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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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 (±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 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

ES = electrode spacing
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
We calculated waste volumes and requested remediation estimates:

<table>
<thead>
<tr>
<th></th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>3,000 cubic yards</td>
<td>17,150 cubic yards</td>
<td>39,350 cubic yards (sloped)</td>
</tr>
<tr>
<td>Stake</td>
<td>Slope Stake Area</td>
<td>Controlled Access Area</td>
<td>Controlled Access Area</td>
</tr>
<tr>
<td>Cost</td>
<td>$0.5-$0.7 million</td>
<td>$2.5-$3.7 million</td>
<td>$6.0-$8.6 million</td>
</tr>
</tbody>
</table>
Study Areas: Option 1
Study Areas: Options 2 & 3
Alternatives Comparison

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>North Side</th>
<th>South Side</th>
<th>Best Fit</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cost (in Millions)</td>
<td>$14.8-16.8</td>
<td>$10.5</td>
<td>$6.5</td>
<td></td>
</tr>
<tr>
<td>Neighborhood Disturbance</td>
<td>1 cell tower, 1 shed</td>
<td>2 of 6 homes in this cluster would be relocated. It is difficult to relocate homes nearby.</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Likely Environmental Justice Impact</td>
<td>Yes, half the homes in this cluster would need to be relocated.</td>
<td>Yes, one third of the homes in this cluster would need to be relocated.</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Residence</td>
<td>3</td>
<td>2</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Cemetery</td>
<td>1</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1 cell tower, 1 shed</td>
<td>3 of 6 homes in this cluster would be relocated. It is difficult to relocate homes nearby.</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Alligator River National Wildlife Refuge</td>
<td>1.69</td>
<td>1.51</td>
<td>2.91</td>
<td></td>
</tr>
<tr>
<td>Canal Relocation (Linear Feet)</td>
<td>5,400.00</td>
<td>0.04</td>
<td>2,700.00</td>
<td></td>
</tr>
<tr>
<td>Coastal Wetlands</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Total CAMA Resources</td>
<td>1.54</td>
<td>13.31</td>
<td>6.57</td>
<td></td>
</tr>
<tr>
<td>Total Jurisdictional Wetlands (Acres)</td>
<td>7.18</td>
<td>11.90</td>
<td>9.84</td>
<td></td>
</tr>
<tr>
<td>Other Natural Resource Impacts</td>
<td>Reduction of 400’ tree buffer protecting ARNWR-managed farmland</td>
<td>Reduction of 400’ tree buffer protecting ARNWR-managed farmland</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

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.

Reference: From NCDOT
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.
Questions & Discussion