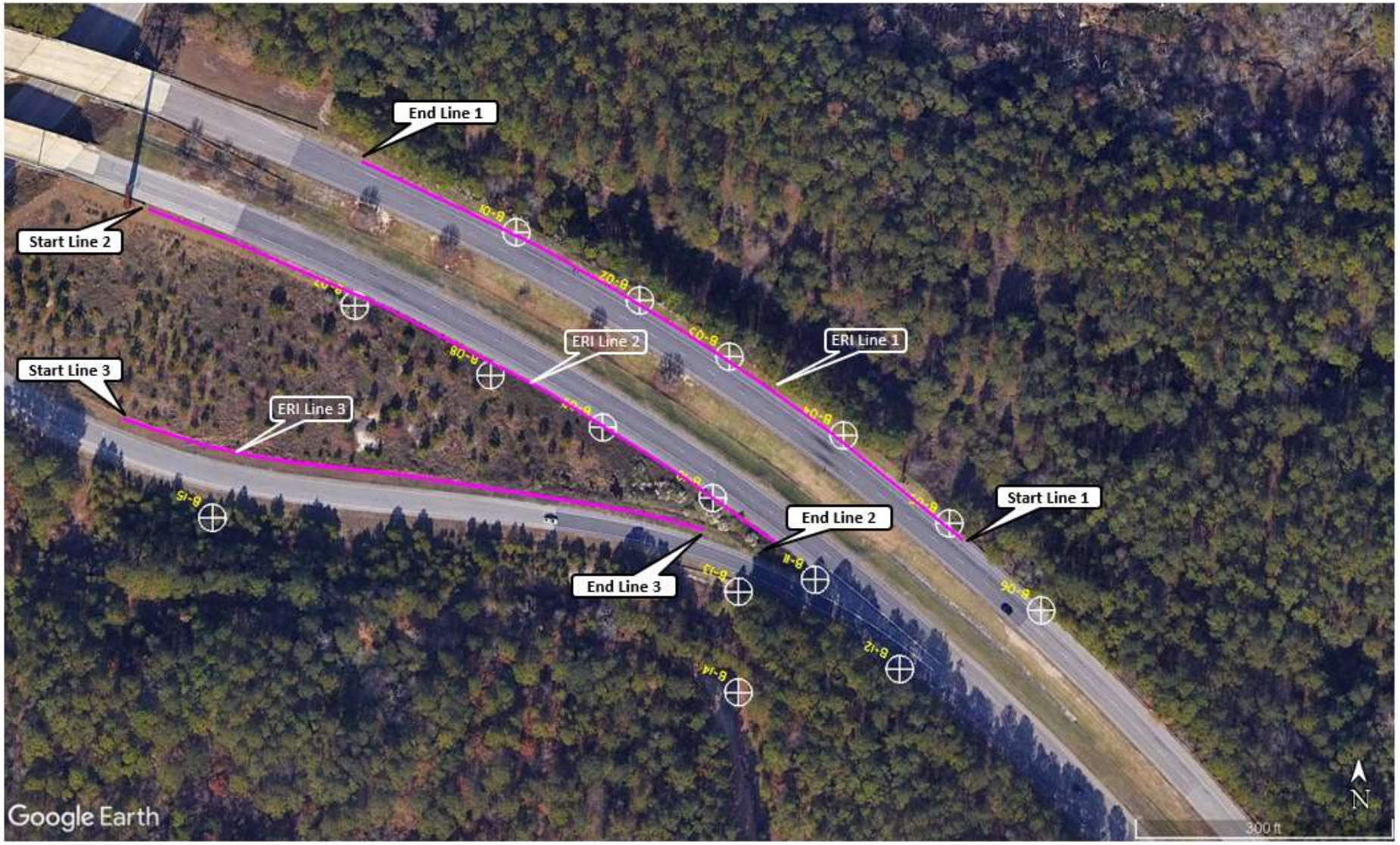
EM DATA COLLECTION

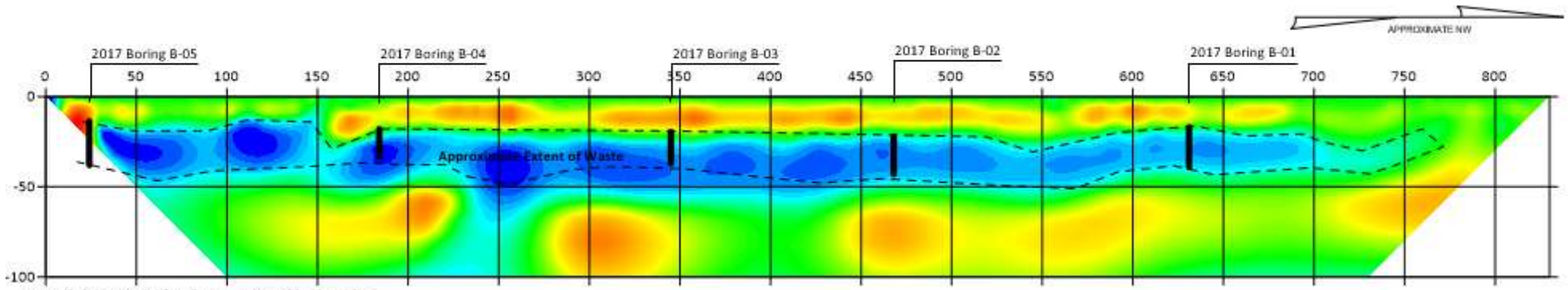
- Geophex GEM2 multi-frequency conductivity meter
- Carried by field person
- Real-time DGPS
- Approx. 10,000 linear feet of production data


Conductive response from buried waste
Area of low conductivity, possible gap in waste
5310 Hz Quadrature Response, millisiemens per meter
-1000
-940
-880
-820
-760
-700
-640
-580
-520
-460
-400
-340
-280
-220
-160
-100
-40
20
80
140
200
260
320
380
440
500
North Carolina State Plane Northing, Feet
504200
504100
504000
503900
503800
503700
503600
503500
503400
503300
503200
2003600
2003800
2004000
2004200
2004400
2004600
2004800
North Carolina State Plane Easting, Feet

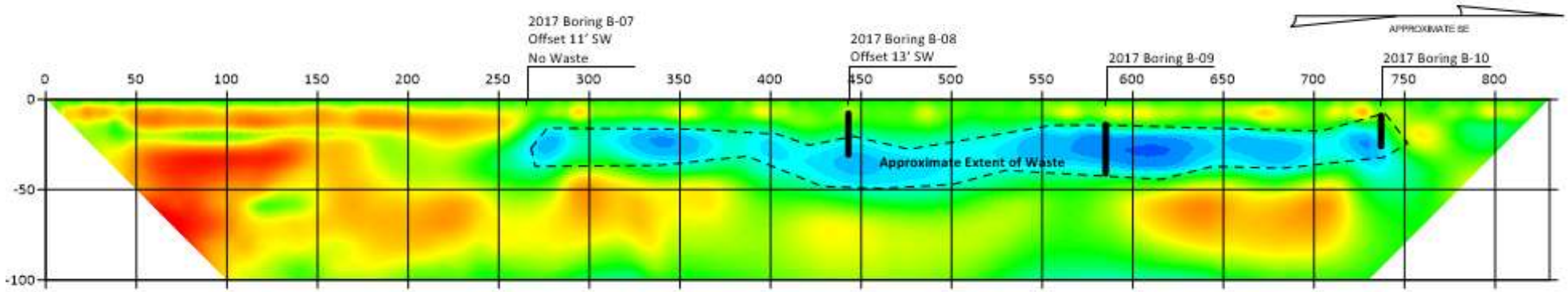
ERI/IP DATA COLLECTION

- AGI Supersting R8 with 56 electrodes spaced 10 feet apart
- DGPS of start and end of arrays
- Approx. 2300 linear feet of production data

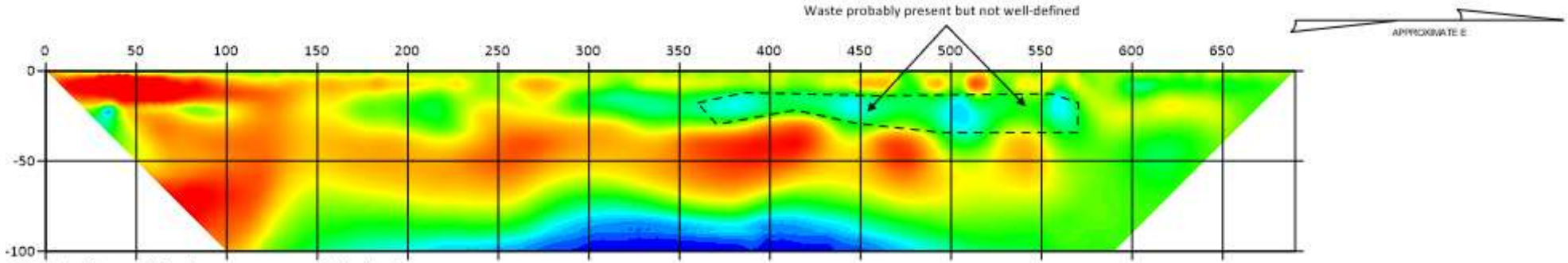

End Line 1
Start Line 2
Start Line 3
ERI Line 2
ERI Line 1
ERI Line 3
End Line 2
End Line 3
Start Line 1
B-01
B-02
B-03
B-04
B-05
B-06
B-08
B-11
B-12
B-13
B-14
B-15
Google Earth
N
300 ft
APPROXIMATE NORTH



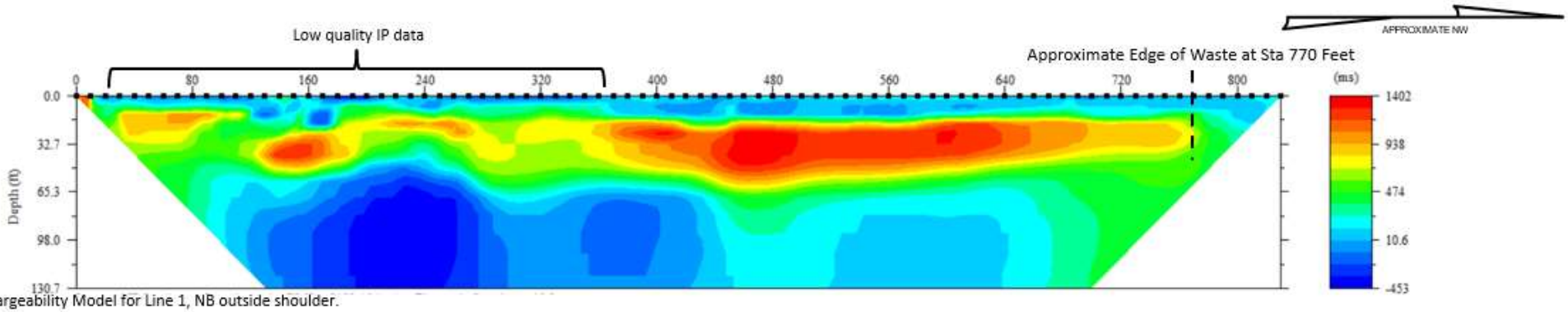
A. Resistivity Model for Line 1, NB outside shoulder.



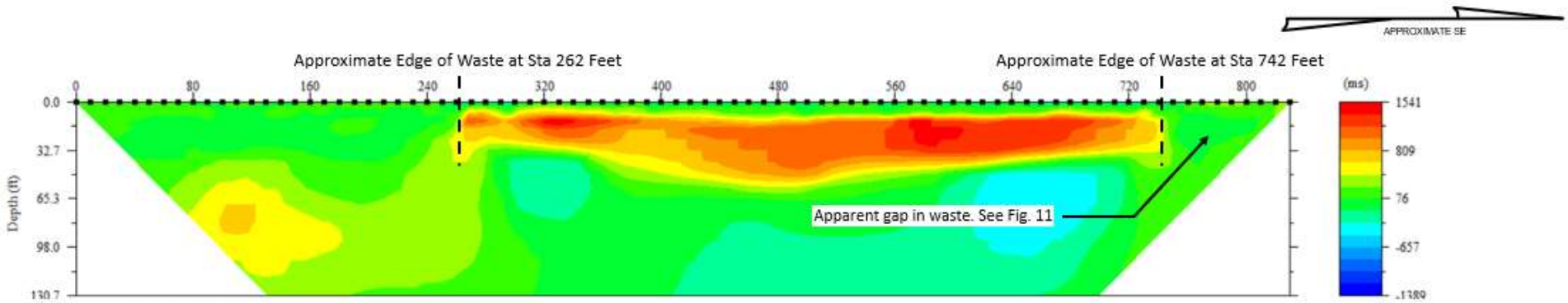
B. Resistivity Model for Line 2, SB outside shoulder.



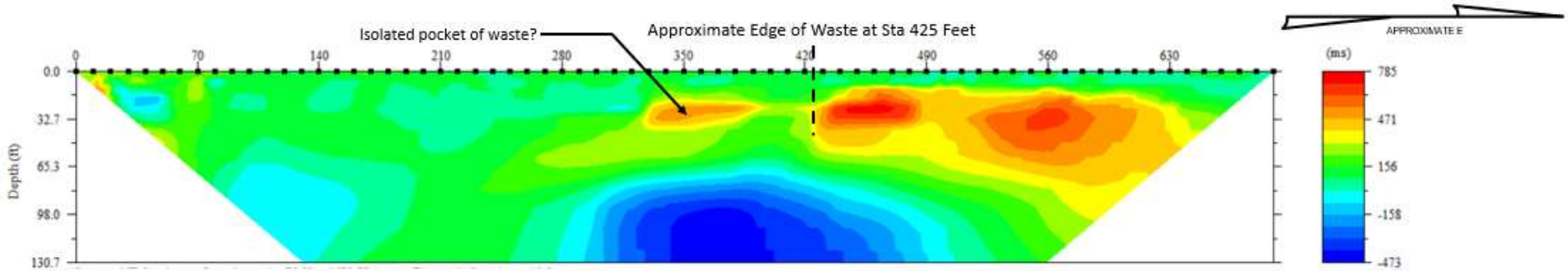
C. Resistivity Model for Line 3, SB on-ramp inside shoulder.



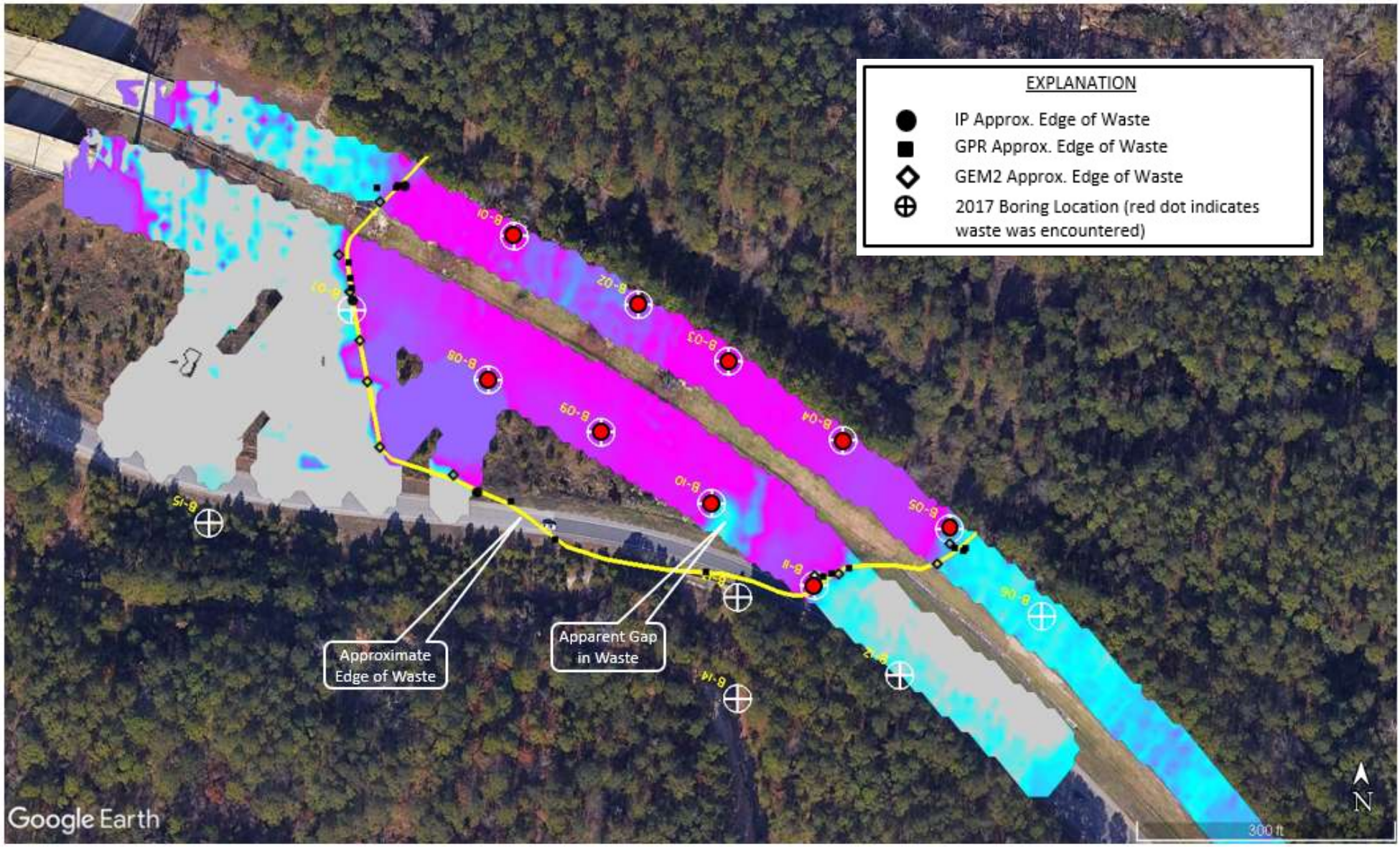
A. Chargeability Model for Line 1, NB outside shoulder.



B. Chargeability Model for Line 2, SB outside shoulder.



C. Chargeability Model for Line 3, SB on-ramp inside shoulder.


EXPLANATION
IP Approx. Edge of Waste
GPR Approx. Edge of Waste
GEM2 Approx. Edge of Waste
2017 Boring Location (red dot indicates waste was encountered)
B-01
B-02
B-03
B-04
B-05
B-06
B-07
B-08
B-09
B-10
B-11
B-12
B-13
B-14
B-15
Approximate Edge of Waste
Apparent Gap in Waste
Google Earth
N
300 ft

WASTE REMOVAL OPTION

- Approximate area of waste below combined footprint of travel lanes and on ramp: 4.4 acres
- Approximate average waste thickness: * 21 feet
- Estimated volume of waste beneath freeway embankment = 92 acre-feet
- Convert to cubic yards by multiplying by 1613 = 148,396 cy

WHAT ELSE COULD BE DONE?

- Collect 2D surface wave seismic data and develop shear wave velocity models for subsurface stiffness
- Predict areas where additional settlement likely to occur or use information to help design a dynamic compaction program.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