GEL Engineering of NC INC

an affiliate of The GEL Group INC

GEOPHYSICAL INVESTIGATION REPORT

Intersection of NC 87 Bypass and US 701
Bladen County Landfill
State Project R-4903
WBS Element # 40224.1.1
Bladen County

North Carolina Department of Transportation
Geotechnical Engineering Unit
1589 Mail Service Center
Raleigh, North Carolina 27699-1589

August 15, 2012

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Signature Page

This document, entitled "Geophysical Investigation Report," has been prepared for portions of Bladen County Landfill and areas adjacent to NC 87 Bypass near and east of the intersection of NC 87 Bypass and US Hwy. 701 located in Bladen County, North Carolina (State Project R-4903, WBS Element # 40224.1.1). It has been prepared by GEL Engineering of NC, Inc. in accordance with the Notice to Proceed provided by the North Carolina Department of Transportation-GeoEnvironmental Section, Geotechnical Engineering Unit for the exclusive use of the North Carolina Department of Transportation. It has been prepared in accordance with accepted quality control practices and has been reviewed by the undersigned.

GEL ENGINEERING OF NC, INC.
an Affiliate of The GEL Group, Inc.

NORTH CAROLINA LICENSED GEOLOGIST SEAL 1682 ANDREW D. EYER

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08-15-12
Date

GEOPHYSICAL INVESTIGATION REPORT

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Executive Summary

At the request of the North Carolina Department of Transportation (NCDOT), GEL Engineering of NC, Inc. (GEL) conducted a geophysical investigation at the closed Bladen County Landfill in Bladen County, North Carolina, to determine the lateral and vertical extent of landfilled waste within an area of interest in which NCDOT has proposed the alignment of a westbound off ramp for NC 87 Bypass. The investigation was conducted July 2 – 6, 2012, and included the deployment of a CMD-4 electromagnetic ground conductivity and magnetic susceptibility instrument, and SuperSting R8 electric resistivity and induced polarization imaging (ERI/IP) instruments.

The results of the geophysical investigation have provided reliable data that enabled GEL to delineate the lateral and vertical extent of the landfilled waste located within the area of interest, as presented in Figures 9-16 of this report. The data support historical documentation that describes the location and type of waste landfilled (flyash).

Figures 9-16 indicate that portions of the northernmost NCDOT proposed off ramp alignment (Option No. 1 shown in Figure 3) are located within a delineated area of landfilled flyash, as shown in Figure 13. Portions of the southernmost NCDOT proposed off ramp alignment (Option No. 2 shown in Figure 3) appear to be located within the delineated "trench" of landfilled flyash within the NC 87 Bypass ROW, as shown in Figure 13. Therefore, neither proposed alignment may be preferred by NCDOT due to the presence of underlying flyash. However, it is recommended that an alternate off ramp alignment located between the Option No. 1 and Option No. 2 proposed alignments be considered by NCDOT since that area appears to be devoid of landfilled waste, based on the results of the geophysical investigation.

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1.0 Introduction

This document presents the details of a geophysical survey performed within the right-of-way (ROW) of NC 87 Bypass east of US 701 and within a portion of the closed Bladen County Landfill on the north side of NC 87 Bypass. The North Carolina Department of Transportation (NCDOT) has proposed the construction of an off ramp for the westbound lanes of NC Hwy 87 Bypass that would be located immediately adjacent to the closed Bladen County Landfill, which is located on the north side of the Bypass.

The site location is shown on Figure 1, an excerpt from the United States Geological Survey (USGS) 7.5-minute quadrangle map of Elizabethtown South, North Carolina. The geophysical survey was conducted by GEL Engineering of NC, Inc. (GEL) in accordance with the Notice to Proceed issued by NCDOT on June 27, 2012.

The primary purpose of this investigation was to evaluate the vertical and lateral extent of landfill waste within the area of interest shown in Figure 2, especially in the vicinity of the proposed location of the NC 87 Bypass off ramp alignment. Figure 3 shows NCDOT's two original off ramp alignment options for the Bypass.

2.0 Background

GEL conducted research to evaluate the historical development, use, and closure of the Bladen County Landfill, the planning and construction of NC 87 Bypass adjacent to the landfill, and the interaction between the landfill operations and the construction of NC 87 Bypass. Copies of files obtained from the North Carolina Department of Environment and Natural Resources (NCDENR) and NCDOT, Division 6. In addition, GEL interviewed personnel from NCDOT, Division 6, Bladen County Solid Waste Department, and Richardson Smith Gardner, Bladen County's environmental consultant that currently performs postclosure monitoring for the closed Bladen County Landfill.

Bladen County Landfill operated as a municipal solid waste landfill (MSWLF) under North Carolina Department of Environment, Health and Natural Resources (DEHNR) Permit 09-01, which was issued on February 23, 1981. It was closed in 1994 and replaced by a municipal waste transfer station, which is located adjacent to the northeast portion of the closed landfill, on Mercer Mill Road. Based on 1994 NCDENR landfill inspection reports, the planned final cover for the landfill consisted of 18 inches of clay and 6 inches of topsoil.

Figure 4 shows the total area of the landfill property as of 1989, and includes the proposed 300-foot wide ROW for NC 87 Bypass. Based on Bladen County Solid Waste Department Records, the southern portion of the landfill located immediately north of the proposed ROW for NC 87 Bypass was used as a monofill to landfill flyash received from a Cogentrix plant located in the Elizabethtown area. This was confirmed by our discussion with Bladen County Solid Waste personnel that were working at the landfill prior to its closure. The flyash was landfilled during the late 1980s. Figure 5 is excerpt from aerial imagery obtained from NCDOT that shows flyash landfilling operations near what is believed to be the southern terminus of the primary flyash disposal area, immediately north of the proposed NC 87 Bypass ROW. A separate cell within the southerly portion of the landfill was also used for landfilling the flyash, as shown in Figure 4. The location of this cell appears to correspond with the location of the flyash "trench" described below.

NC 87 Bypass was constructed through the Bladen County Landfill property in the 1990s (NCDOT Project 8.1420501, R-0522). The Bypass 300-foot wide ROW is shown in Figure 4. As described in NCDOT's interoffice memorandum dated March 22, 1990 an approximately 115-foot wide, 20-foot deep trench of landfilled flyash oriented northwest-southeast was identified within the proposed ROW for the Bypass between -L-line station 288 + 10 to -L- line station 289 + 25, as shown in Figure 6. NCDOT's records indicate that the trench represents the only Bladen County Landfill material located within the Bypass ROW. NCDOT's design for the Bypass specified undercutting the flyash trench during construction, as shown in Figure 7.

No documentation was found regarding landfilling operations that occurred in the southernmost portion of the Bladen County Landfill, on the south side of the NC 87 Bypass. Field reconnaissance of that portion of the closed landfill indicated the presence of centrally located large mound that is assumed to contain landfilled waste (see Photograph 1 in Appendix I). Small patches of household waste, including roof shingles, were observed bleeding through the surface of the mound during our inspection.

Acceptance of waste at the Bladen County Landfill was discontinued in 1994, and it was reportedly closed by grading a 24-inch thick clay and topsoil cover over the remaining landfilled waste. The closed landfill is separated by NC 87 Bypass, as shown in Figure 2. Documentation from NCDOT and NCDENR files indicates that there is no landfilled waste located within the NC 87 Bypass ROW with the exception of the trench of landfilled flyash described above, which was undercut by NCDOT during the construction of the Bypass. The apparent southerly extent of landfilled waste (reportedly flyash) on the north side of the NC 87 Bypass ROW is represented by the east-west trending slope shown in Photograph 2.

An area of apparent separation between two closed landfill cells (and apparently devoid of landfilled waste) located in the portion of the landfill on the north side of NC 87 Bypass is represented by an east-west trending drainage swale that was observed during our field reconnaissance, and is shown in Photographs 3 and 4.

3.0 Local Geology and Surroundings

The Bladen County Landfill is located in a relatively undeveloped area of Bladen County, approximately 1.5 miles south of the center of Elizabethtown, North Carolina. Surrounding land uses include mostly agricultural and commercial activities.

This area is located in the Coastal Plain physiographic province of North Carolina. The area of interest in the vicinity of the Bladen County Landfill is typified by Cretaceous prodelta and delta front deposits of the Black Creek and Peedee Formations, which typically consist of marine sand, lignitic sand, and clay. The land surface is nearly level and gently sloping, and contains well drained to poorly drained soils.

The United States Department of Agriculture's *Web Soil Survey* (2012) (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx) maps the native soil in the area of interest within the closed Bladen County Landfill and adjacent portions of NC 87 Bypass as Wagram fine sand, which is characterized as loamy, well drained marine terrace deposits. The native soils identified by NCDOT in 1990 within the proposed ROW of NC 87 Bypass adjacent to the closed landfill (from approximately -L- line station 288 + 00 to -L- line station 294 + 00) were "loose to medium dense fine to coarse sand and silty sand, with some relatively thin, discontinuous layers of plastic clay."

Based on data from borings recently completed in the area of interest, groundwater is encountered at a depth of 10 feet or less below land surface (bls) within the NC 87 Bypass ROW, and at depths exceeding 20 feet within some of the landfilled areas located north of the Bypass. The locations of nine existing groundwater monitoring wells surrounding the closed landfill are shown in Figure 8, and potentiometric data collected from the wells in April 2012 indicate that groundwater flows in a northwesterly direction. Richardson Smith Gardner and Associates of Raleigh, North Carolina performs postclosure groundwater monitoring of the wells on a semi-annual basis on behalf of Bladen County Landfill.

4.0 Geophysical Evaluation

The geophysical investigation included the deployment of a CMD-4 electromagnetic ground conductivity and magnetic susceptibility instrument, and SuperSting R8 electric resistivity and induced polarization imaging (ERI/IP) instruments. These technologies were used in concert with one another in order to identify the lateral and vertical distribution of flyash within the area of investigation. A brief description of each technology is presented in the following paragraphs followed by a discussion of the results of the geophysical investigation.

4.1 CMD-4 Electromagnetic Ground Conductivity Methodology

CMD-4 measures variations in electrical conductivity and magnetic susceptibility of subsurface materials. The conductivity is determined by inducing a primary electromagnetic field and measuring the amplitude and phase shift of an induced secondary magnetic field. The secondary magnetic field is created by subsurface conductive materials behaving as an inductor as the primary field is passed through them.

Terrain conductivity systems such as the CMD-4 are commonly used to delineate variations in ground conductivity. There are two components of the induced electromagnetic field measured by the CMD-4 system. The first is the quadrature-phase (out-of-phase) component that measures the bulk conductivity of soil and groundwater. The conductivity readings increases or even become negative when the sensors are close to metallic objects. The second is the in-phase component that measures the magnetic susceptibility and is therefore more sensitive to isolated metallic objects such as pipes, drums, underground storage tanks, and other metallic debris. Both positive and negative readings indicate subsurface metal. By observing the response of the in-phase and quadrature-phase components, it is possible to differentiate whether a change in bulk conductivity is due to the presence of buried metallic objects or due to changes in subsurface soil conditions or pore fluid conductivity.

The presence of metal buildings, fences, and other metallic surface objects cause interference and makes data interpretation for subsurface features near these objects difficult. The CMD-4 has an effective depth of exploration of up to approximately 20 feet below ground surface. However, the ability to detect small features decreases with depth.

4.2 R8 resistivity and Induced Polarization Imaging Methodology

Electrical resistivity surveying is an active geophysical technique that involves the introduction of a known amount of current into the ground and subsequently measuring the earth's response in order to measure variations in their respective electrical potentials. By introducing a known amount of current into the ground and subsequently measuring the voltage potential, the resistivity of a particular volume of earth is measured. It is important to note that actual ground resistivity is not measured during a resistivity survey but rather the apparent resistivity. Actual resistivities are determined later through the inversion process.

Resistivity methods typically require that a series of small current and potential electrodes be pushed into the ground in various configurations. The electrodes are connected to a transmitter/recording instrument that generates the induced current and stores the measurements for later processing and analysis. The R8 version of the SuperSting Resistivity System measures up to eight electrode combinations simultaneously, thereby reducing measuring time compared with standard one-channel systems. The configuration of the electrodes is dependent on the objectives of the investigation (i.e., vertical soil and bedrock profiling, contaminant mapping, or fracture mapping). The most commonly employed arrays for resistivity surveying are the Wenner, Schlumberger, and Dipole-Dipole. Pseudodepth sections are developed by increasing the spacing between the potential electrode dipole and the current electrode dipole in steps.

Since many underground features have electrical properties that differ from their surroundings, electrical imaging can be used to detect and delineate a large array of targets. These include: clay layers, sand or gravel lenses, the top-of-rock and rock pinnacles or float blocks, saltwater intrusion, leachate plumes, NAPLs, hydrocarbons, dam seepage, mineralized zones, water-bearing fractures, buried foundation elements, waste disposal pits or trenches, graves, mines, tunnels, caves, ice or permafrost thicknesses, and more. The IP has an effective depth of exploration equal to approximately 1/3 of the length of the transect being evaluated.

For some targets, recording the induced polarization (IP) or chargeability improves detection and discrimination. IP measures the ability of the subsurface to hold a charge like a capacitor by measuring a residual potential after interrupting the current abruptly. Common contributors to IP anomalies are clay minerals (membrane polarization) and metallic minerals (mainly sulfide minerals). IP can also be used for delineating landfills since buried metal typically has a strong IP effect. The IP effect or chargeability is measured in milliseconds (ms).

The combined results of various electrode spacings are plotted as a pseudodepth section or contour map of apparent resistivity and chargeability versus depth. Inversion of the pseudodepth sections is required to convert the section to actual resistivity and chargeability cross-sections. GEL uses EarthImager 2D by Advanced Geosciences Inc., which is an industry standard resistivity and IP inversion software.

4.3 Geospacial Positioning Methodology

Sub-meter differential GPS positioning data were collected at the site using a TopCon GMS-2 system with a PG-A5 antenna. A Trimble Geodimeter 600 total station was also used in order to achieve high quality positioning data in wooded area and to provide elevation data. GPS data was collected simultaneously with the CMD data by streaming and merging the data sets in the geophysical data collector. Surface metal and other pertinent surface features were also surveyed to facilitate the interpretation of the geophysical data. All positioning data was converted to WGS 84 North Carolina State Plane CS83, US Survey feet coordinates to seamlessly overlaying the geophysical data on NCDOT plans.

National Geodetic Survey benchmark No. PATH-EB0672 was used for vertical control during the investigation. The benchmark is located at the intersection of NC 87 Bypass and US 701, and has an established elevation of 125.22 feet (NAVD 88).

4.4 Field Procedures

The geophysical investigation was conducted from July 2 to July 6, 2012. CMD-4 data were collected first in order to determine the lateral extent of the flyash material. CMD-4 data was collected across the open parts of the site with a profile separation of approximately 20 feet. After analyzing the data, additional CMD-4 data was also collected in wooded areas to the west of the open parts of the site in order to delineate the western edges of the flyash material.

After analyzing all CMD-4 data, final ERI/IP profile locations were determined (Figure 11). This ERI/IP investigation was conducted with Wenner arrays using a electrode separation of 4 meters (13.1 feet). This configuration was selected after comparing data collected with Dipole-Dipole and Wenner for one profile (Profile 7), and after running computer simulations. The Wenner array was found to produce higher quality data (larger signal to noise ratio) and more reliable inversion models. The ground surface at all profile locations was found to be fairly resistive resulting in low output currents and noisy data. GEL attempted to mitigate these difficulties by pouring saltwater over the electrodes prior to commencing data collection. This method reduced the contact resistance by approximately 50 percent at most electrodes (from approximately 10,000 ohms to approximately 5,000 ohms for the locations with the highest contact resistance). However, some data points (typically 10-20%) were still too noisy and subsequently removed prior to inversion. The remaining data was still sufficient for interpretation.

At the completion of the ERI/IP investigation, GEL located the horizontal and vertical position of start and end point of each resistivity profile as well as a majority of the electrodes. The electrode positioning data was used in order to incorporate surface elevation variations into the data processing.

4.5 Data Evaluation and Presentation

Following the completion of the data collection, the Conductivity data (Figure 9) and Inphase data (Figure 10) were plotted and analyzed for flyash material. Although the flyash was detected in both conductivity data and inphase data, the inphase data seemed to be less influenced by surface metal and seemed to identify the landfill limits more clearly and were, therefore, the primary dataset used for determining the flyash limits.

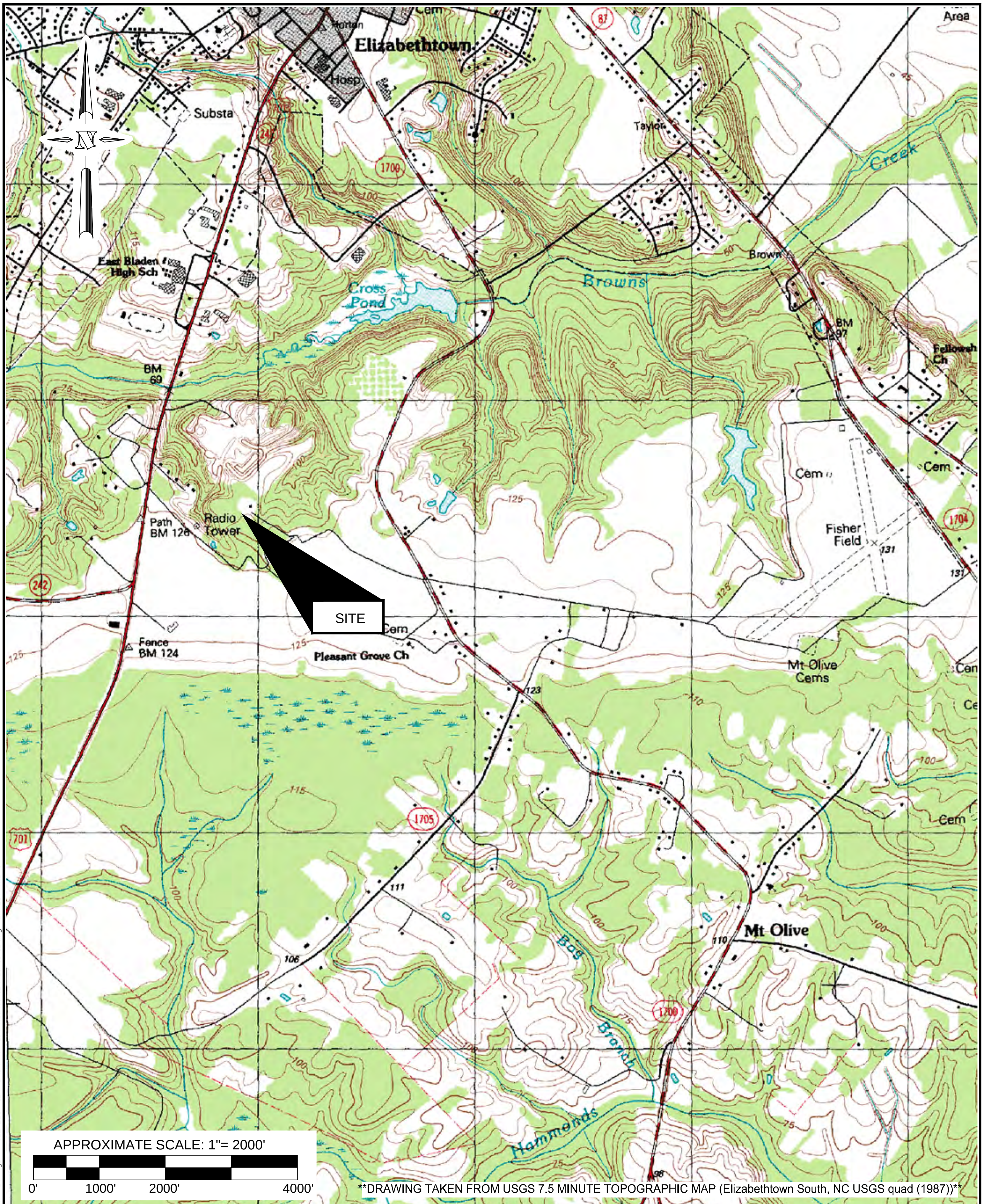
ERI/IP data were inverted to resistivity and chargeability cross sections using EarthImager 2D (Appendix II). Noisy data points were deleted from the data set prior to the inversion process. Four borings were used for calibrating the ERI/IP data. The location of these borings and the approximate depth to the bottom of the flyash at the boring locations are shown on Figure 11 and Appendix II. The deeper parts of the flyash material consistently exhibit a lower resistivity than the shallow parts. This is most likely due to the presence of groundwater in the deeper parts. Due to a sharp contrast in resistivity between the bottom of the flyash and the native soils below the flyash, the ERI data successfully imaged the bottom of the flyash throughout the site. The ERI datasets were therefore the primary dataset for determining the distribution of the flyash along the profiles. The IP data was less conclusive. At most locations, ERI data and borehole data correlated very well. However, ERI data seemed to somewhat overestimate the thickness of the flyash close to the edges of the landfill cells. This is a result of the electrical currents preferring the path of least resistance and not being distributed homogeneously in the ground at those locations. GEL therefore mainly relied on the boring data to estimating the slope of the flyash along the landfill edges. By combining the CMD 4, ERI/IP, and boring data, GEL developed a contour map showing the depth to the bottom of the flyash within the area of investigation (Figure 12). The contour map was also exported to CAD and overlaid on NCDOT plans (Figure 13) The contour map was also used to add flyash limits to the NCDOT cross sections (Figures 14-16).

5.0 Conclusions and Recommendations

The results of the geophysical investigation have provided reliable data that enabled GEL to delineate the lateral and vertical extent of the landfilled waste located within the area of interest, as presented in Figures 9-16 of this report. The data support historical documentation that describes the location and type of waste landfilled (flyash).

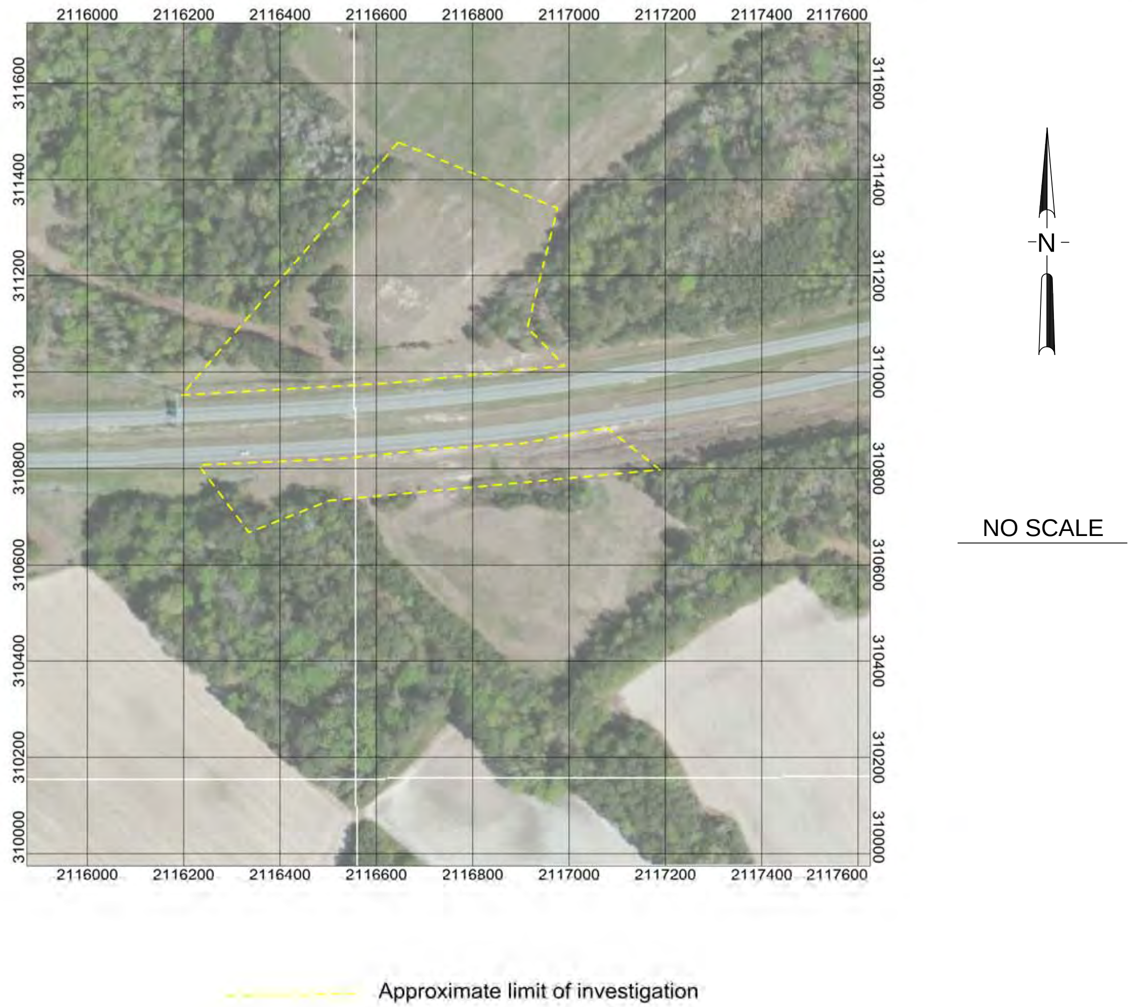
Figures 9-16 indicate that portions of the northernmost NCDOT proposed off ramp alignment (Option No. 1 shown in Figure 3) are located within a delineated area of landfilled flyash, as shown in Figure 13. Portions of the southernmost NCDOT proposed off ramp alignment (Option No. 2 shown in Figure 3) appear to be located within the delineated “trench” of landfilled flyash within the NC 87 Bypass ROW, as shown in Figure 13. Therefore, neither proposed alignment may be preferred by NCDOT due to the presence of underlying flyash. However, it is recommended that an alternate off ramp alignment located between the Option No. 1 and Option No. 2 proposed alignments be considered by NCDOT since that area appears to be devoid of landfilled waste, based on the results of the geophysical investigation.

FIGURES



GEL Engineering of NC Inc. an affiliate of THE GEL GROUP INC Post Office Box 14262 Research Triangle Park, NC 27709 P 919.544.1100 F 919.544.4755 www.gel.com problem solved	PROJECT: ncdt00412 GEOPHYSICAL INVESTIGATION REPORT BLADEN COUNTY LANDFILL NC 87 BYPASS AND US 701 BLADEN COUNTY, NORTH CAROLINA TIP #R-4903, WBS ELEMENT #40224.1.1	SITE LOCATION MAP	FIGURE 1
	DATE: July 24, 2012	DRAWN BY: TJP	APPRV. BY: ADE

PLOTTED: Jul 25, 2012 - 1:50pm BY: tjp FILE LOCATION: G:\I-P\N\ncdt\ncdt00412\ncdt00412.dwg LAYOUT TAB: 1



GEL ENGINEERING of NC, Inc. *an Affiliate of THE GEL GROUP, Inc.* GEL Post Office Box 14262 Research Triangle Park, NC 27709 (919) 544-1100	PROJECT: ncdt00412		
	GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1	SITE MAP SHOWING AREA OF INTEREST FOR GEOPHYSICAL INVESTIGATION	FIGURE 2
	DATE: August 9, 2012	DRAWN BY: ADE	

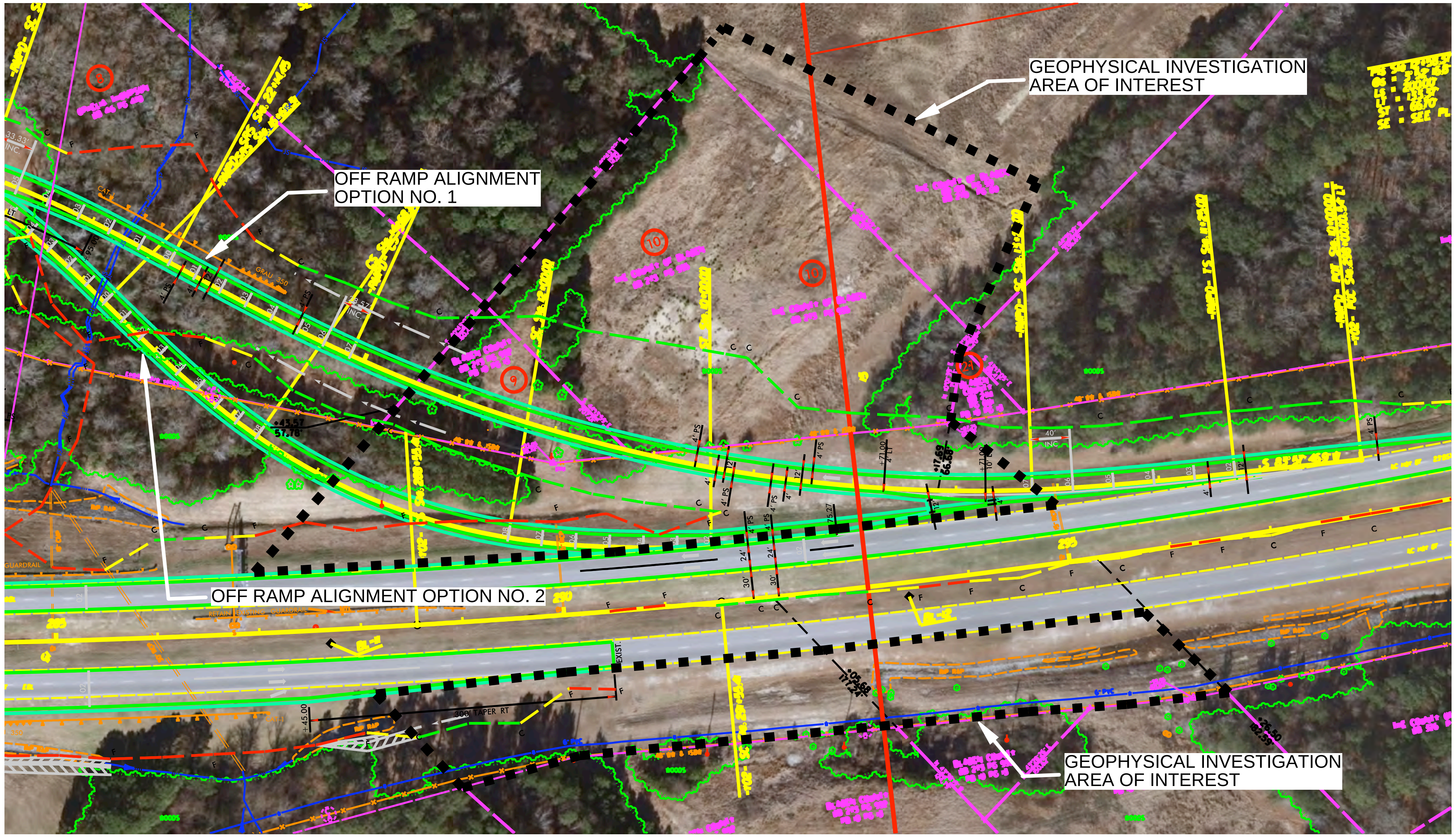


FIGURE IS AN EXCERPT FROM NCDOT R4903_RDY_DSN.DGN FILE

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GEOPHYSICAL INVESTIGATION REPORT

INTERSECTION OF NC 87 BYPASS AND US 701
BLADEN COUNTY LANDFILL
BLADEN COUNTY, NORTH CAROLINA
STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1

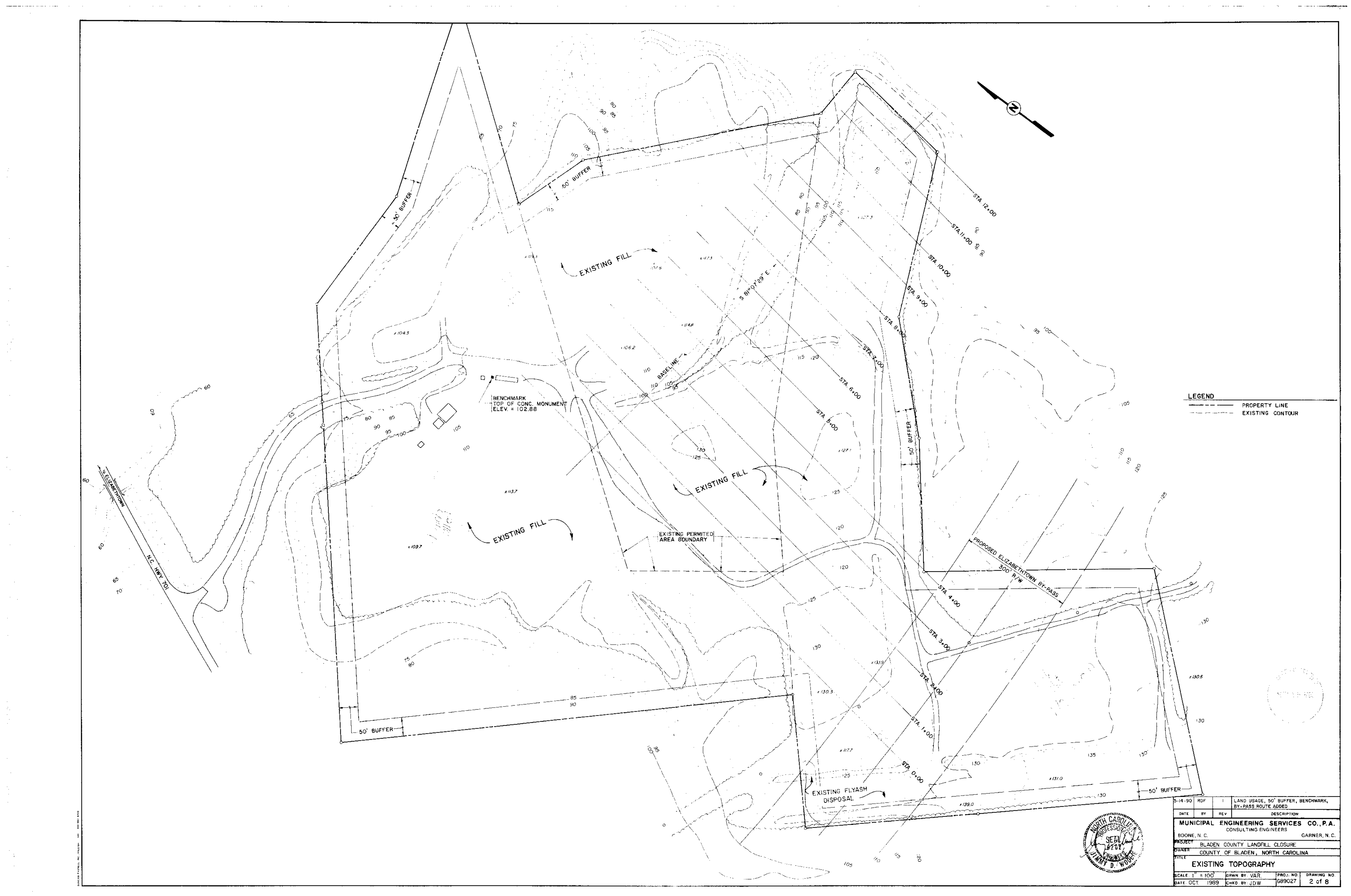
SITE MAP SHOWING NCDOT PROPOSED
OFF RAMP ALIGNMENT OPTIONS, JUNE 2012

FIGURE
3

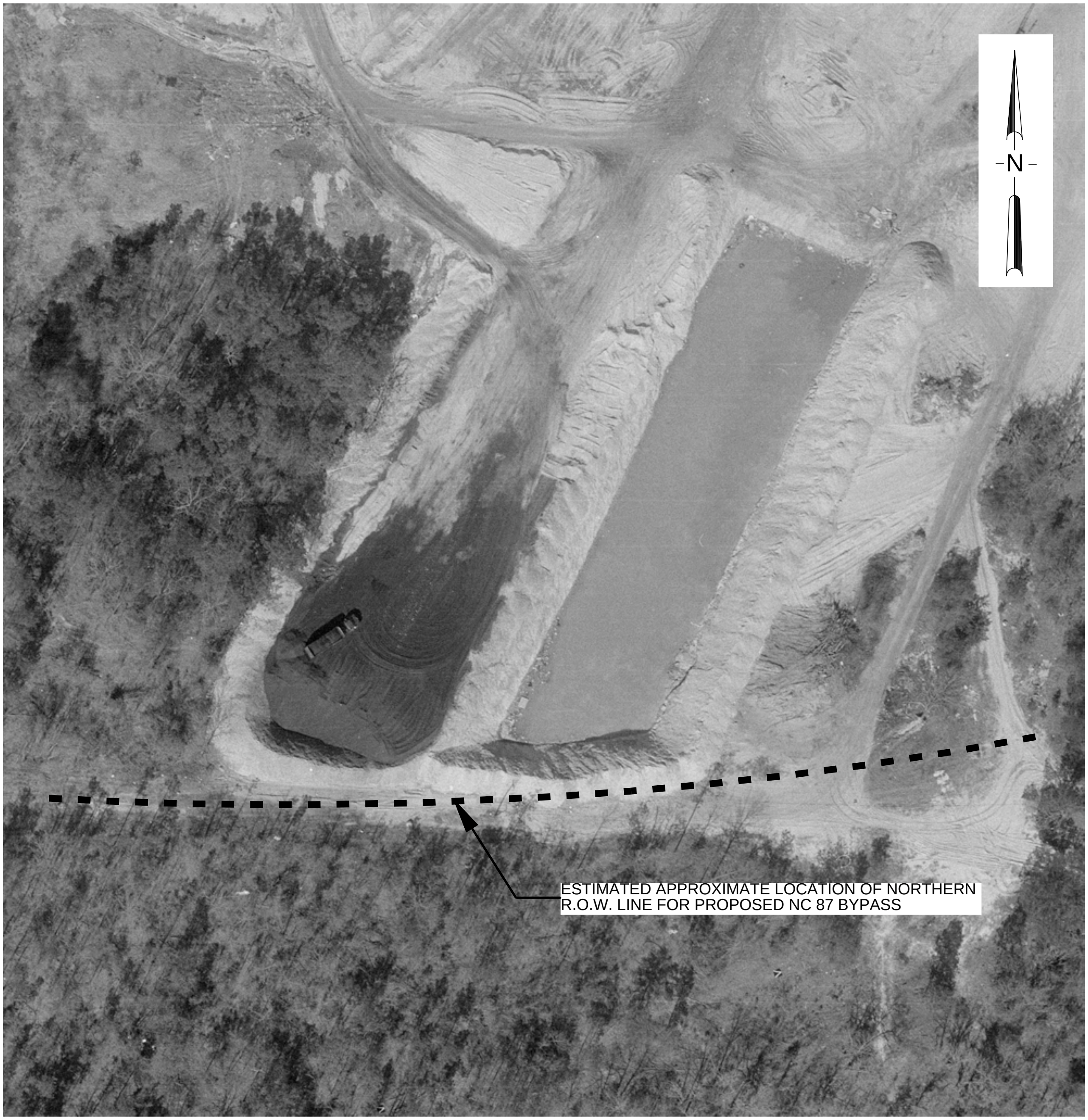
DATE: August 8, 2012

DRAWN BY: ADE

APPRV. BY:



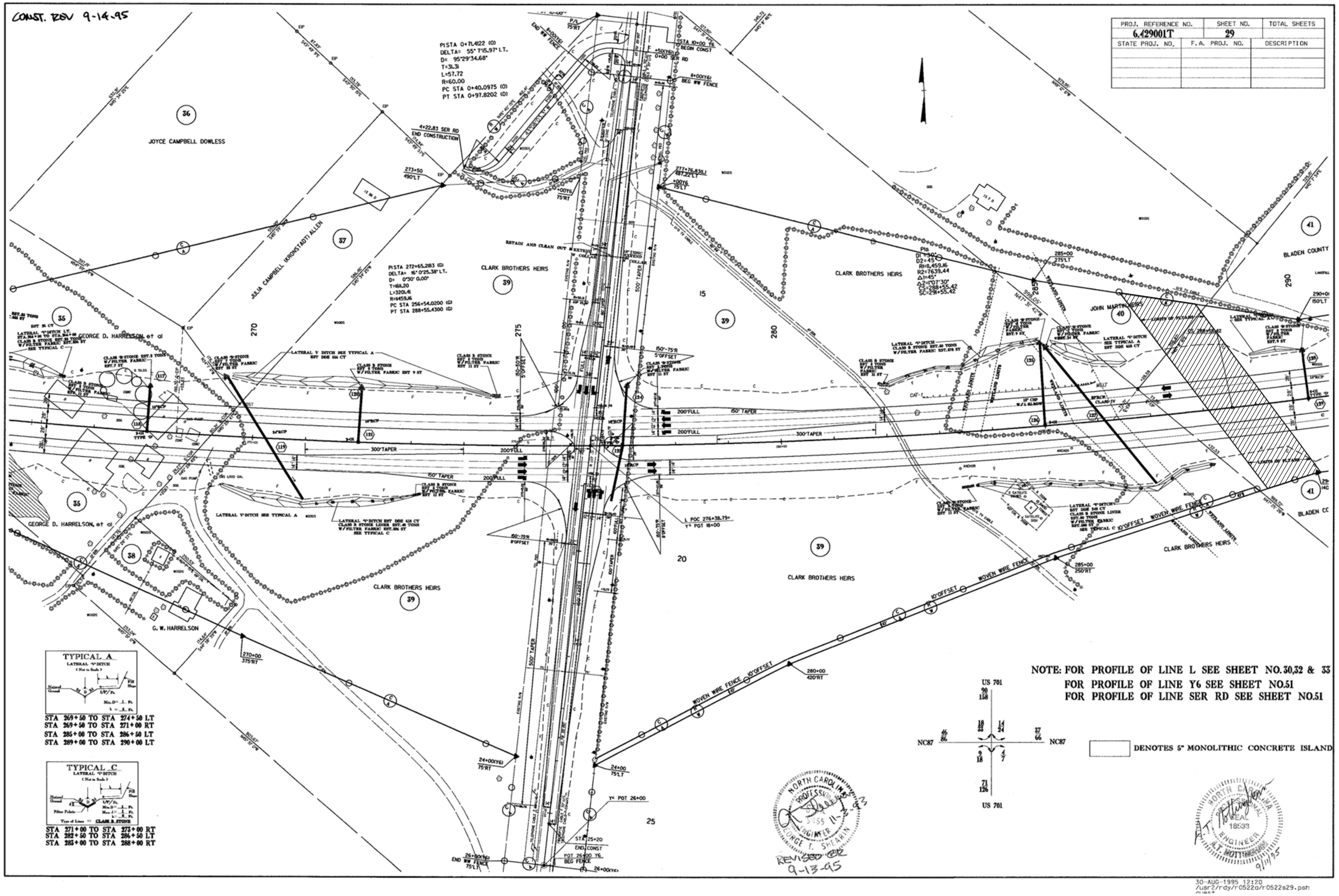
GEL Engineering of NC, Inc. *an Affiliate of The GEL Group, Inc.* GEL P.O. BOX 27709 RESEARCH TRIANGLE PARK, NC (919) 544-1100	PROJECT: ncdt00412 GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1 DATE: August 9, 2012	BLADEN COUNTY LANDFILL PROPERTY BOUNDARY AND TOPOGRAPHY AS OF 1989 DRAWN BY: ADE APPRV. BY:	FIGURE 4



NO SCALE

EXCERPT FROM NCDOT M-2093 IMAGERY
DATED MARCH 13, 1987

GEL Engineering OF NC, Inc. *an Affiliate of THE GEL GROUP, Inc.* GEL Post Office Box 14262 Research Triangle Park, NC 27709 (919) 544-1100	PROJECT: ncdt00412 GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903 WBS ELEMENT NO. 40224.1.1	AERIAL PHOTOGRAPH SHOWING FLY ASH LANDFILLING OPERATIONS AT BLADEN COUNTY LANDFILL IN MARCH 1987	FIGURE 5
	DATE: August 8, 2012	DRAWN BY: ADE | APPRV. BY:	



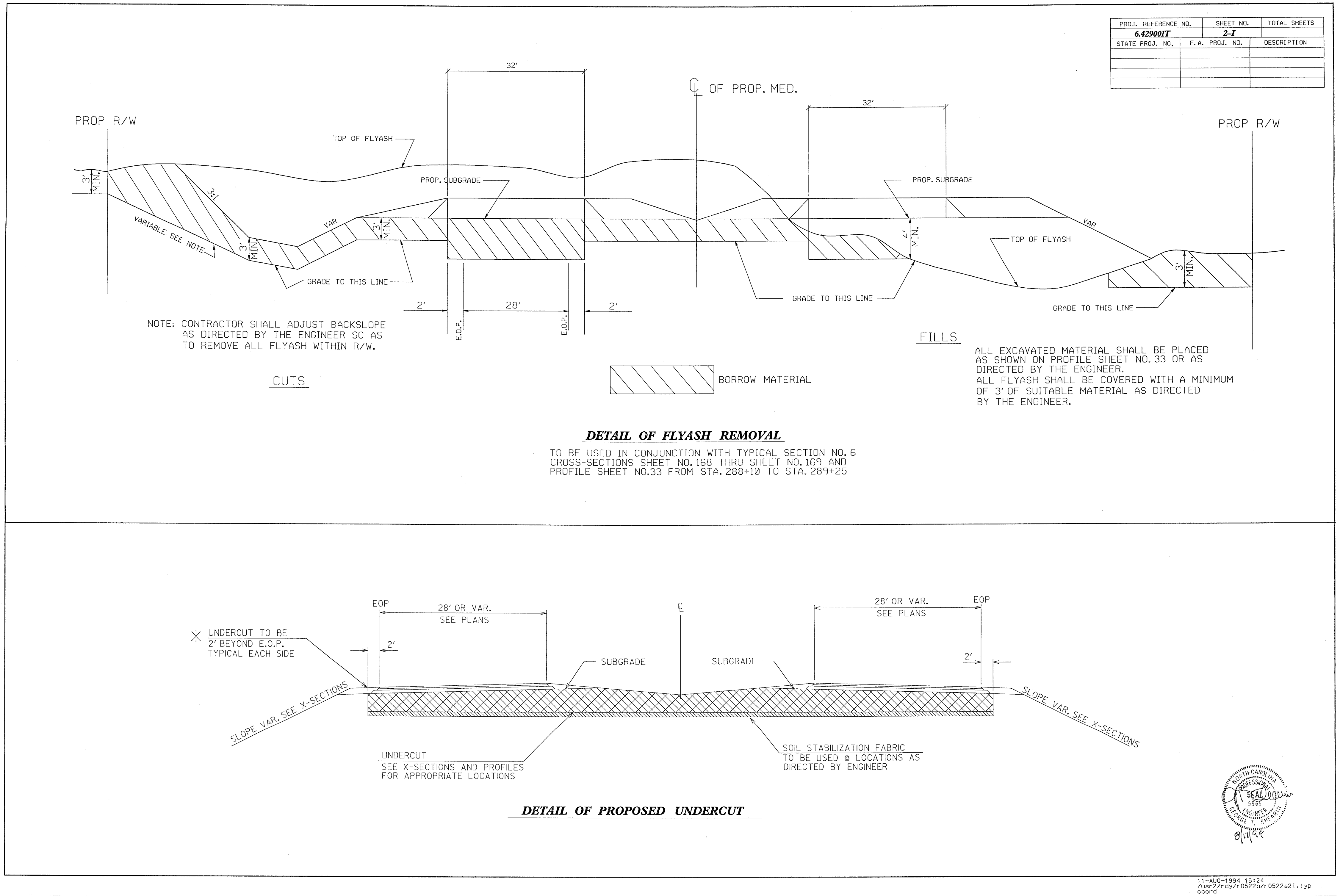
LEGEND

"TRENCH" OF LANDFILLED FLYASH IDENTIFIED BY NCDOT IN 1990

SHEET 29 FROM NCDOT PLAN AND PROFILE FOR NC 87 BYPASS, PROJECT 6429001T, R-0522

BLADEN COUNTY LANDFILL IS SHOWN AT EAST EDGE OF SHEET, NORTHEAST OF FLYASH "TRENCH"

GEL Engineering of NC, Inc. *an Affiliate of The GEL Group, Inc.* GEL P.O. BOX 27709 RESEARCH TRIANGLE PARK, NC (919) 544-1100	PROJECT: ncdt00412 GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1 DATE: August 9, 2012	NCDOT PLAN AND PROFILE SHEET FOR NC 87 BYPASS SHOWING LOCATION OF "TRENCH" OF LANDFILLED FLYASH DRAWN BY: ADE	APPRV. BY:	FIGURE 6



NO SCALE

SHEET 2-I FROM NCDOT PLAN AND PROFILE
FOR NC 87 BYPASS, PROJECT 6429001T, R-0522

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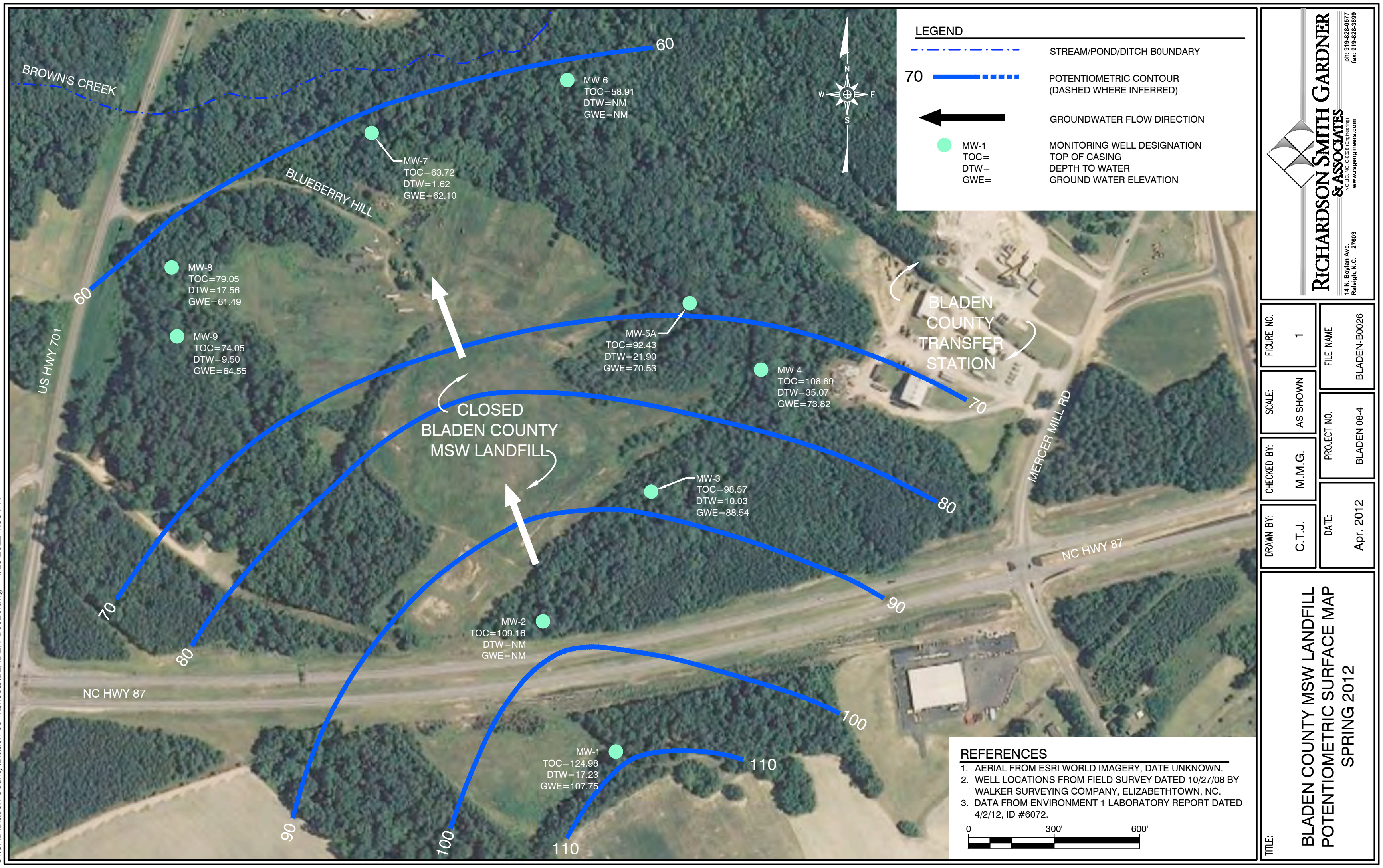
	GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1	NCDOT PROPOSED UNDERCUTTING OF FLYASH "TRENCH"	FIGURE 7
	DATE: August 8, 2012	DRAWN BY: ADE / APPRV. BY:	



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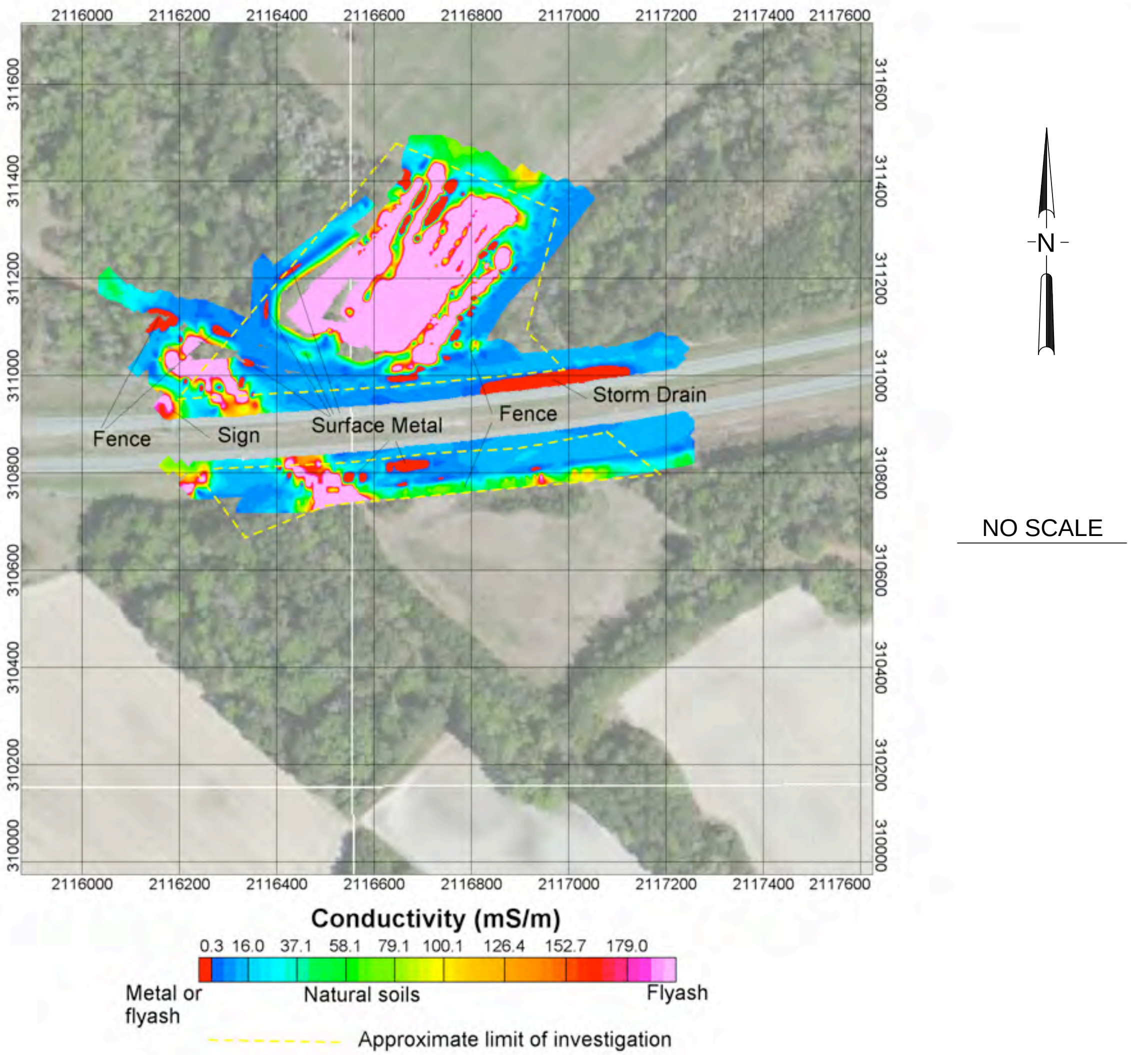
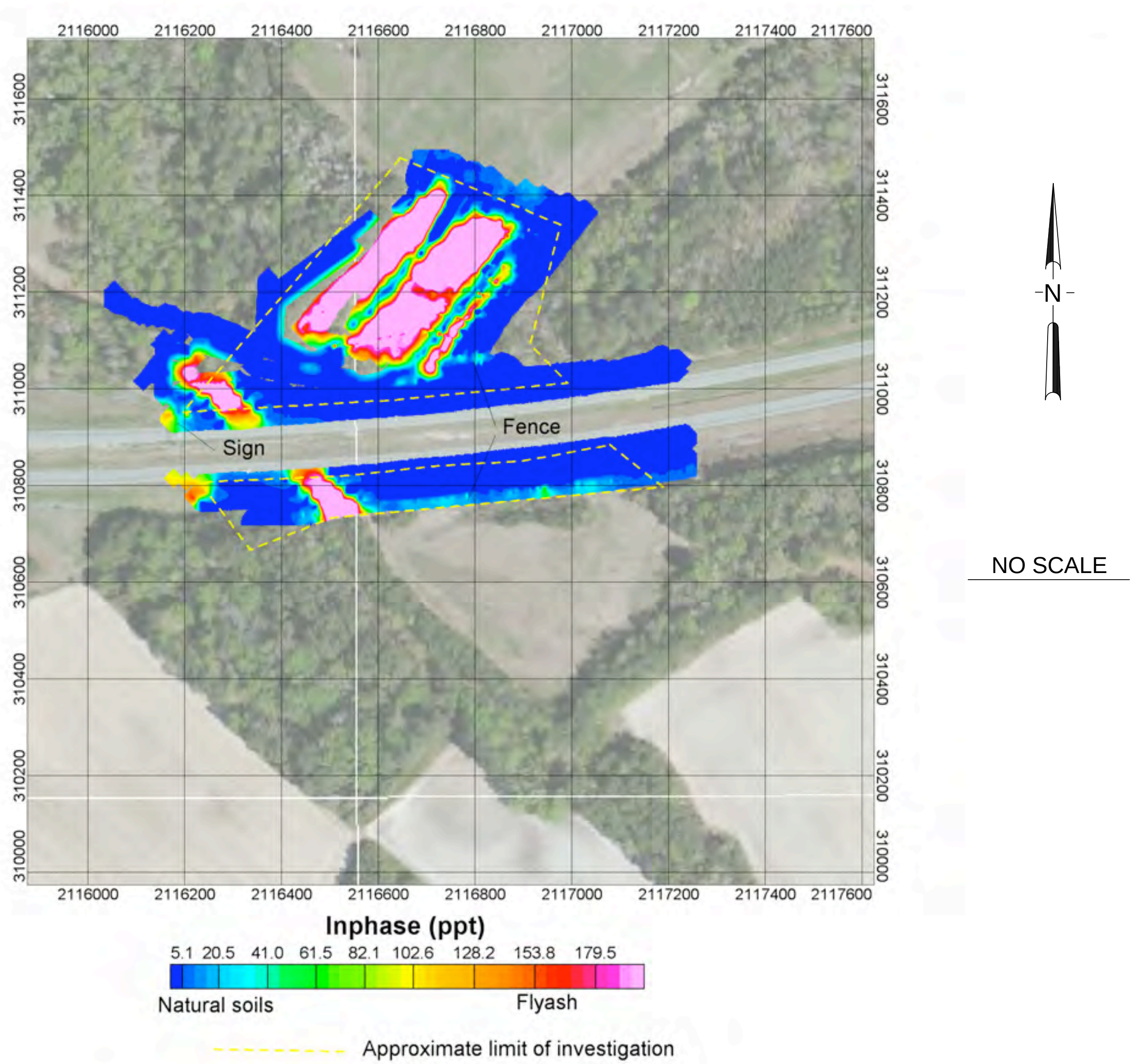
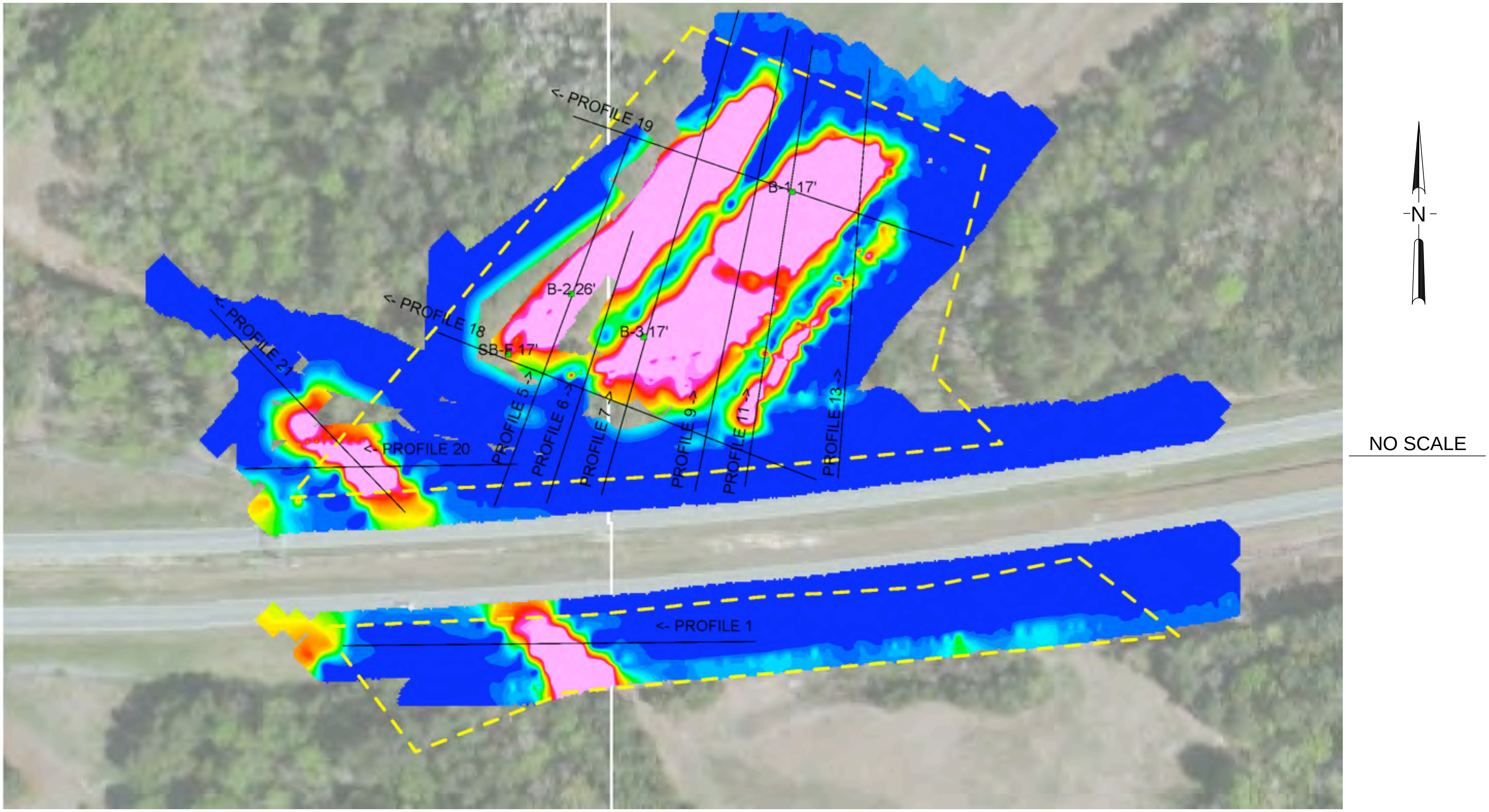
GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1	APRIL 2012 POTENTIOMETRIC MAP FOR BLADEN COUNTY LANDFILL SHOWING LOCATIONS OF EXISTING GROUNDWATER MONITORING WELLS	FIGURE 8
DATE: August 9, 2012	DRAWN BY: ADE	



GEL ENGINEERING of NC, Inc. *an Affiliate of THE GEL GROUP, Inc.* GEL Post Office Box 14262 Research Triangle Park, NC 27709 (919) 544-1100	PROJECT: ncdt00412 GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1	SITE MAP SHOWING CMD-4 CONDUCTIVITY DATA	FIGURE 9
	DATE: August 13, 2012	DRAWN BY: J. Bergstrom	



GEL ENGINEERING of NC, Inc. ***an Affiliate of THE GEL GROUP, Inc.*** GEL Post Office Box 14262 Research Triangle Park, NC 27709 (919) 544-1100	PROJECT: ncdt00412 GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1	SITE MAP SHOWING INPHASE CMD-4 DATA	FIGURE 10
	DATE: August 13, 2012	DRAWN BY: J. Bergstrom	



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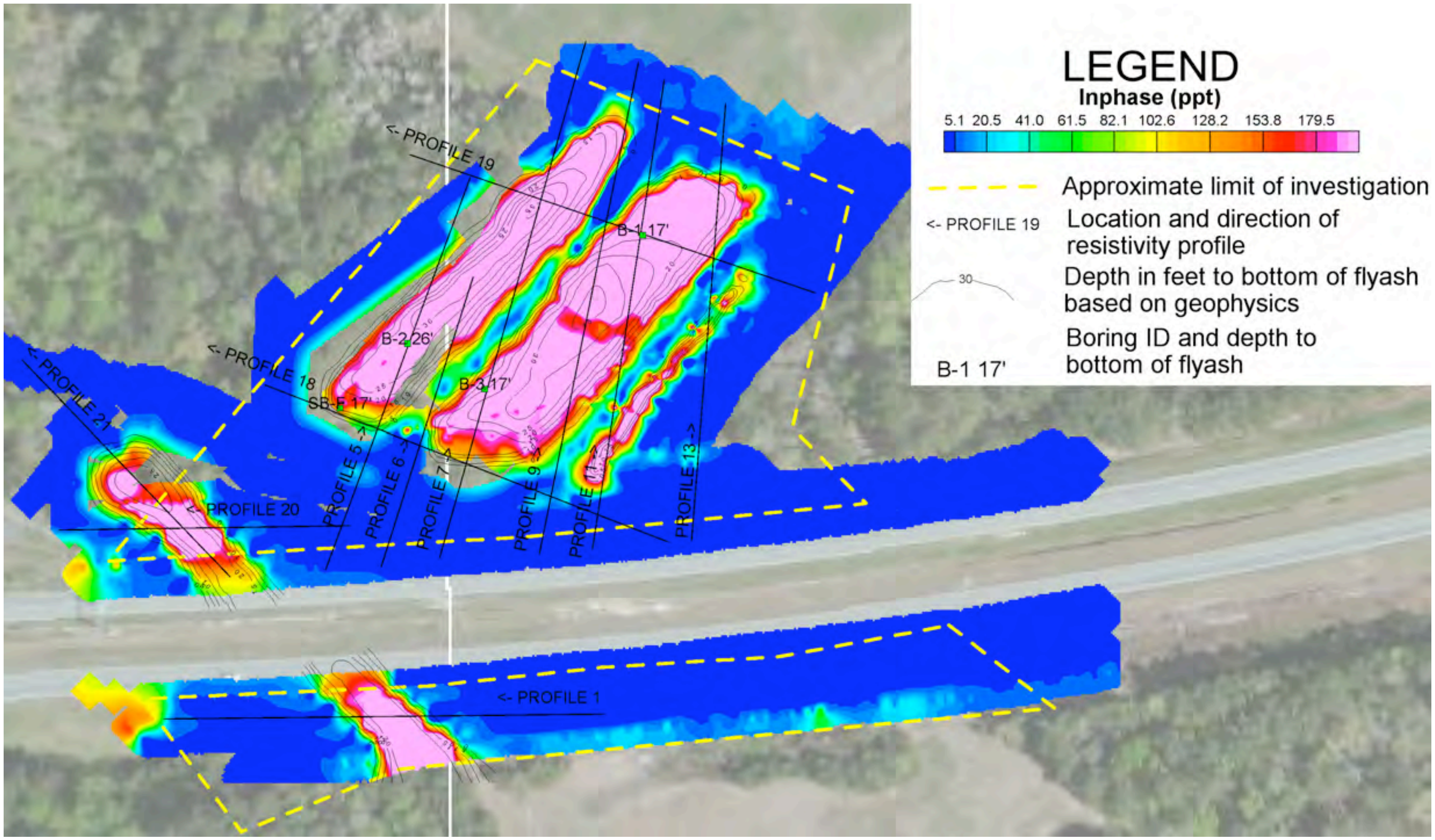
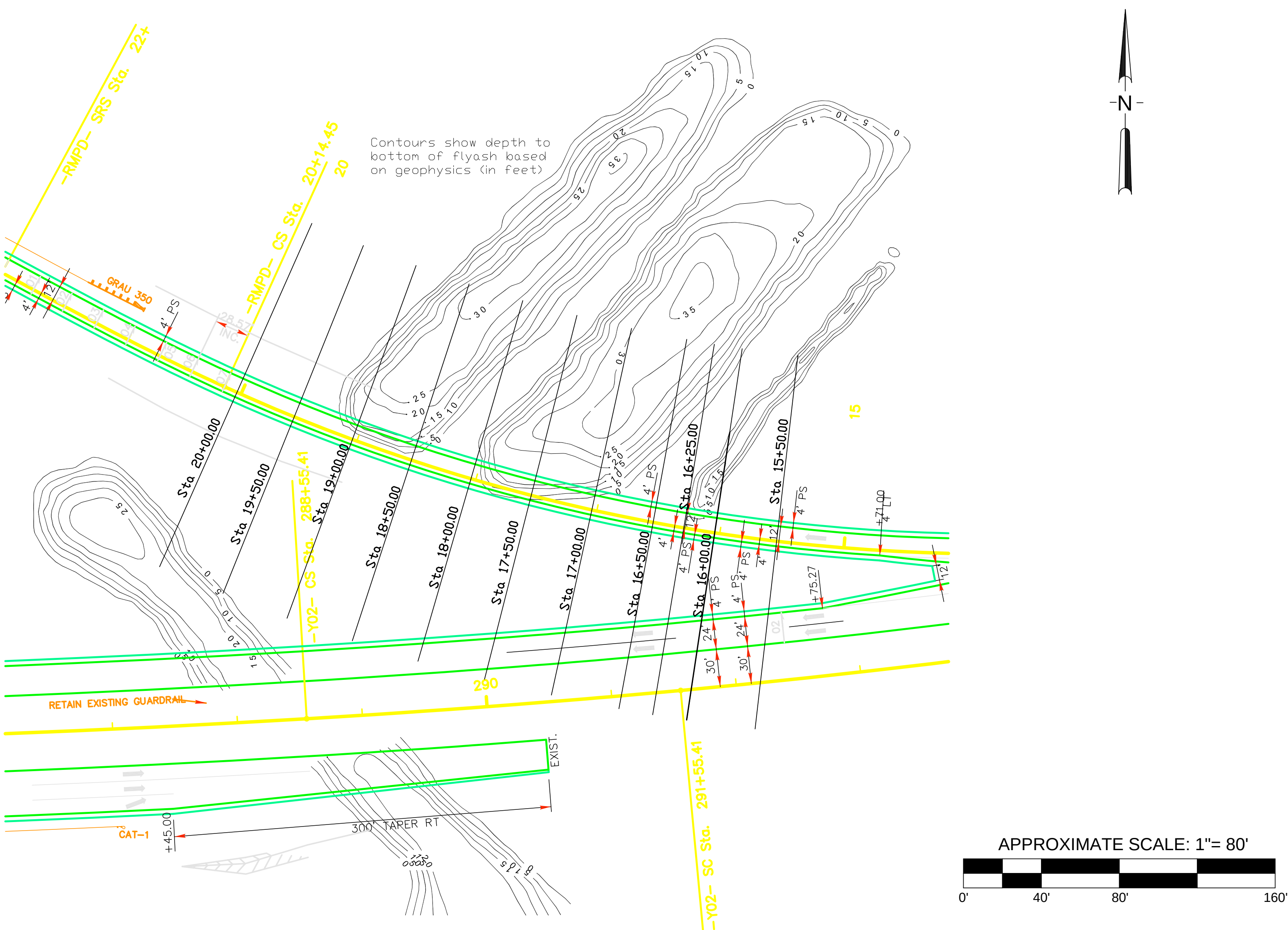
PROJECT: ncdt00412		
GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1	SITE MAP SHOWING CMD-4 INPHASE DATA, RESISTIVITY PROFILE LOCATIONS AND SOIL BORING LOCATIONS	FIGURE 11
DATE: August 13, 2012	DRAWN BY: J. Bergstrom	



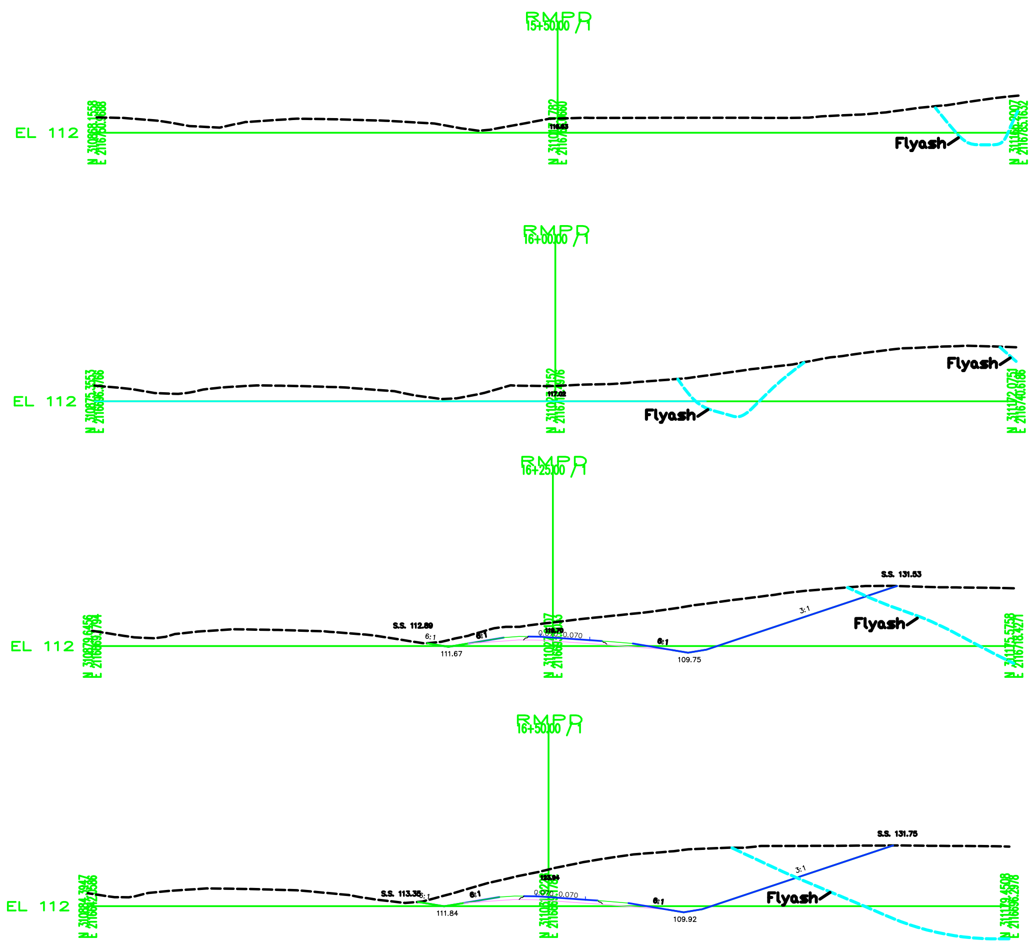
-N-

NO SCALE

GEL ENGINEERING of NC, Inc. *an Affiliate of THE GEL GROUP, Inc.* GEL Post Office Box 14262 Research Triangle Park, NC 27709 (919) 544-1100	PROJECT: ncdt00412 GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1	SITE MAP SHOWING ESTIMATED DEPTH TO BOTTOM OF THE FLYASH BASED ON ERI/IP DATA	FIGURE 12
	DATE: August 13, 2012	DRAWN BY: J. Bergstrom	



GEL ENGINEERING of NC, Inc. *an Affiliate of THE GEL GROUP, Inc.*	Post Office Box 14262 Research Triangle Park, NC 27709 (919) 544-1100
PROJECT: ncdt00412	
GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1	SITE MAP SHOWING ESTIMATED DEPTH TO BOTTOM OF THE FLYASH AND LOCATIONS OF NCDOT CROSS SECTIONS
FIGURE 13	
DATE: August 13, 2012	DRAWN BY: J. Bergstrom



APPROXIMATE SCALE: 1"= 80'

0' 40' 80' 160'

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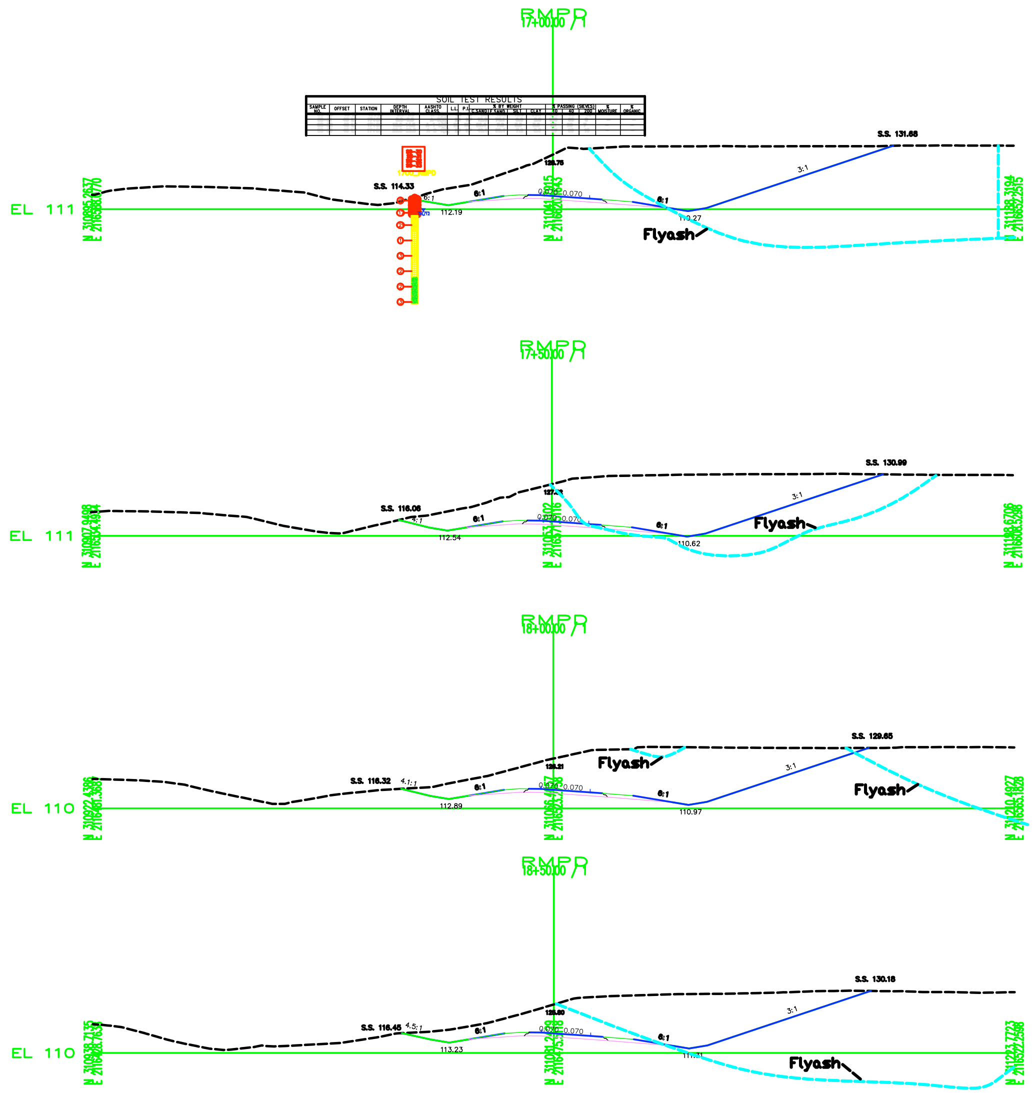
PROJECT: ncdt00412		
GEOPHYSICAL INVESTIGATION REPORT INTERSECTION OF NC 87 BYPASS AND US 701 BLADEN COUNTY LANDFILL BLADEN COUNTY, NORTH CAROLINA STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1	SITE MAP SHOWING CROSS SECTIONS FOR STATIONS 15+50 TO 16+50	FIGURE 14
DATE: August 13, 2012	DRAWN BY: J. Bergstrom	



APPROXIMATE SCALE: 1"= 80'

0' 40' 80' 160'

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GEOPHYSICAL INVESTIGATION REPORT

INTERSECTION OF NC 87 BYPASS AND US 701
BLADEN COUNTY LANDFILL
BLADEN COUNTY, NORTH CAROLINA
STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1

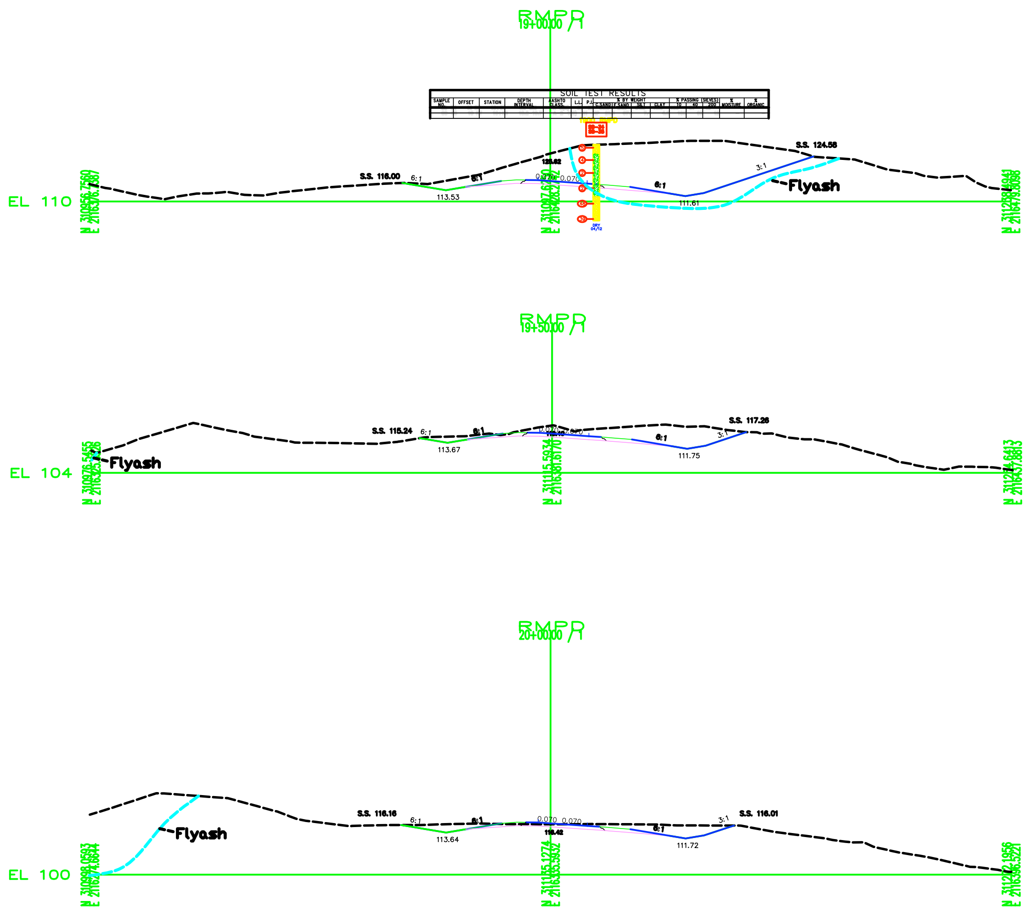
SITE MAP SHOWING CROSS SECTIONS
FOR STATIONS 17+00 TO 18+50

FIGURE

15

DATE: August 13, 2012

DRAWN BY: J. Bergstrom



APPROXIMATE SCALE: 1"= 80'

0' 40' 80' 160'

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PROJECT: ncdt00412

GEOPHYSICAL INVESTIGATION REPORT

INTERSECTION OF NC 87 BYPASS AND US 701
BLADEN COUNTY LANDFILL
BLADEN COUNTY, NORTH CAROLINA
STATE PROJECT R-4903, WBS ELEMENT NO. 40224.1.1

SITE MAP SHOWING CROSS SECTIONS
FOR STATIONS 19+00 TO 20+00

FIGURE

16

DATE: August 13, 2012

DRAWN BY: J. Bergstrom

APPENDICES

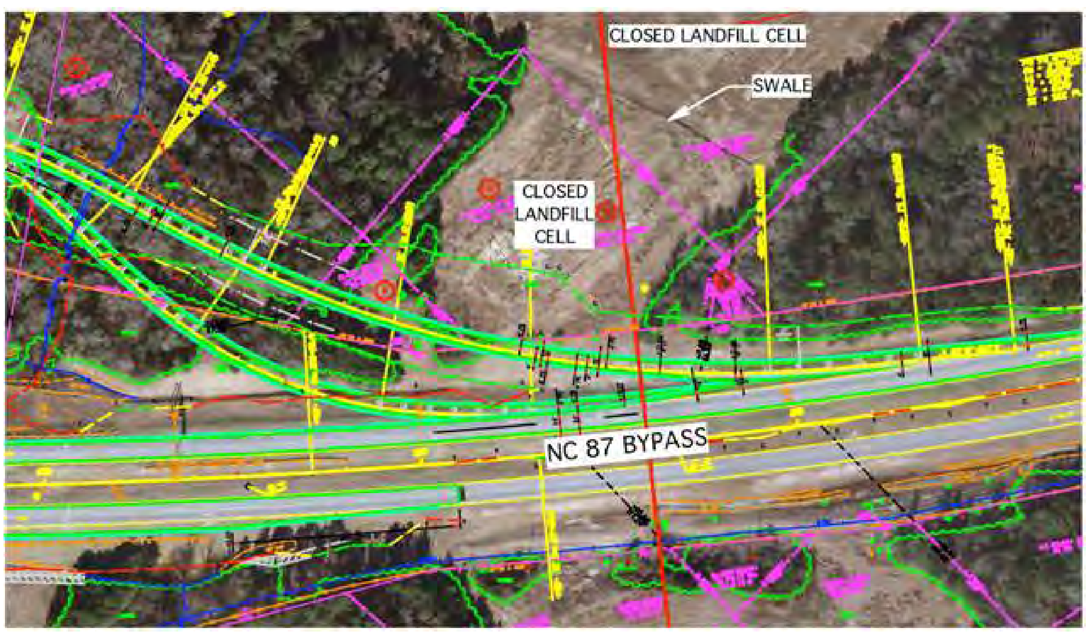
APPENDIX I

Photographs

Photograph 1: View looking northeast at closed landfill cell on south side of NC 87 Bypass.

Photograph 2: View looking north at east-west trending slope on north side of NC 87 Bypass that represents apparent southerly extent of landfilled waste (reportedly flyash) on the north side of NC 87 Bypass ROW.

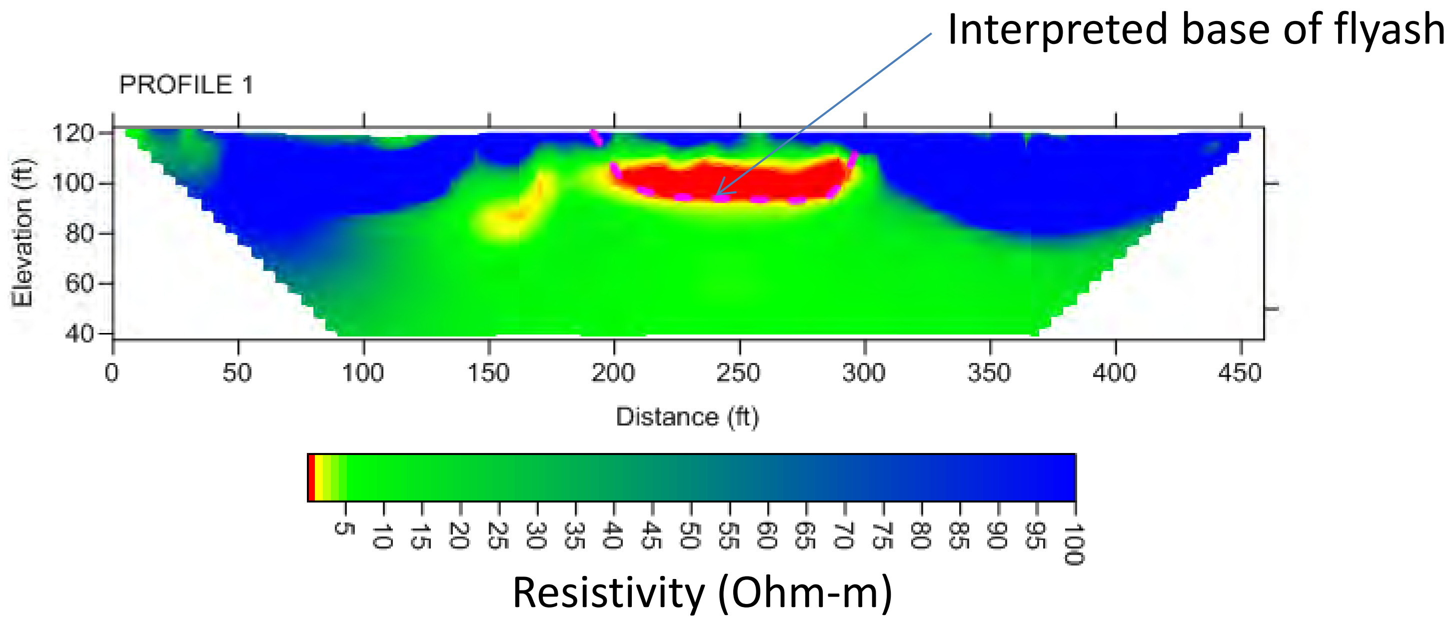
Photograph 3: View looking east along swale separating two closed landfill cells (shown on left and right sides of photograph) on north side of NC 87 Bypass.



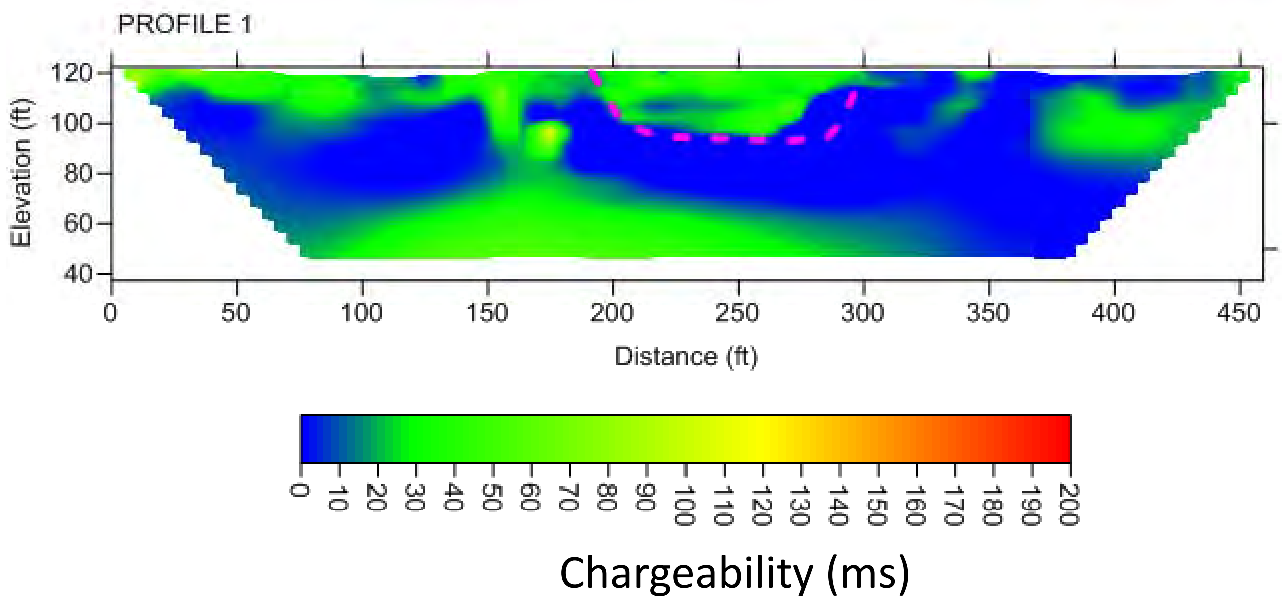
Photograph 4: Aerial photograph showing location of swale shown in Photograph 3 above (NCDOT R4903_rdy_dsn.dgn figure showing alignment options for proposed NC 87 Bypass off ramp).

APPENDIX II

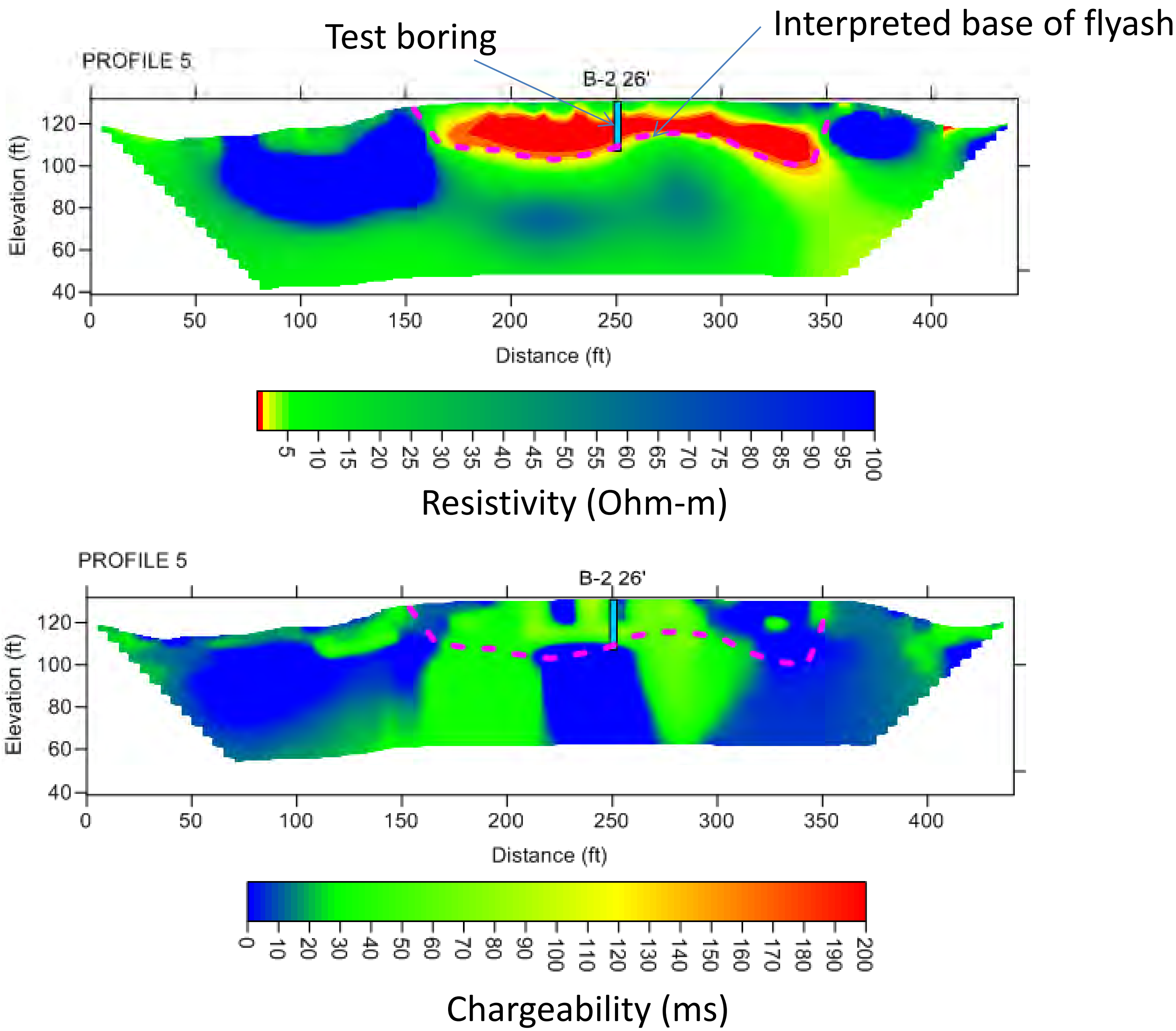
Electrical Resistivity and Induced Polarization Imaging Profiles

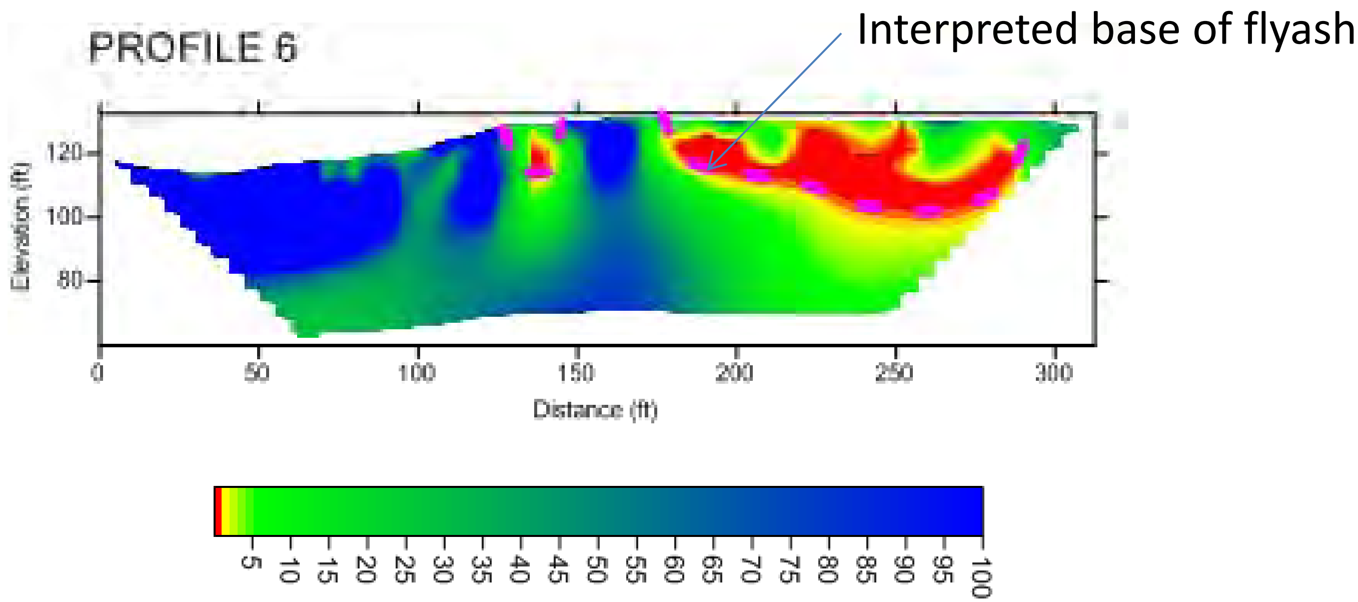


Interpreted base of flyash
PROFILE 1
Elevation (ft)
120
100
80
60
40
Distance (ft)
0 50 100 150 200 250 300 350 400 450
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Resistivity (Ohm-m)

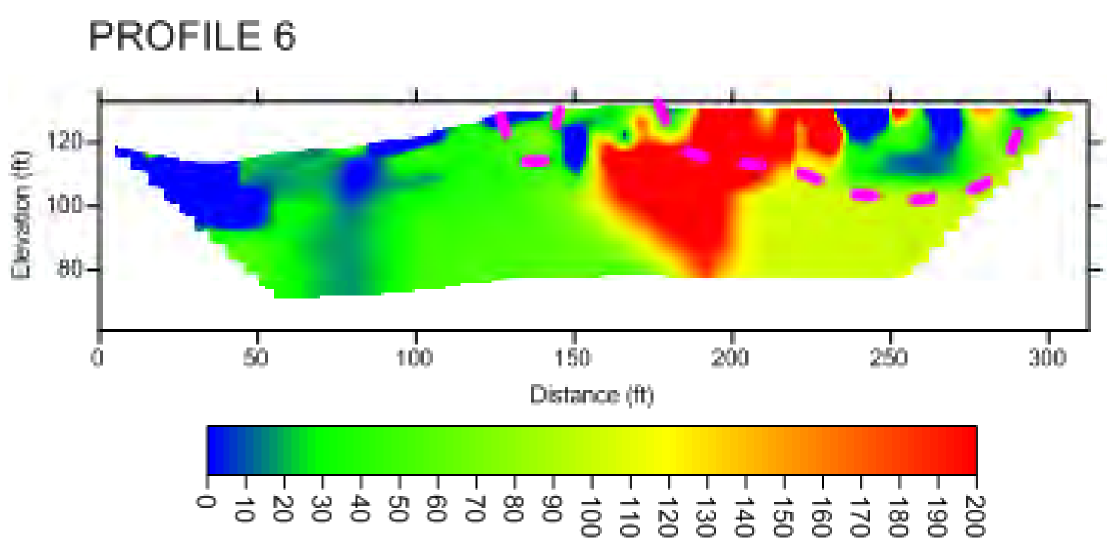


PROFILE 1
Elevation (ft)
120
100
80
60
40
Distance (ft)
0 50 100 150 200 250 300 350 400 450
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Chargeability (ms)

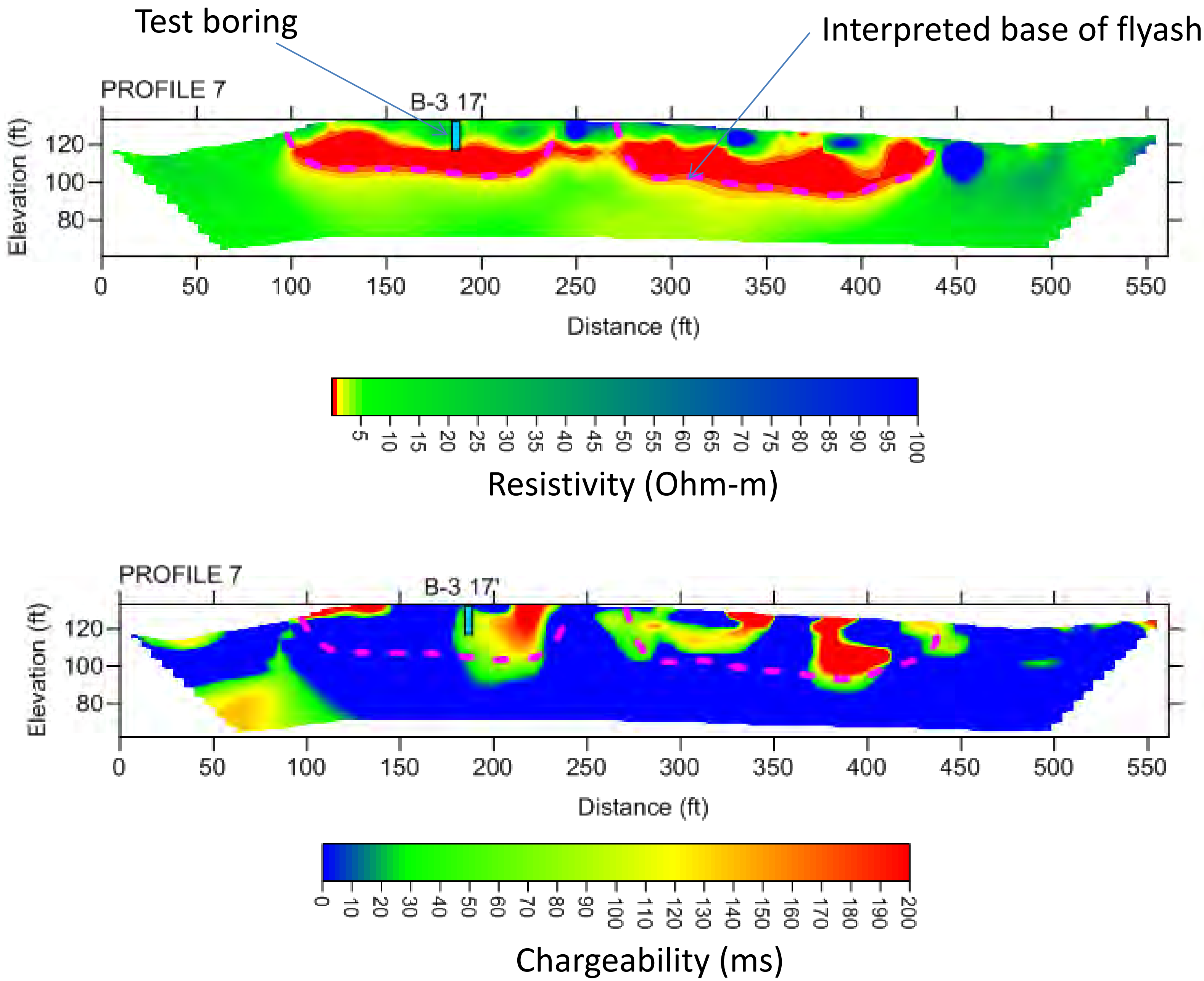

Test boring
Interpreted base of flyash
PROFILE 5
B-2 26'
Elevation (ft)
Distance (ft)
Resistivity (Ohm-m)
PROFILE 5
B-2 26'
Elevation (ft)
Distance (ft)
Chargeability (ms)



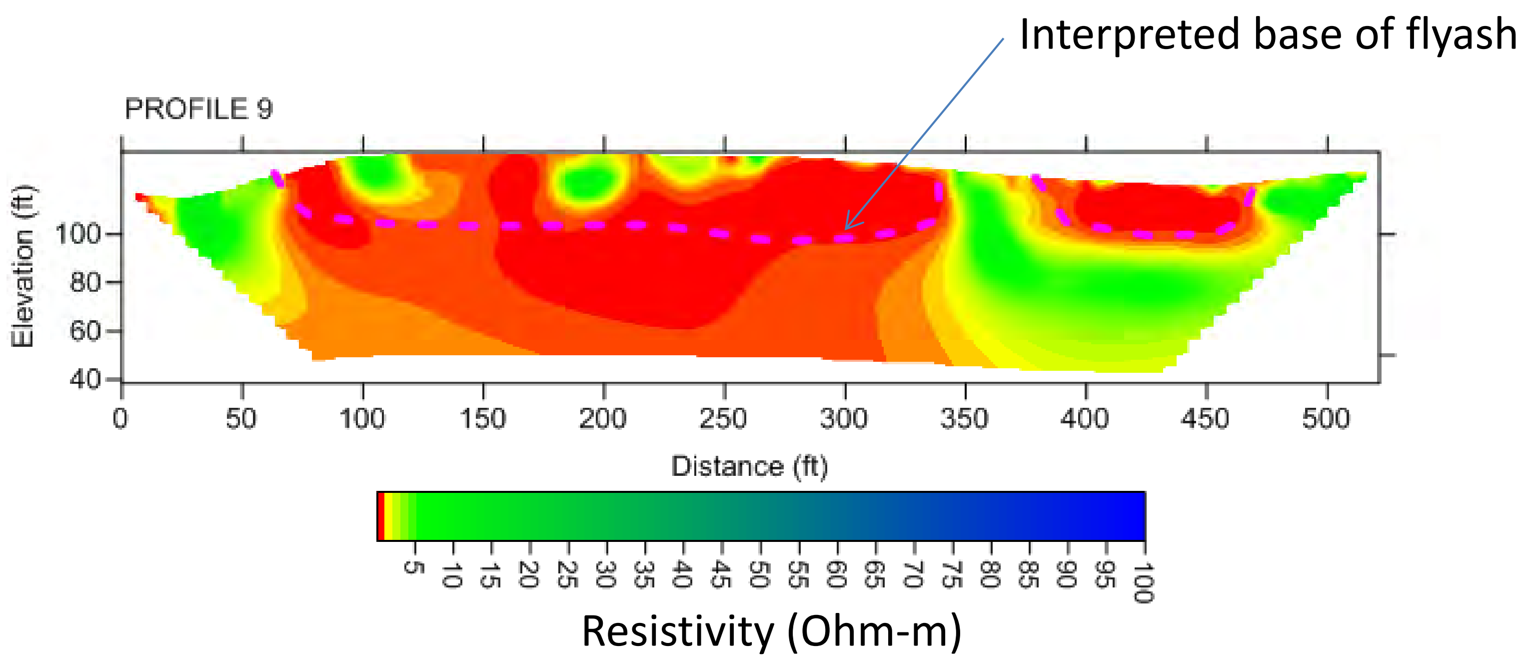
Resistivity (Ohm-m)

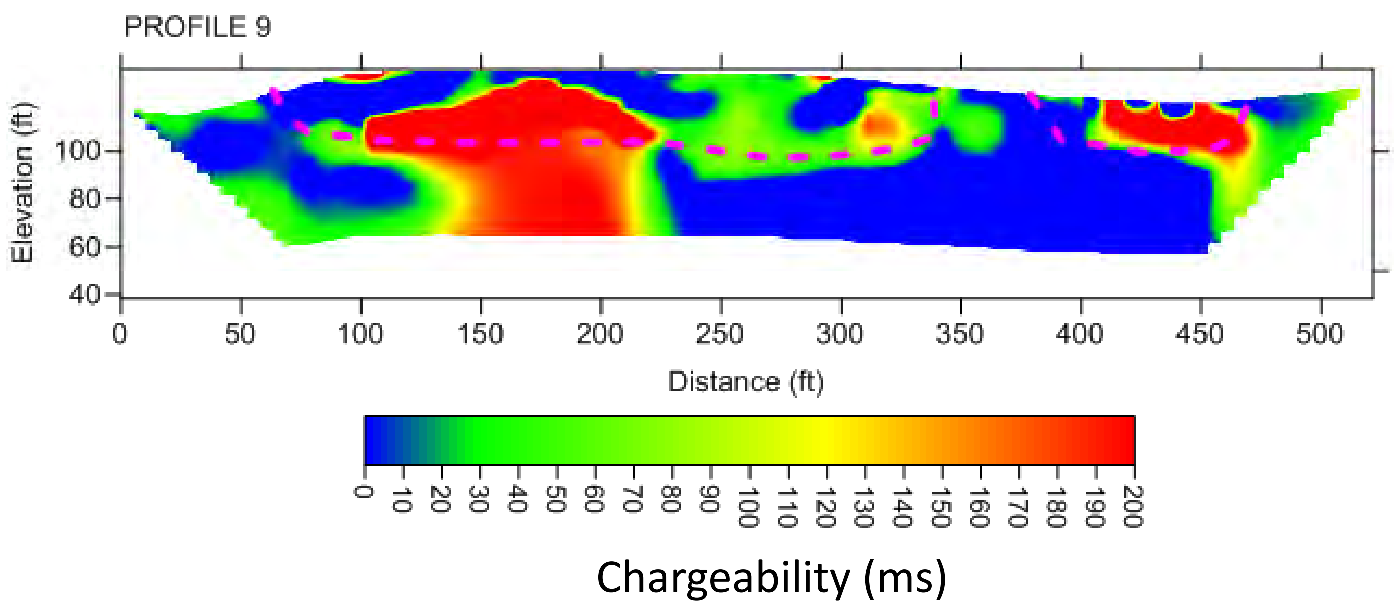


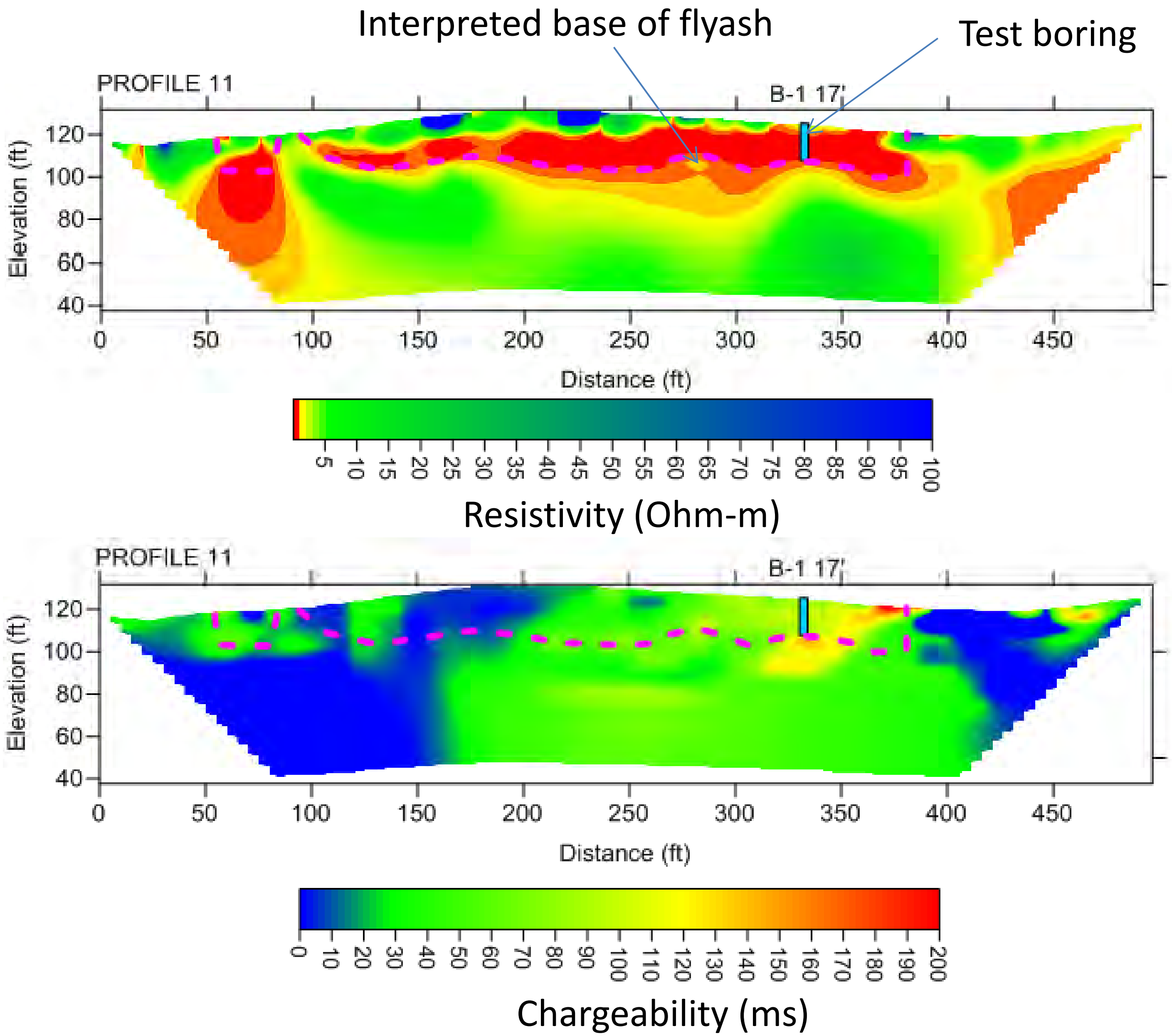
Chargeability (ms)



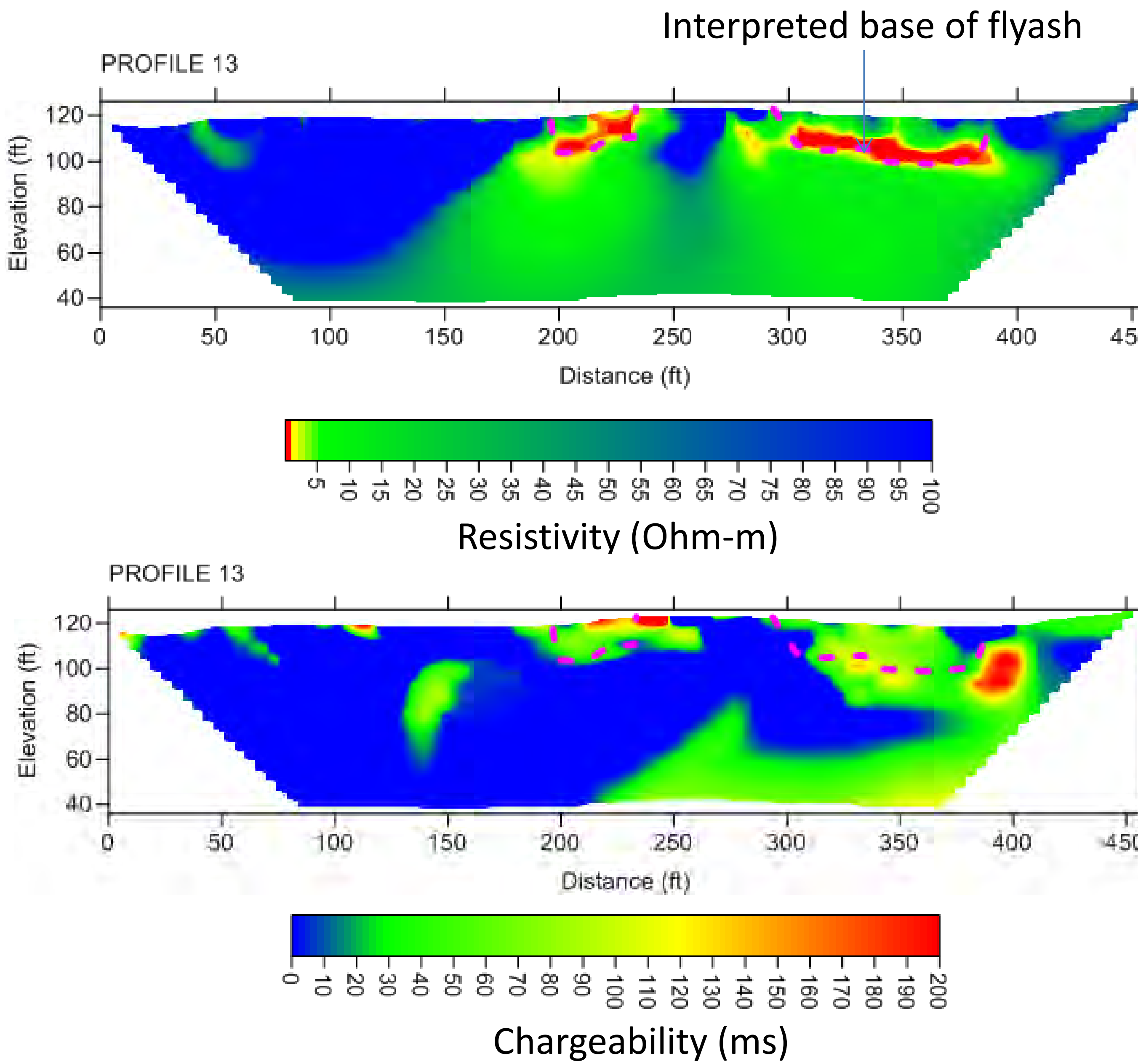
Test boring
Interpreted base of flyash
PROFILE 7
B-3 17'
Elevation (ft)
120
100
80
0
50
100
150
200
250
300
350
400
450
500
550
Distance (ft)
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Resistivity (Ohm-m)
PROFILE 7
B-3 17'
Elevation (ft)
120
100
80
0
50
100
150
200
250
300
350
400
450
500
550
Distance (ft)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Chargeability (ms)


Interpreted base of flyash
PROFILE 9
Elevation (ft)
100
80
60
40
0
50
100
150
200
250
300
350
400
450
500
Distance (ft)
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Resistivity (Ohm-m)

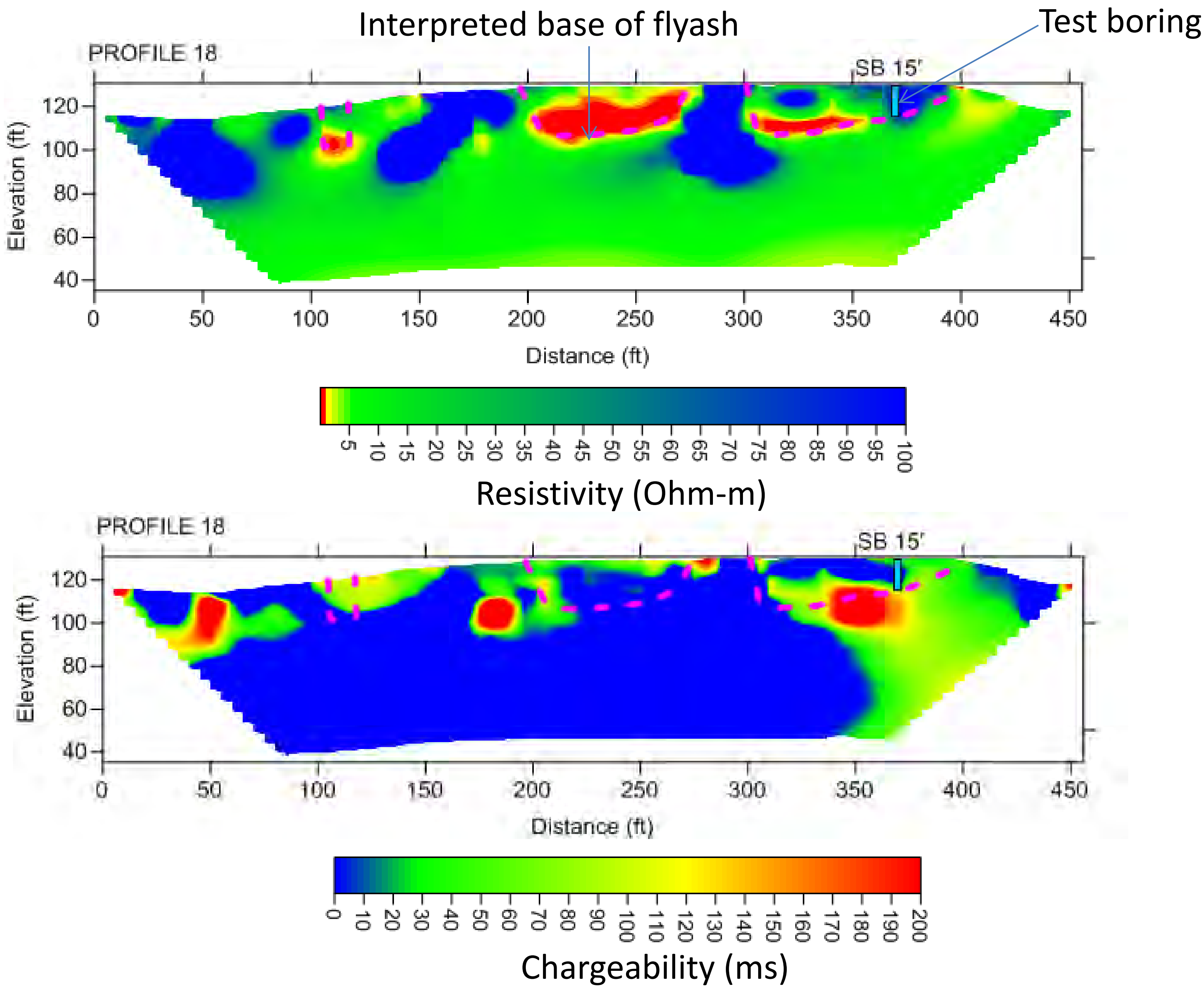

PROFILE 9
Elevation (ft)
100
80
60
40
0
50
100
150
200
250
300
350
400
450
500
Distance (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
Chargeability (ms)

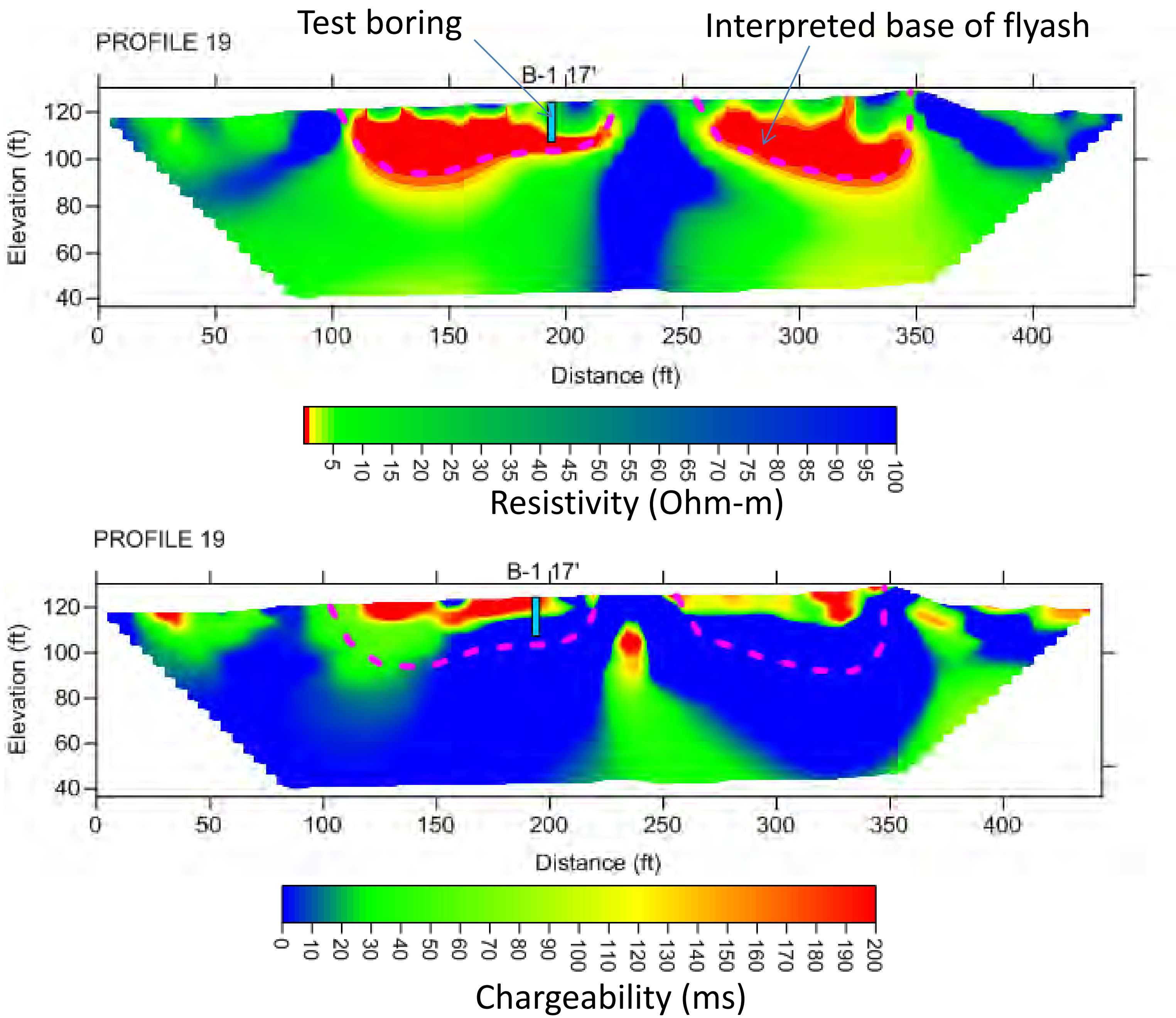


Interpreted base of flyash
Test boring
PROFILE 11
B-1 17'
Elevation (ft)
Distance (ft)
Resistivity (Ohm-m)
PROFILE 11
B-1 17'
Elevation (ft)
Distance (ft)
Chargeability (ms)

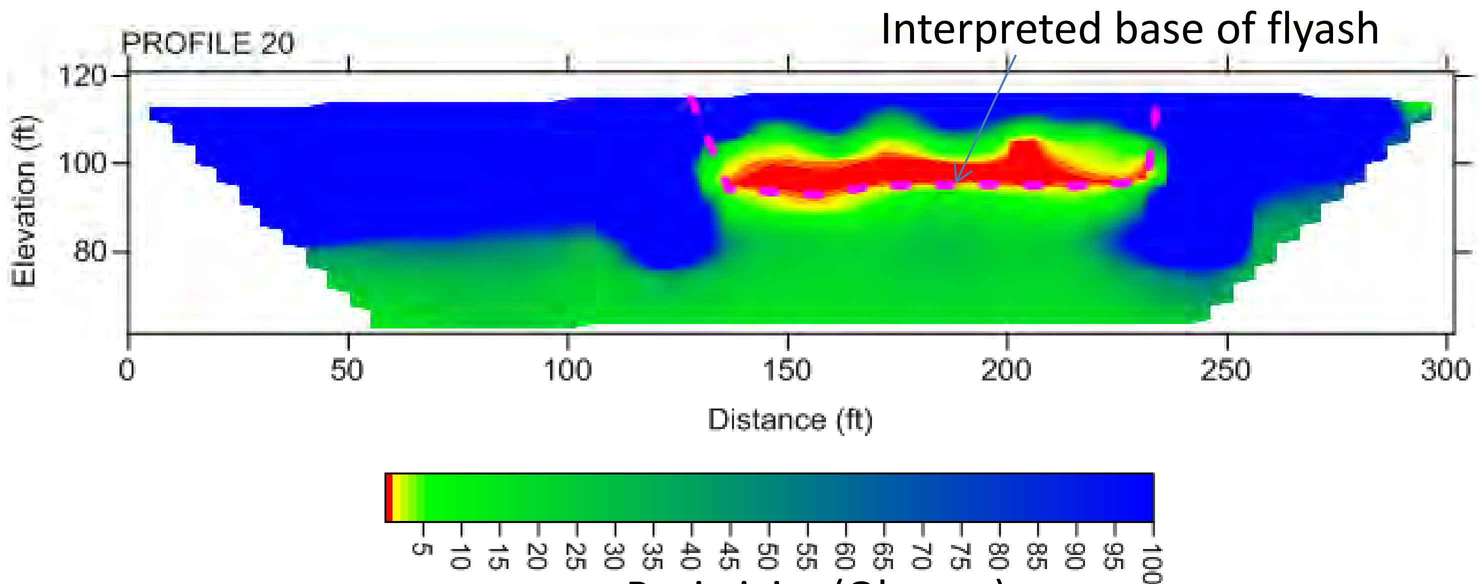


Interpreted base of flyash
PROFILE 13
Elevation (ft)
120
100
80
60
40
0
50
100
150
200
250
300
350
400
450
Distance (ft)
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Resistivity (Ohm-m)
PROFILE 13
Elevation (ft)
120
100
80
60
40
0
50
100
150
200
250
300
350
400
450
Distance (ft)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Chargeability (ms)

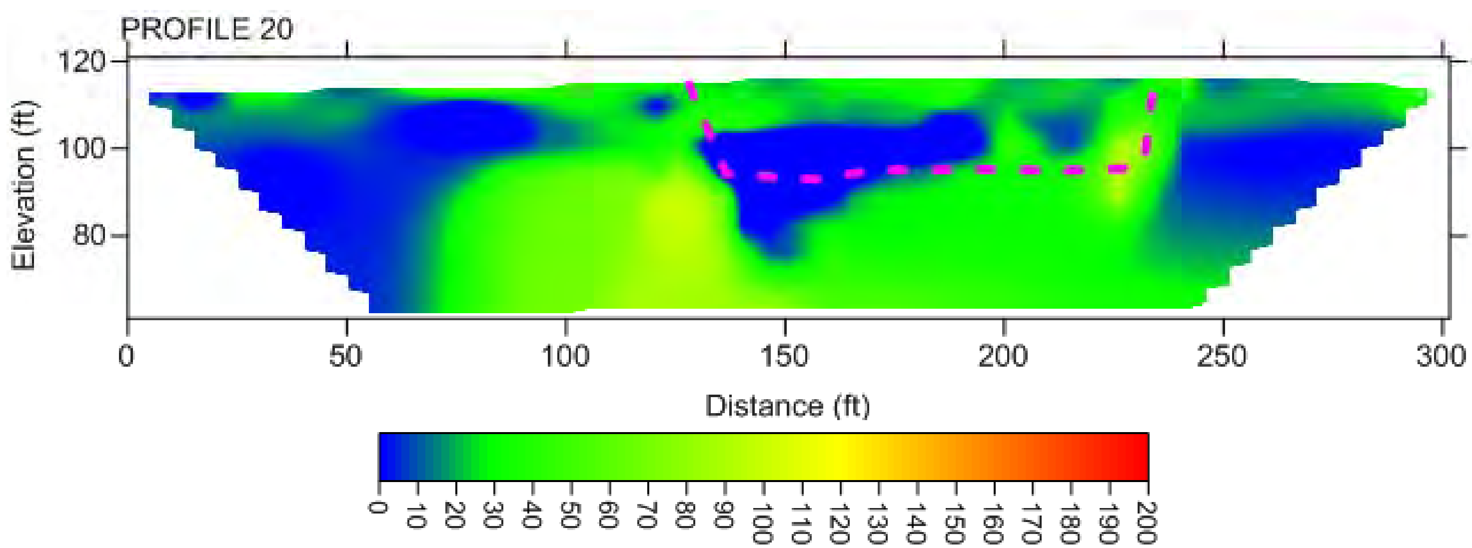

Interpreted base of flyash
Test boring
PROFILE 18
SB 15'
Elevation (ft)
120
100
80
60
40
0
50
100
150
200
250
300
350
400
450
Distance (ft)
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Resistivity (Ohm-m)
PROFILE 18
SB 15'
Elevation (ft)
Distance (ft)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Chargeability (ms)



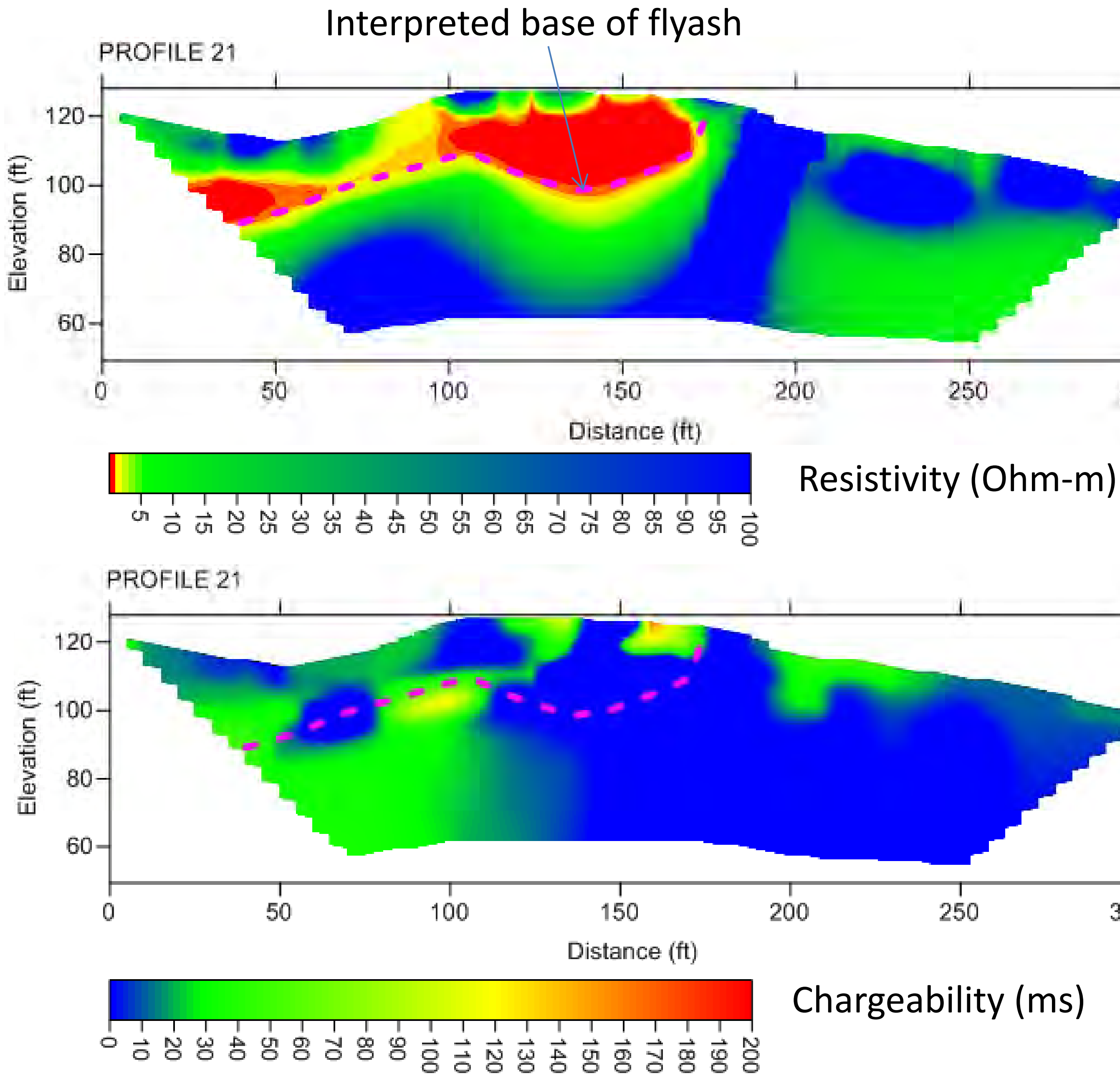
Test boring
Interpreted base of flyash
PROFILE 19
B-1 17'
Elevation (ft)
120
100
80
60
40
0
50
100
150
200
250
300
350
400
Distance (ft)
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Resistivity (Ohm-m)
PROFILE 19
B-1 17'
Elevation (ft)
120
100
80
60
40
0
50
100
150
200
250
300
350
400
Distance (ft)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Chargeability (ms)



Resistivity (Ohm-m)



Chargeability (ms)



Interpreted base of flyash
PROFILE 21
Elevation (ft)
Distance (ft)
Resistivity (Ohm-m)
PROFILE 21
Elevation (ft)
Distance (ft)
Chargeability (ms)