



Schnabel
ENGINEERING

Geophysical Surveys to Help Quantify the Impact of a Municipal Landfill on the Widening of US 64 in Dare County, NC

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Geo3T2 Conference

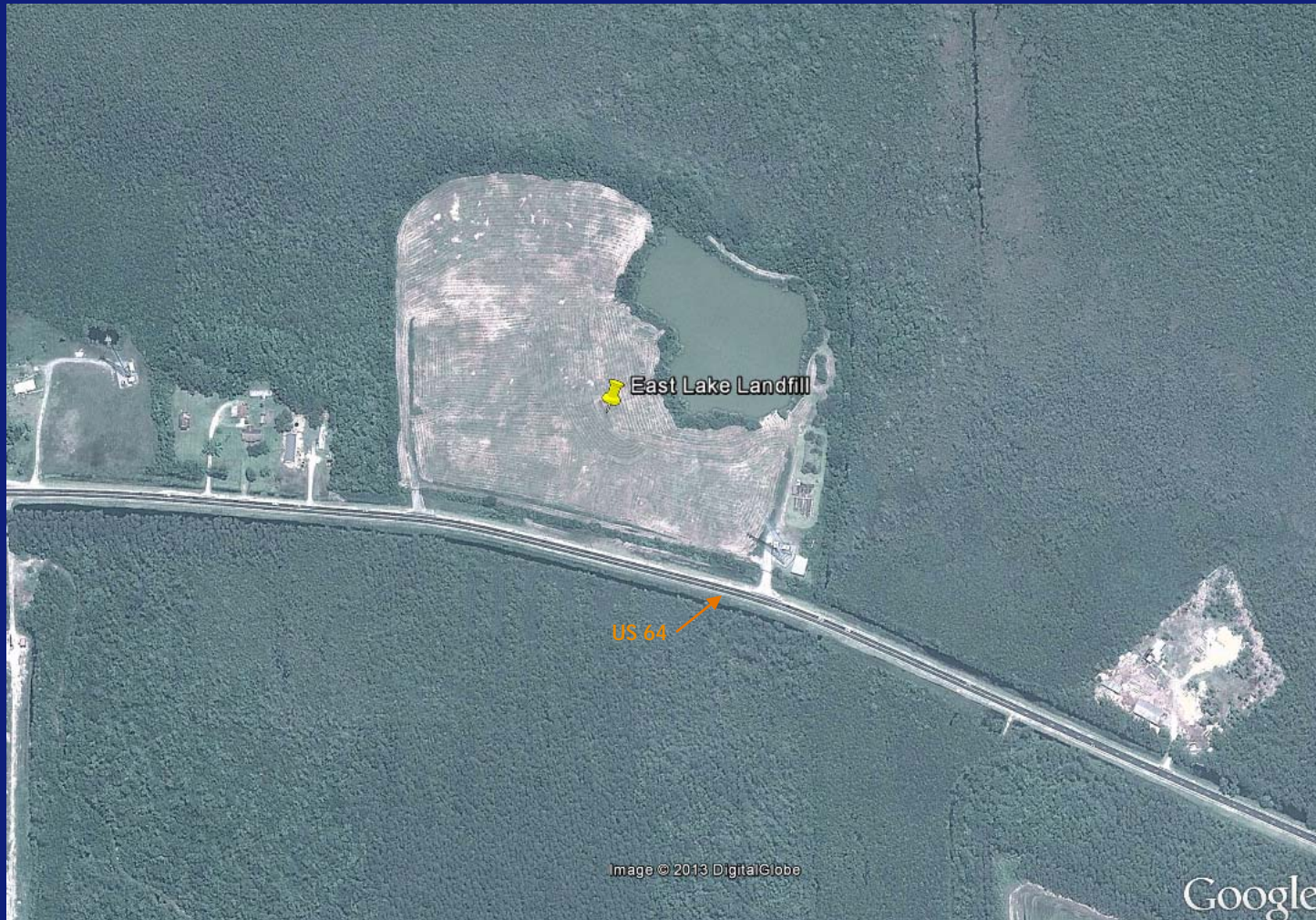
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Project Location: East Lake Landfill



Project Location : East Lake Landfill



East Lake Landfill & Project Plan

- East Lake Landfill
 - Originally unregulated landfill without a liner
 - Contains a cap comprised of non-layered soil and relatively low relief ($\pm 10'$)
- NCDOT Project R-2544
 - Proposed adding 2 lanes N of existing highway
 - ROW acquisition is necessary
 - Proposed controlled access will encroach onto the landfill

What Were the Project Goals?

- Evaluate the lateral extent of waste within the proposed controlled access
- Evaluate the volume of waste within the proposed controlled access
- Estimate the remediation cost of a north-south widening

EM31 Survey

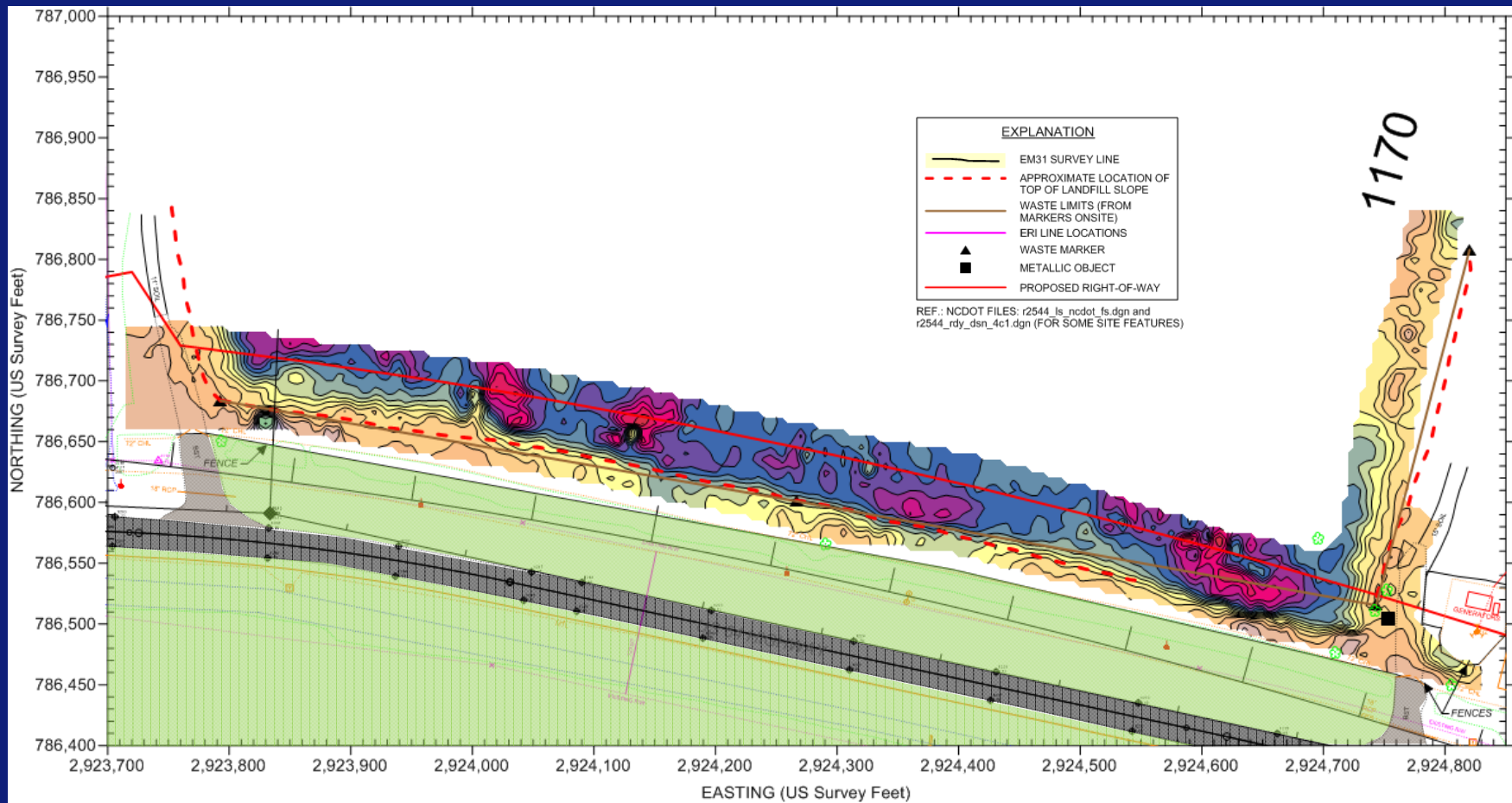
- Geonics EM31 Terrain Conductivity Meter with a Trimble GPS system
- Provides a conductivity response and a metal detection response



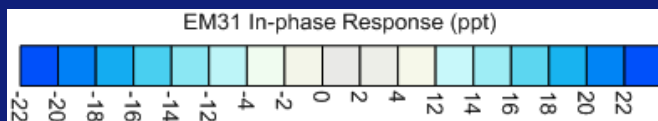
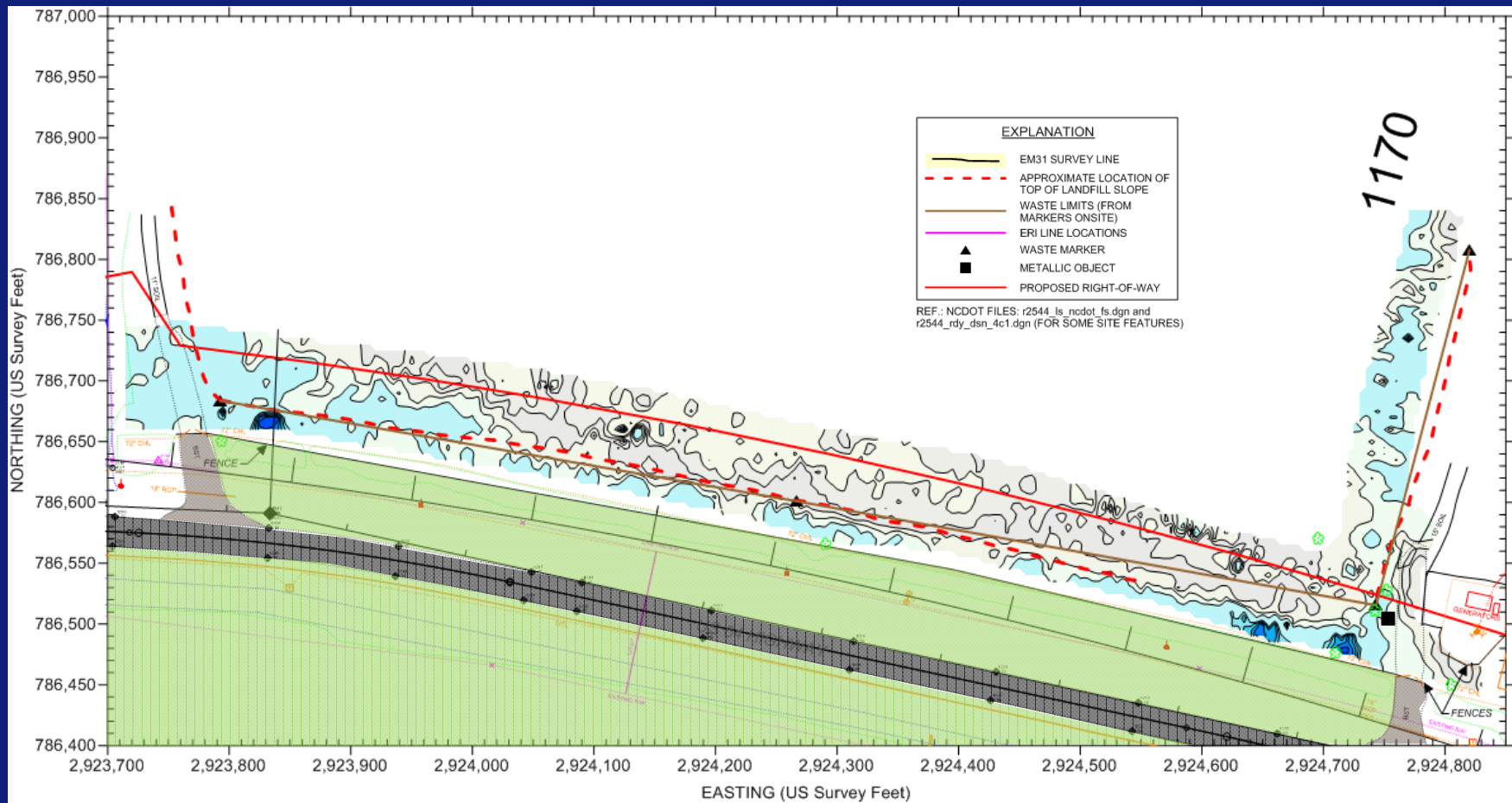
EM31 Application and Usefulness

- Maps geologic variations, groundwater contaminants, or any subsurface feature associated with changes in ground conductivity
- Allows data to be collected quickly in many environments
- Can measure small changes in conductivity precisely
- Can detect metallic objects well with the in-phase component

EM31 Conductivity Response

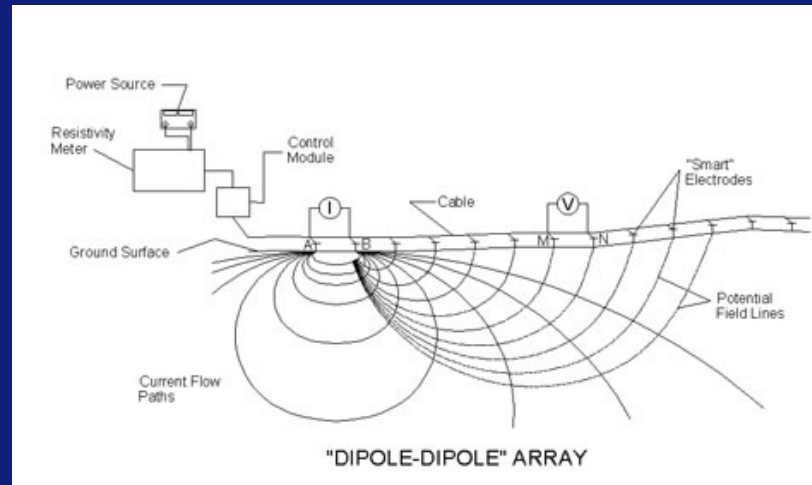


EM31 Metal Detection Response

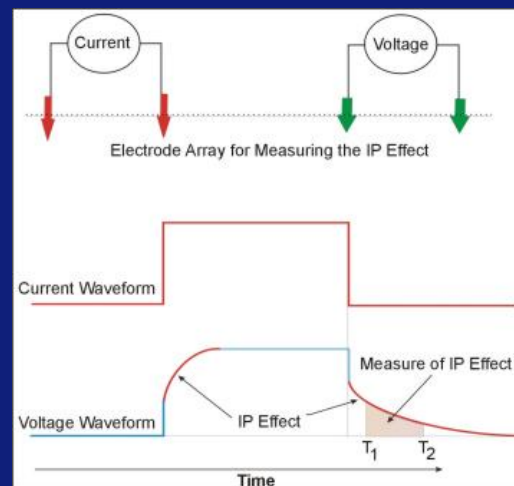


Electrical Resistivity/Induced Polarization

Electrical Resistivity Imaging

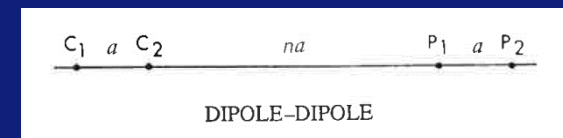


Induced Polarization

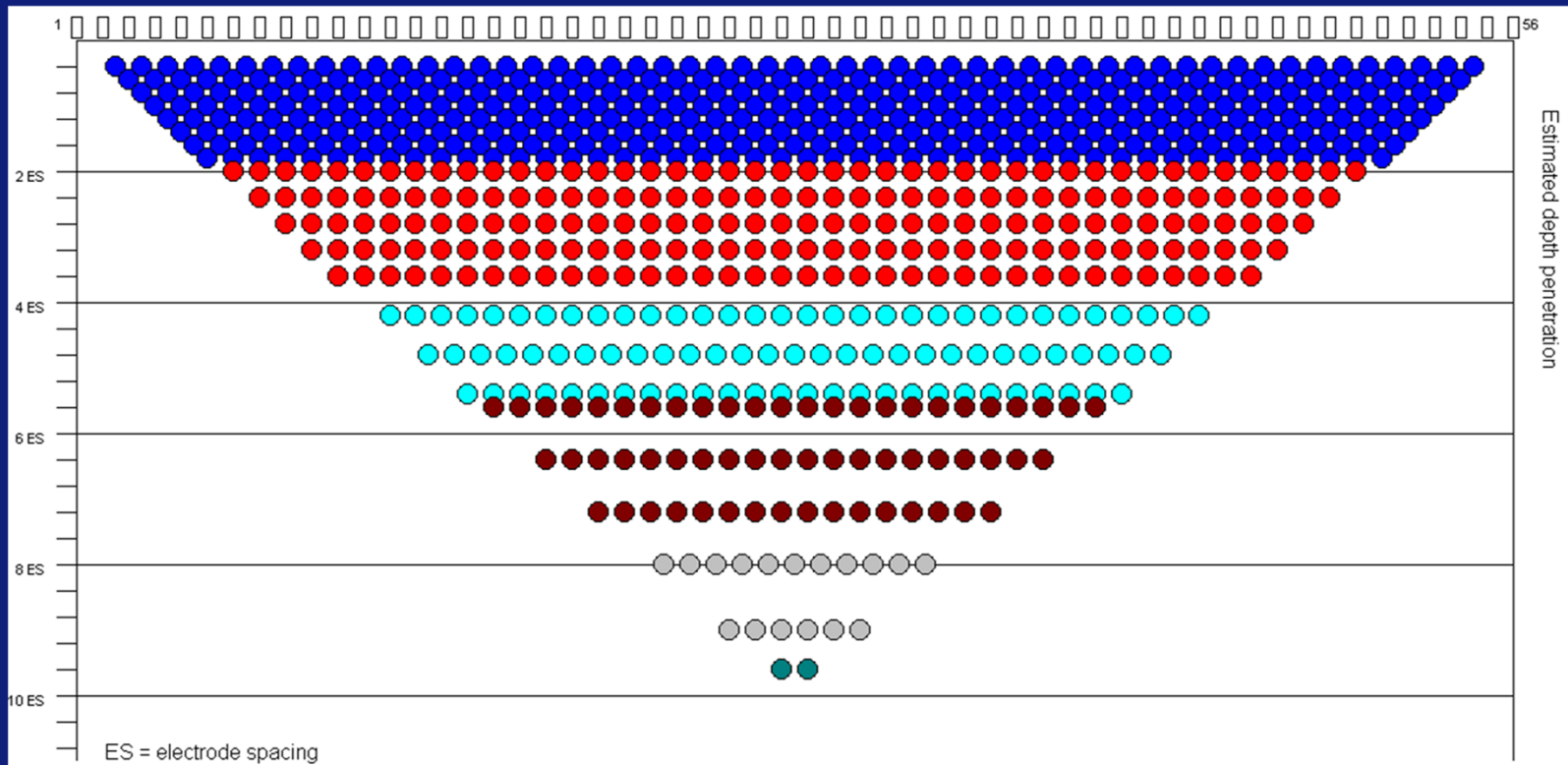


Electrical Resistivity/Induced Polarization

- AGI Supersting R8 instrument
- 56 electrodes, 2 meter spacing
- Dipole-dipole ERI/IP configuration



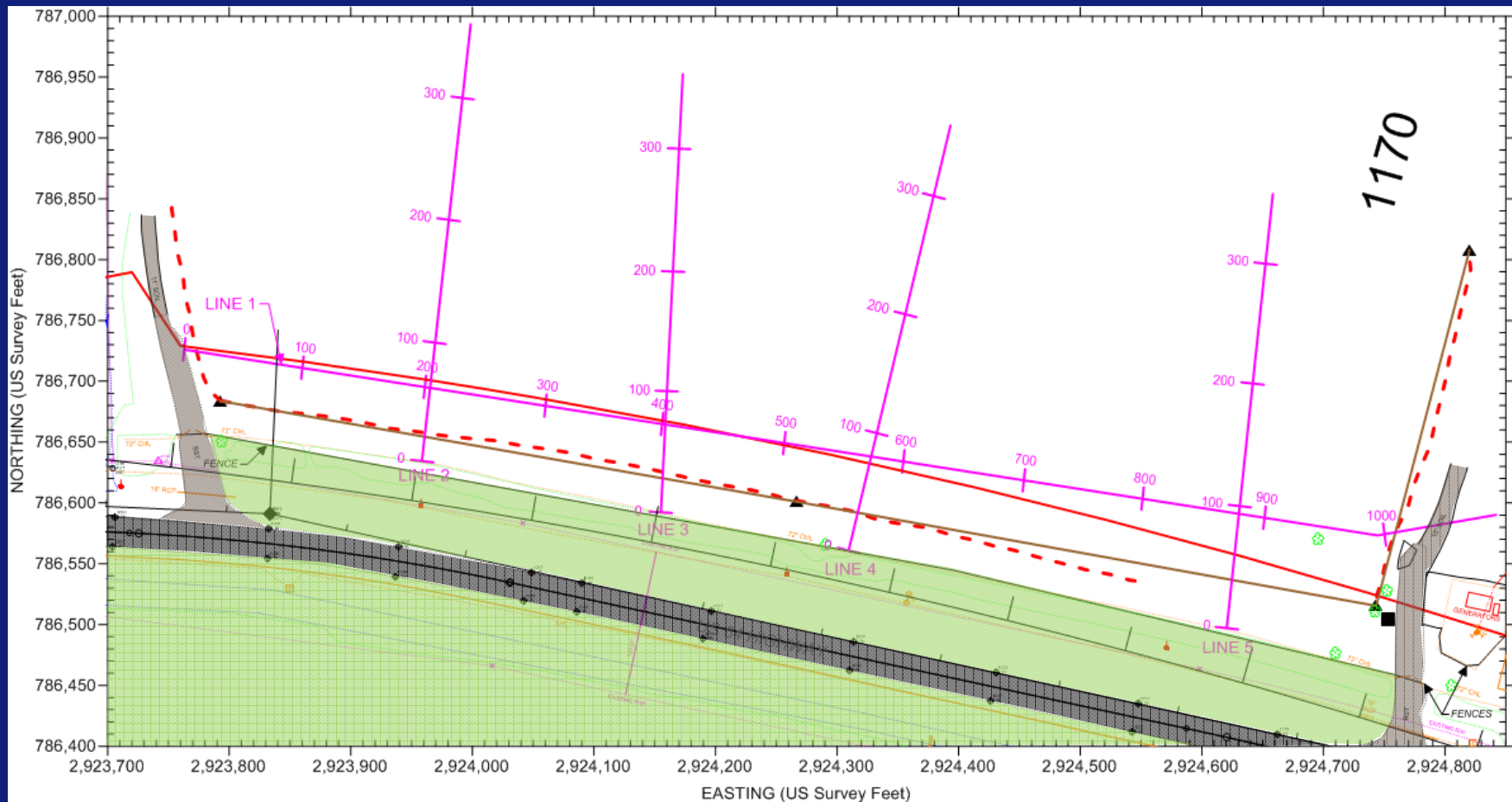
ERI/IP Data Sampling Schematic



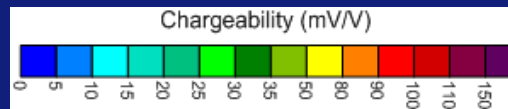
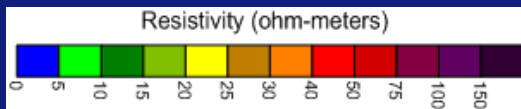
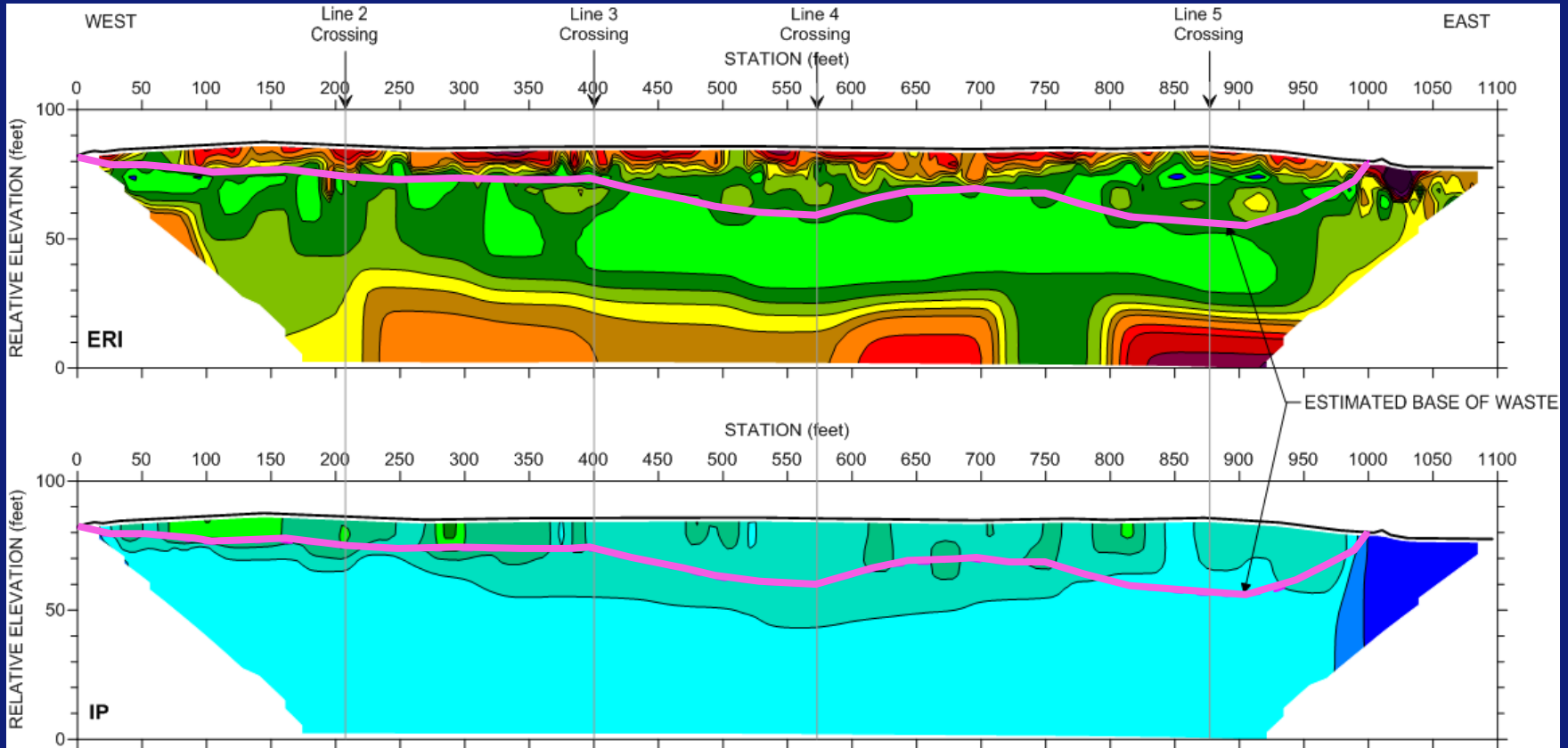
ERI/IP Advantages & Disadvantages

- Resistivity measurements affected by:
 - Changes in moisture content
 - Porosity
 - Dissolved solids in groundwater
- Induced Polarization
 - Less affected by subsurface changes in moisture content, etc.
 - Can often indicate the base of waste in landfills more accurately

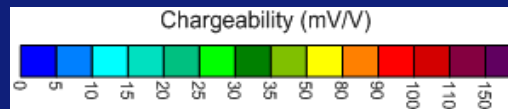
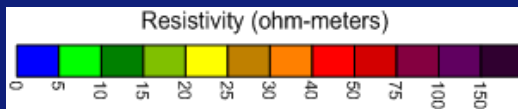
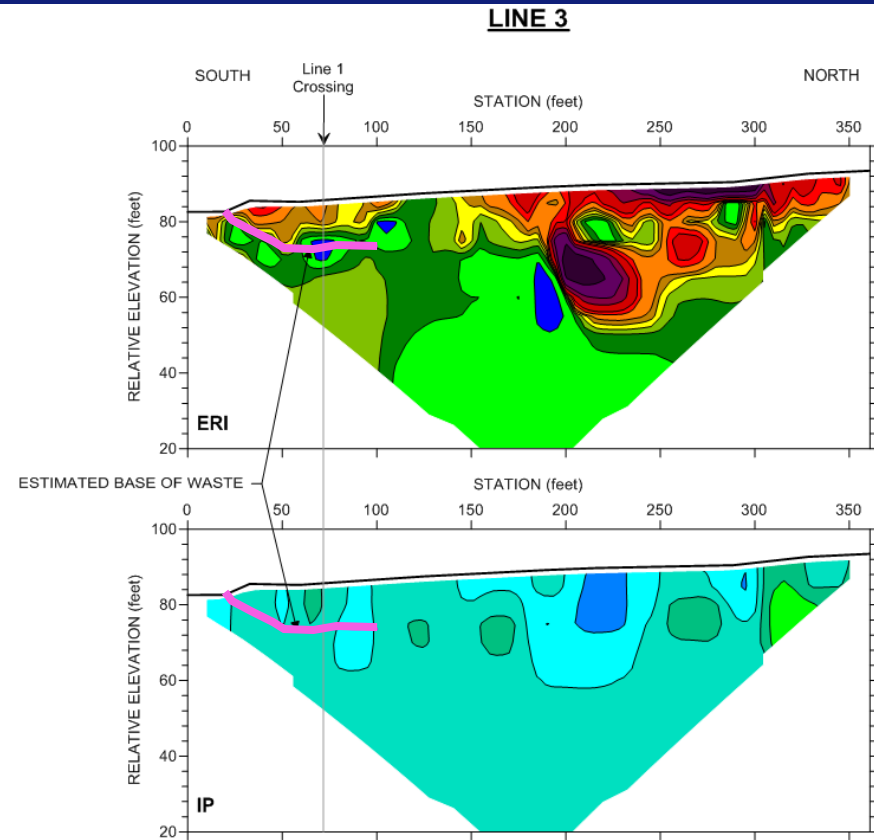
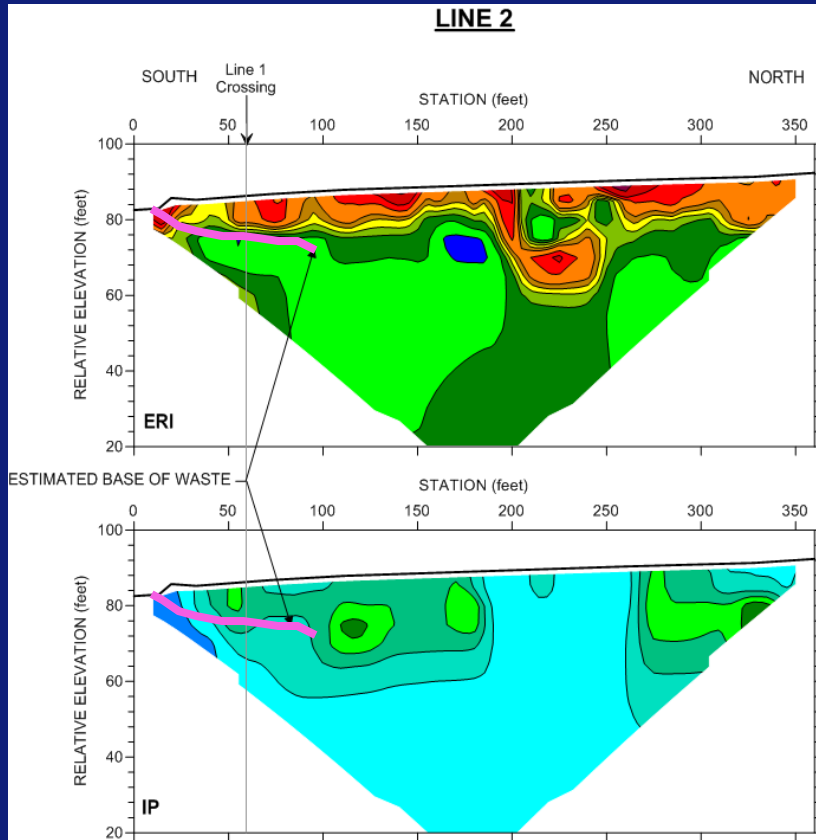
Electrical Resistivity/Induced Polarization



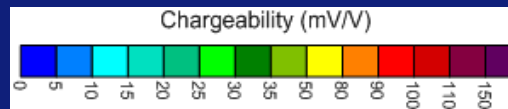
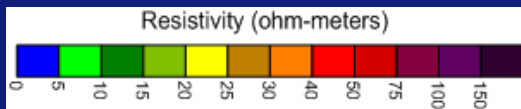
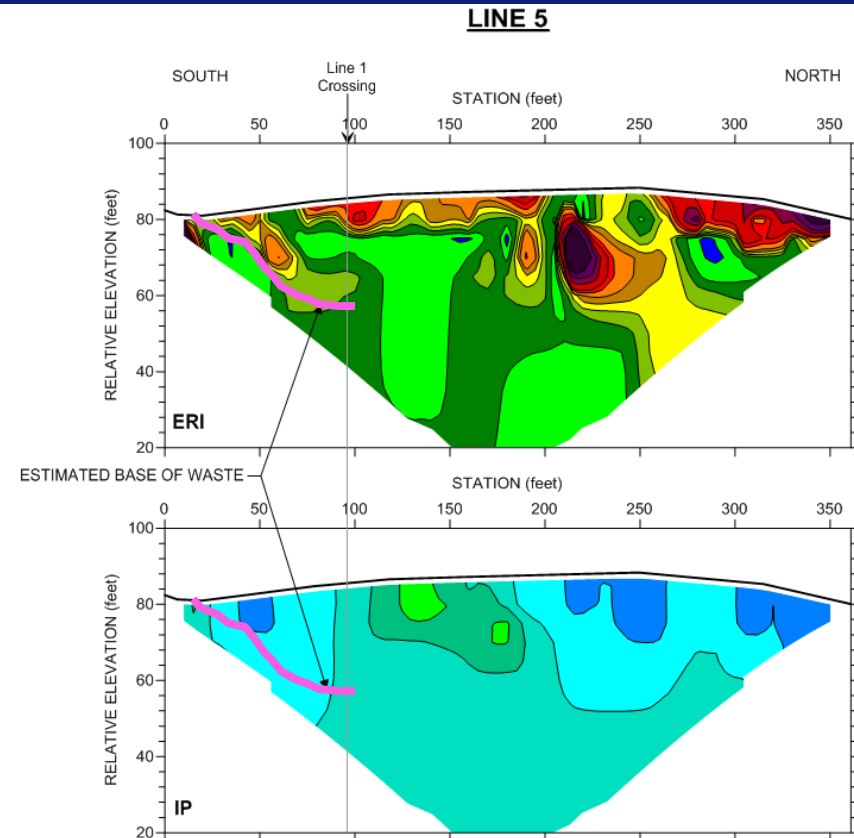
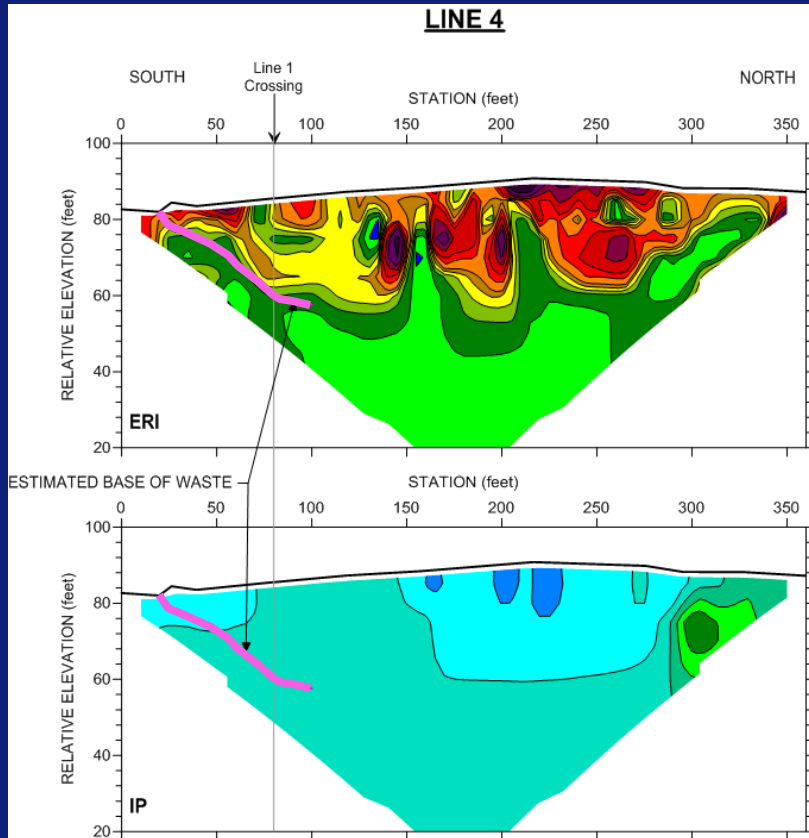
ERI/IP Line 1



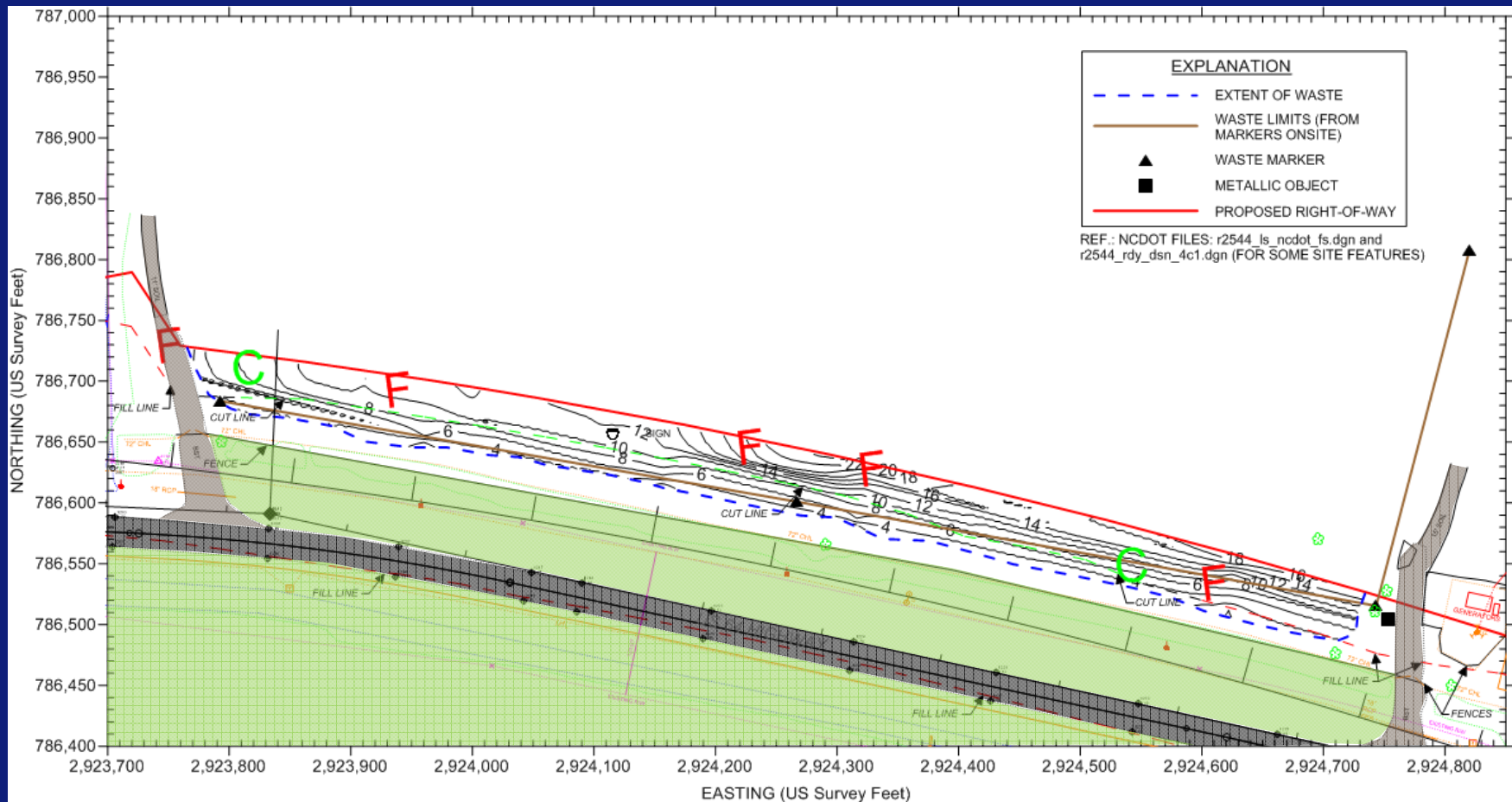
ERI/IP Lines 2 and 3



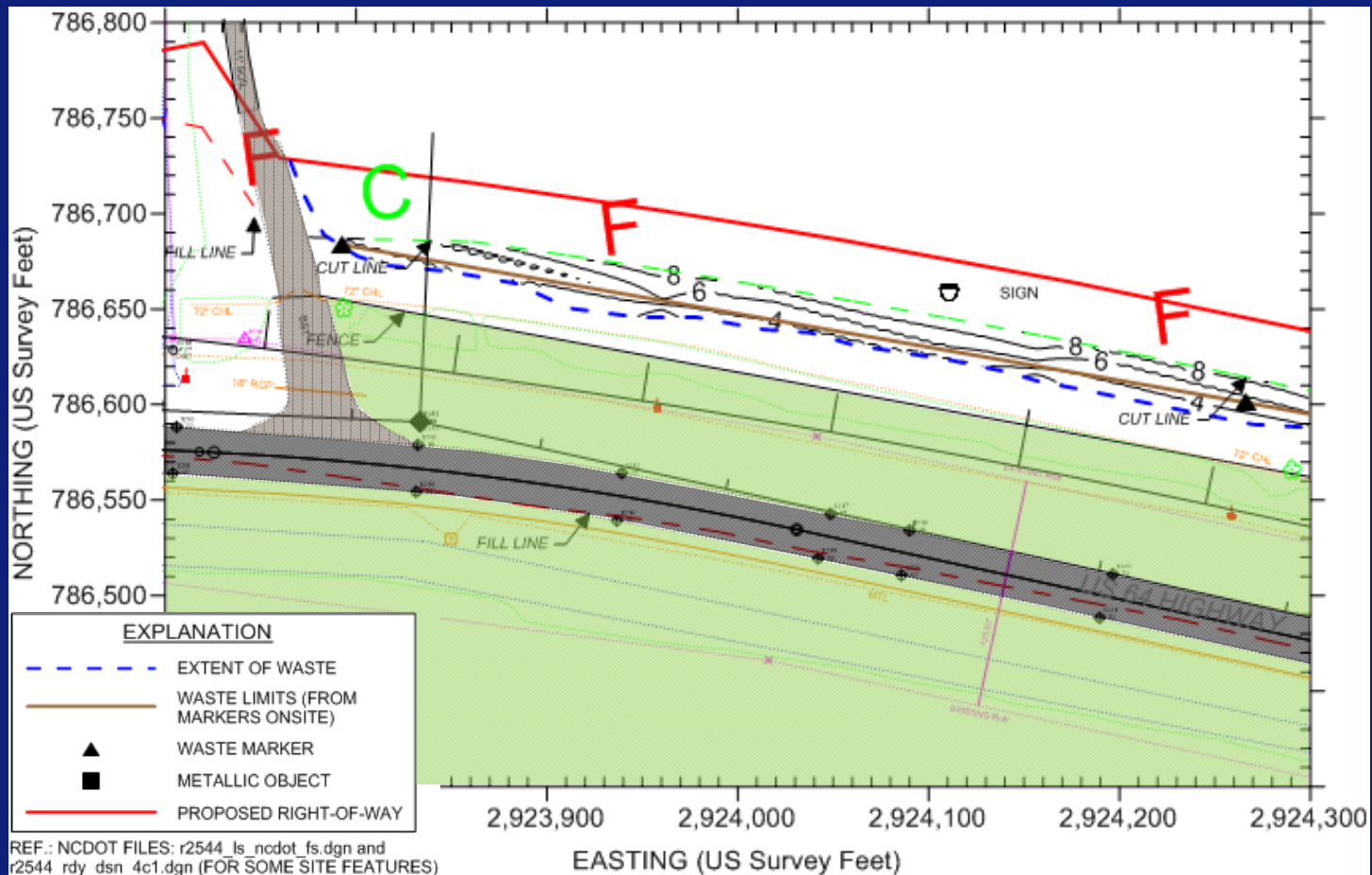
ERI/IP Lines 4 and 5



Extent and Thickness of Waste Contours



Extent and Thickness of Waste Contours



Remediation Costs (3 Options)

We calculated waste volumes and requested remediation estimates:

Option 1

3,000 cubic yards

Slope Stake Area

\$0.5-\$0.7 million

Option 2

17,150 cubic yards

Controlled Access Area

\$2.5-\$3.7 million

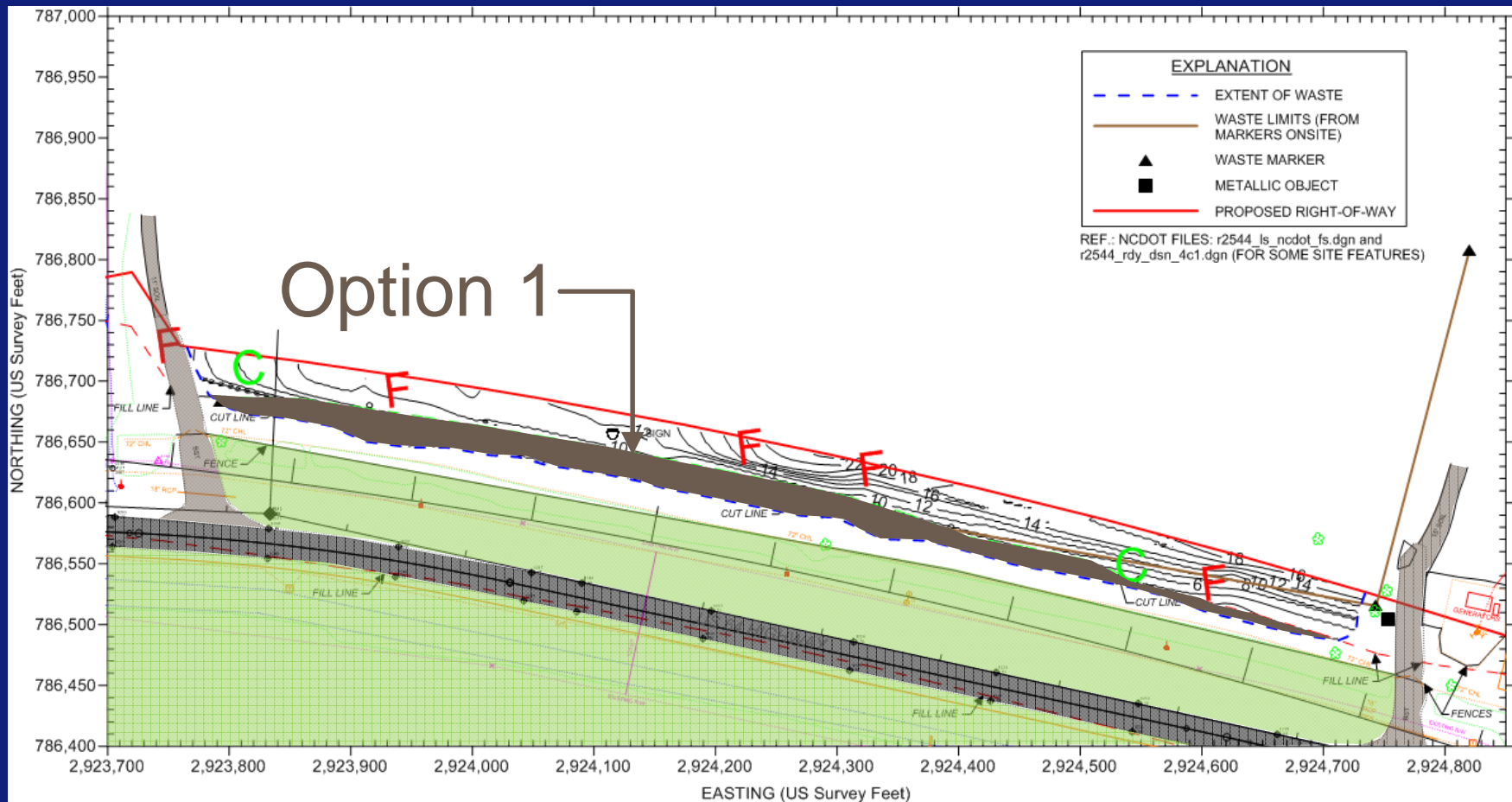
Option 3

39,350 cubic yards (sloped)

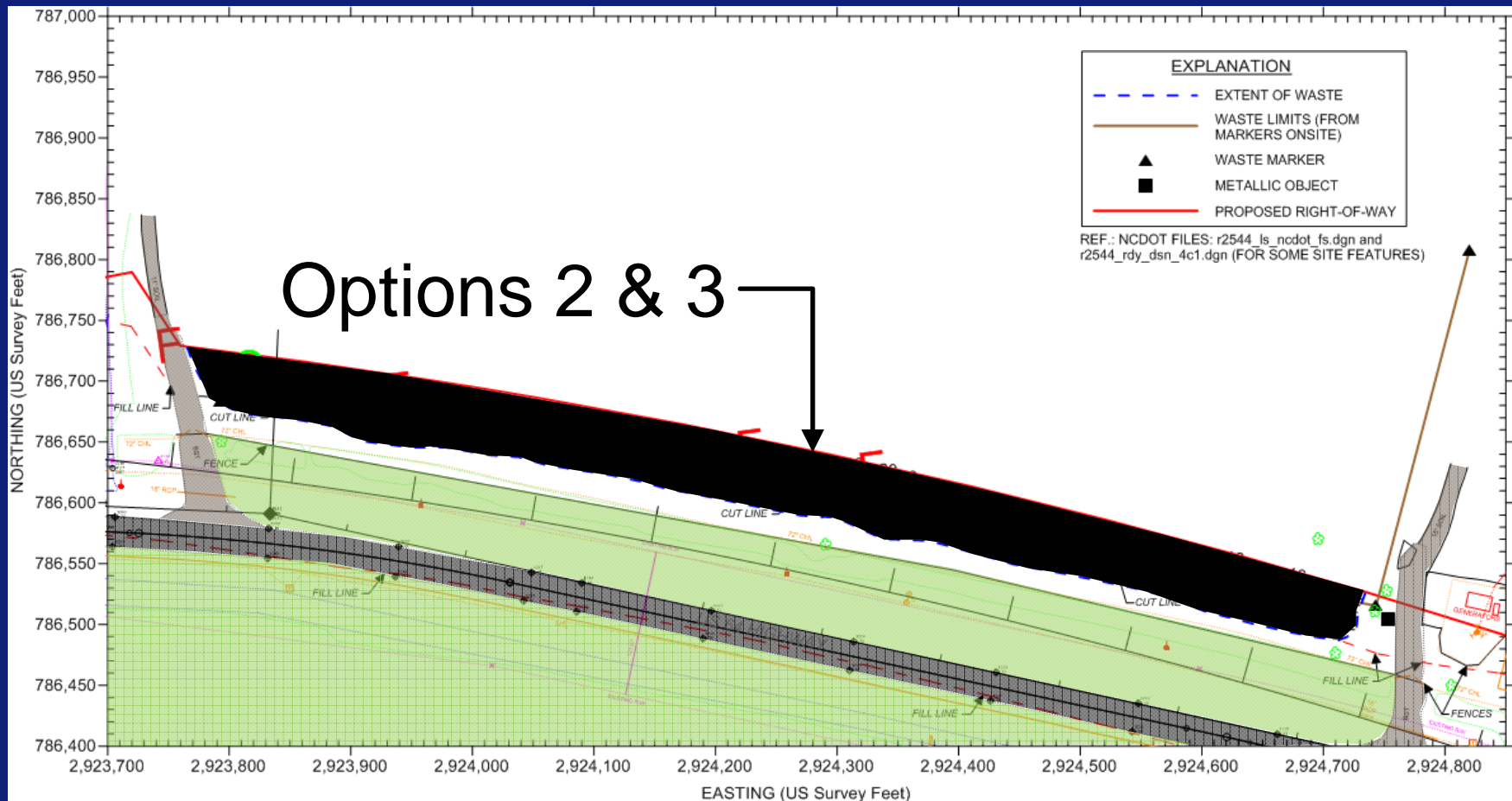
Controlled Access Area

\$6.0-\$8.6 million

Study Areas: Option 1



Study Areas: Options 2 & 3



Alternatives Comparison

Impact Category		Section 5-3		
		North Side	South Side	Best Fit/ Hybrid
Total Cost (in Millions)		\$14.8 to 16.8 (including landfill costs) ¹	\$10.5	\$8.5
Community	Neighborhood Disturbance	3 of 6 homes in this cluster would be relocated. It is difficult to relocate homes nearby.	2 of 6 homes in this cluster would be relocated. It is difficult to relocate homes nearby.	None
	Likely Environmental Justice Impact (Disproportionately High and Adverse)	Yes, half the homes in this cluster would need to be relocated.	Yes, one third of the homes in this cluster would need to be relocated.	
	Relocations			
	Residence	3	2	None
	Cemetery	1		1
	Other	1 cell tower, 1 shed		None
Alligator River National Wildlife Refuge		1.69	1.51	2.91
Natural Resources (Acres)	Canal Relocation (Linear Feet)		5,400.00	2,700.00
	Coastal Wetlands		0.04	
	Total CAMA Resources	1.54	13.31	6.57
	Total Jurisdictional Wetlands (Acres)	7.18	11.90	9.84
	Other Natural Resource Impacts		Reduction of 400' tree buffer protecting ARNWR-managed farmland	Reduction of 400' tree buffer protecting ARNWR-managed farmland

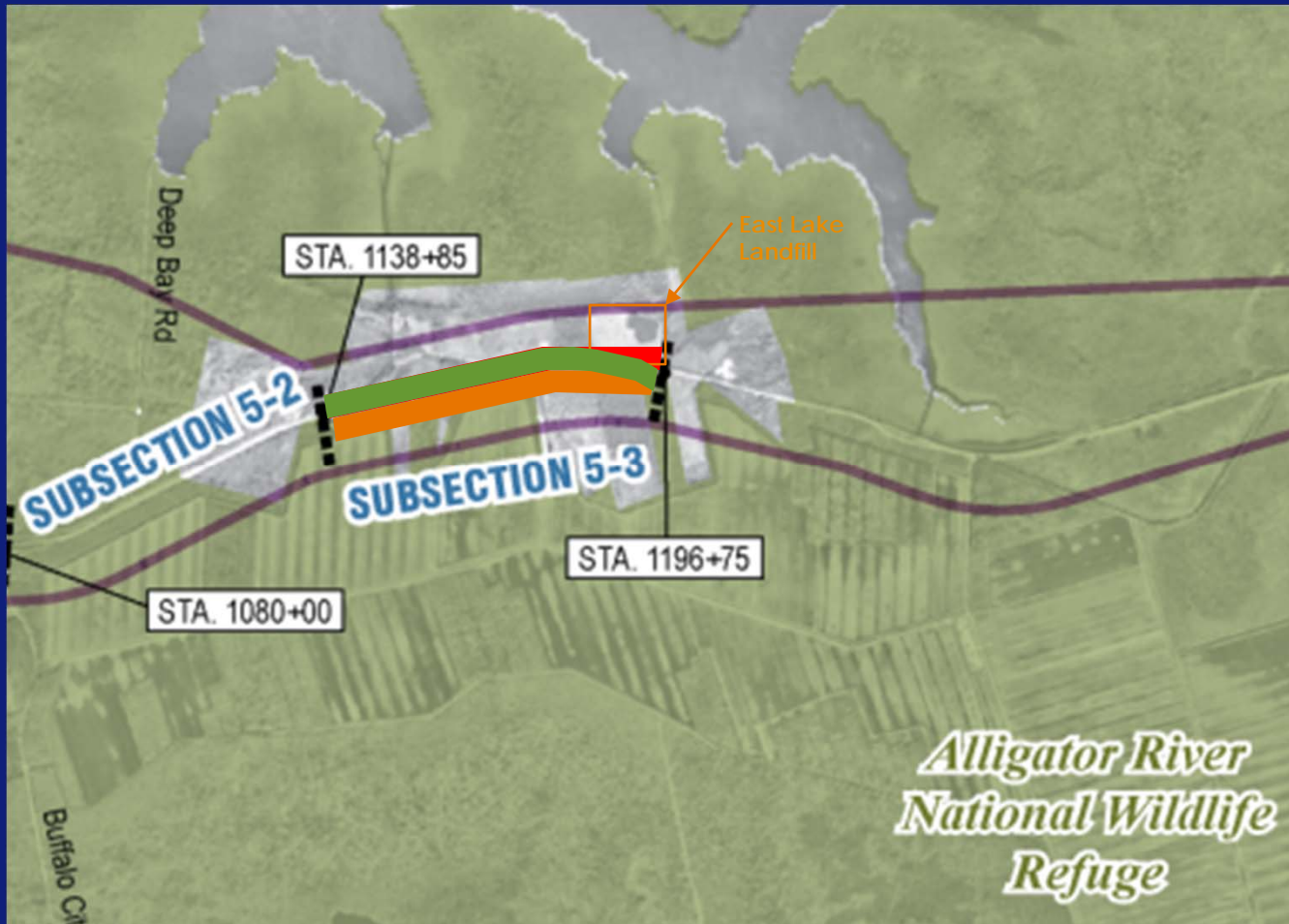
¹ A geophysical survey concluded that the edge of the landfill waste lies within the proposed right-of-way for the North-Side Widening. The estimated cost for the excavation and offsite disposal is \$6 to \$8 million.

Benefits of Geophysical Surveys

Schnabel helped the DOT evaluate design options and make a decision:

- Avoids the landfill waste
- Avoids residences and cell tower
- Limits canal relocation/wetland impact
- Limits construction costs

Project Subsection 5-3 (1.09 miles)



Reference: From NCDOT

East Lake Landfill and Vicinity



Summary/Conclusions

EM31 surveys are useful for evaluating the extent of waste.

ERI/IP surveys are useful for evaluating waste extent and volume.

Waste volume calculations allowed remediation cost estimating.

The possible remediation costs helped the DOT create alternatives.

The final design avoids the waste and limits construction costs.

Acknowledgments

Coauthors

Schnabel Engineering

NCDOT



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Questions & Discussion

