Prism GeoImaging

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Fishers, Indiana 46038-2728
www.prismgeo.com

May 2, 2023

Natalie Stoflet
Senior Staff Geologist
5835 W. 74th Street
Indianapolis, IN 46278-1757
natalie.stoflet@sme-usa.com

Re: Geophysical Investigation
UST Search
Former Filling Station
310 Hoosier Ave
Oolitic, Indiana
Prism Project No. 00-059-086

Dear Natalie,

Prism GeoImaging, Inc. (*Prism*) is pleased to present SME with this letter report documenting the geophysical investigation at the above-referenced project site (the "Site").

Introduction

Based on discussions with SME prior to the geophysical investigation, it was my understanding there is concern that one or more an underground storage tanks (USTs) may exist on the property. The site is approximately 0.6 acres in size, paved in asphalt and concrete with the station building and dispenser canopy remaining in the central portion of the Site. The filling station is no longer active, but the tanks, vent lines, fill ports, and dispenser island appear to be intact in the vicinity of the site building. Additionally, the southern portion of the site is reportedly a closed landfill. You have contracted Prism to complete a geophysical search to verify the UST system location and try to identify the bounds of the landfill.

Geophysical Methods

The geophysical methods that Prism chose to use on this project are time-domain electromagnetic metal detection (EMD) and ground penetrating radar (GPR) for the UST search, and electromagnetic induction conductivity mapping (ECM) for the dump investigation. A short discussion of these methods is as follows.

Electromagnetic Metal Detection

EMD data were collected with an EM61-MK2 metal detector manufactured by Geonics Ltd. In Mississauga, Ontario, Canada. The EM61-MK2 is a high-sensitivity, high-resolution, time-domain electromagnetic metal detector. It consists of two vertically separated 1-meter by 0.5-meter coaxial coils mounted to a wheel assembly. The instrument operator pulls the coil assembly along the line of profile while data is collected nearly continuously. The EM61-MK2 is designed to take readings from the bottom coil (designated as channel three) and an additional reading from the top coil. The top and bottom coil readings are then subtracted to selectively filter out the effect from near-surface metal objects (designated as channel difference calculation). The channel three reading is considered to be a measure of all metal both shallow and deep within the detection limits of the instrument, while the channel difference calculation is a measure of predominantly deeper metal only.

Ground Penetrating Radar

GPR works on a reflection principle, whereby a narrow band radar pulse of short duration is emitted downward into the ground by a transmitting antenna. A receiving antenna is used to record radar waves that are moving upward after being reflected from the boundaries between materials that have contrasting electrical conductivities and dielectric constants. The deeper an object is, the later in time the reflection will appear. Using knowledge of the velocity of radar waves in soil, the GPR profile can be presented in terms of estimated depth. The penetration depth of GPR is highly dependent on soil type. Clays and moist silty soils will disperse the radar signal and prevent it from penetrating into the subsurface. Thus, clayey soils block GPR and effectively limit the depth of exploration. GPR is often used for locating USTs underneath reinforced concrete because the high-resolution signal can penetrate the reinforcing mat and reflect off the tank surface below. The high-resolution subsurface characterization of GPR makes it well-suited to detecting abandoned and relic utilities; therefore, it is often used for boring clearance investigations as well.

GPR data were acquired using a cart-mounted 250 Mhz Noggin Plus GPR system manufactured by Sensors and Software Inc. in Mississauga, Ontario, Canada. The estimated signal penetration depth was approximately 5-6 feet.

Electromagnetic Conductivity Mapping

Electrical conductivity is one of the most widely varying physical properties of natural materials. Certain minerals, such as native metals and graphite, conduct electricity via the passage of electrons; however, electronic conduction is generally very rare in the subsurface. Most minerals and rocks are insulators, and electrical current preferentially travels through the water-filled pores in soils and rocks by the passage of the free ions in pore waters (i.e., ionic conduction). It thus follows that degree of saturation, interconnected porosity, and water chemistry (i.e., total dissolved solids) are the major controlling variables of the conductivity of soils and rocks. In general, electrical conductivity directly varies with changes in these parameters.

Conductivity geophysical surveys are often used for locating and mapping the extent of buried waste, fill material, and landfilled areas by providing indications of soil type based on the electrical conductivity. Typically, coarse materials (sand, gravel, non-reinforced concrete rubble, etc.) are the least conductive, whereas silt, clay, ash, cinders, wood, paper and other fine grained, moist materials are conductive to the highest degree of non-metallic materials. There is no unique direct conversion from conductivity values to lithology. However, based on site knowledge, geometric shapes and relationships of various anomalies, and the observed ranges of resistivity values, reasonable geologic interpretations can be made.

Electromagnetic induction conductivity instruments require no direct ground contact and therefore are well-suited to rapid scanning of very large areas, although affording limited information on the vertical distribution of anomalies. The instrument used for this work is an EM31, an industry-standard electromagnetic conductivity meter manufactured by Geonics Ltd. in Mississauga, Ontario, Canada. The EM31 operates by inducing electrical current flow in the subsurface by generating an electromagnetic field via a transmitter coil of wire; a receiver coil located at the other end of the instrument (separated by a distance of 12 feet) is used to measure the resulting subsurface current flow. The instrument then converts the transmitter output and receiver input values into apparent conductivity and magnetic susceptibility measurements.

The EM31 offers two depths of exploration. Operating the instrument with the transmitter/receiver coils oriented vertically (producing horizontal dipoles) preferentially samples the shallow subsurface materials; the manufacturer rates the maximum depth of exploration in this orientation to be 9 feet (75% of the 12 feet coil spacing). Operating the instrument with the transmitter/receiver coils oriented horizontally (producing vertical dipoles) preferentially samples deeper subsurface materials, the manufacturer rates the maximum depth of orientation in this orientation to be 19 feet (150% of the coil separation) with materials at about 8-12 feet depth having the greatest effect on the instrument readings.

Data Collection

EM61-MK2 were collected along profiles spaced approximately 2-3 feet apart using an RTK GNSS system to determine the instrument position (see Figure 1 for data coverage). Possible UST anomalies identified with the EM61-MK2 were additionally scanned with GPR, analyzing and interpreting the radar data in real time.

EM31 data were collected along profiles spaced approximately 10 feet apart, using the same RTK GNSS system to determine the instrument position (see Figure 1 for data coverage). EM31 data were collected in vertical dipoles orientation (19 feet maximum depth of exploration).

Results

UST Search

The EM61-MK2 data were processed with *Surfer v27* authored by Golden Software, Inc. The channel difference map is presented on Figure 2. EM61-MK2 anomalies are generally consistent in character from site to site, independent of the environment. For a typical steel UST, the magnitude of the channel difference anomaly is generally in the low to mid 100's millivolts. Large metal objects that are close to the surface (e.g. reinforced concrete, iron manhole covers) cause high instrument readings that are often too large to be entirely filtered out by the differencing calculation. Standard USTs are often easily identifiable on GPR radargrams, appearing as curved reflections across the tank axis, and flat reflections along the tank axis.

Prominent on the EM61-MK2 channel difference map (Figure 2) are two USTs along with their associated fill ports, product lines, and vent pipes. A linear anomaly connecting the dispenser area to the electrical panel at the back of the building is interpreted as the buried electrical service that feeds the UST system. The UST locations were painted on the ground with high-visibility spray paint. Also prominent on the EM61-MK2 map are sever areas of reinforced concrete, including the dispenser islands. These areas were scanned with GPR, no UST anomalies were found below. GPR scans of the reinforced concrete and USTs indicated a small area that is consistent with a filled excavation, if this is a filled excavation it may contain items of interest to your investigation. These results and interpretations are summarized on Figure 4.

Landfill Investigation

The EM31 data were processed with Surfer v27 authored by Golden Software, Inc. The conductivity map is presented on Figure 3. Utility lines at the western and eastern edges of the property have caused

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interference in the EM31 readings; within these areas any response from landfilled materials would be masked by the utility line response. A large irregularly-shaped area of low conductivity readings (approximately 1-25 mS/m) is interpreted as the landfilled materials; this feature is denoted with a dashed line and slanted line fill on Figure 3 and the results summary on Figure 4. The EM61-MK2 map indicated that scattered metallic material will be found within the landfilled materials.

Limitations

This geophysical survey was intended to locate steel USTs and potential landfilled materials. Anomalies of potential interest that are dissimilar to these targets may have gone undetected or uninterpreted by this survey. Areas obscured by features such as debris and structures may conceal additional anomalies of interest that are unknown at this time.

The enclosed figures are considered to be of sufficient accuracy and precision to provide you with positional data for further investigation activities. The enclosed figures, while they may indicate locations of utilities, are not to be taken as a map of utility locations and are not a substitute for a private utility locate.

Closing

Prism Geoimaging, Inc. appreciates the opportunity to provide SME with this geophysical survey, and I look forward to working with you on future projects. If you should have any questions regarding this project, please do not hesitate to contact me. I can be reached by telephone/txt at 317.379.5796, or by email at jvanderlaan@prismgeo.com.

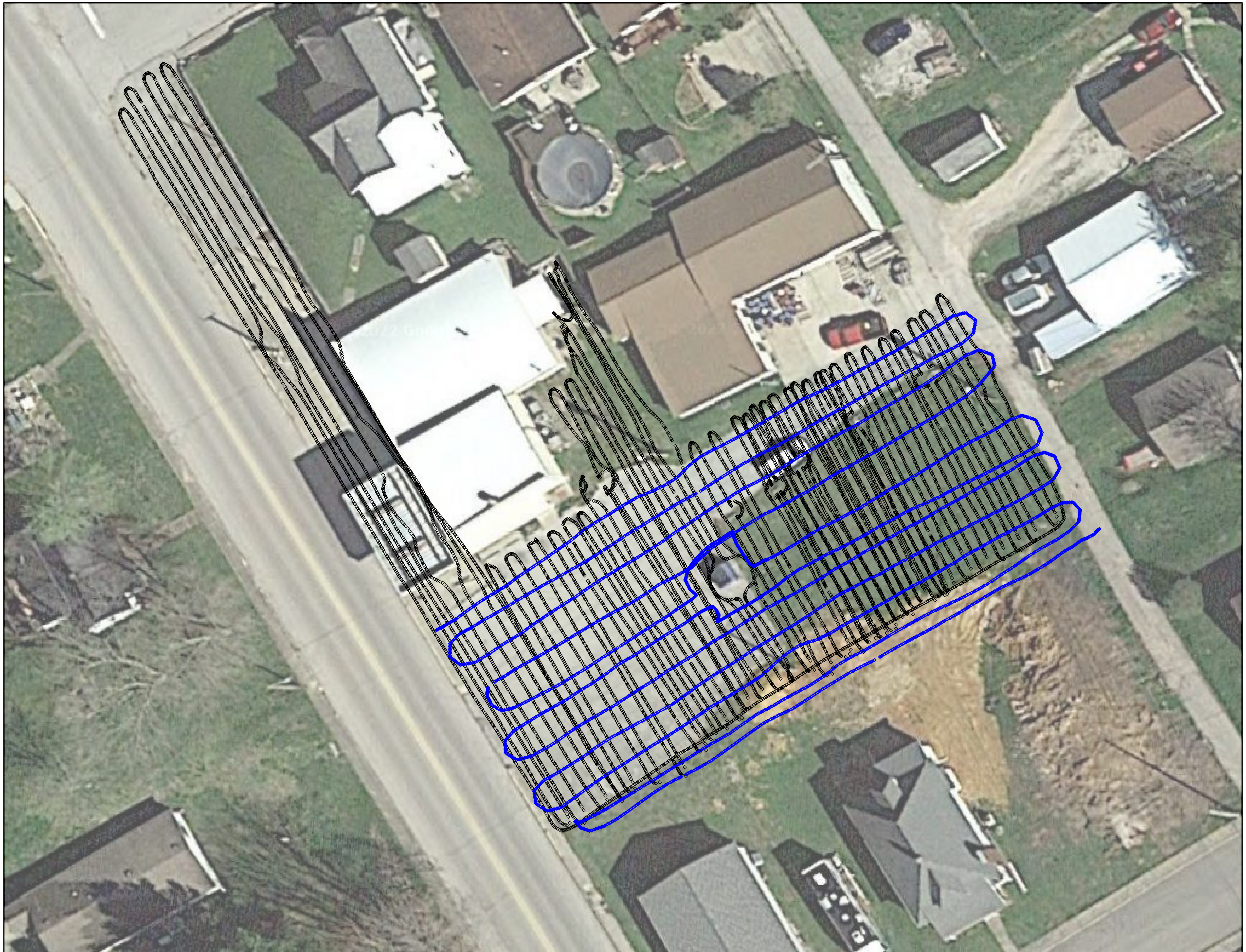
Sincerely,

Prism GeoImaging, Inc.

LICENSED JOHN H. M. VANDERLAAN No. 2146 INDIANA PROFESSIONAL GEOLOGIST

John Vanderlaan, LPG, PG
President / Geophysicist

Attachments:	Figure 1.	Site Layout and Data Coverage
	Figure 2.	EM61-MK2 Channel Difference Map
	Figure 3.	EM31 Conductivity Map
	Figure 4.	Results Summary Map



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EM61-MK2 Data Point Locations

EM31 Data Point Locations

Scale in Feet

0 20 40 60

1" = 30'

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Figure 1

Site Layout And Data Coverage

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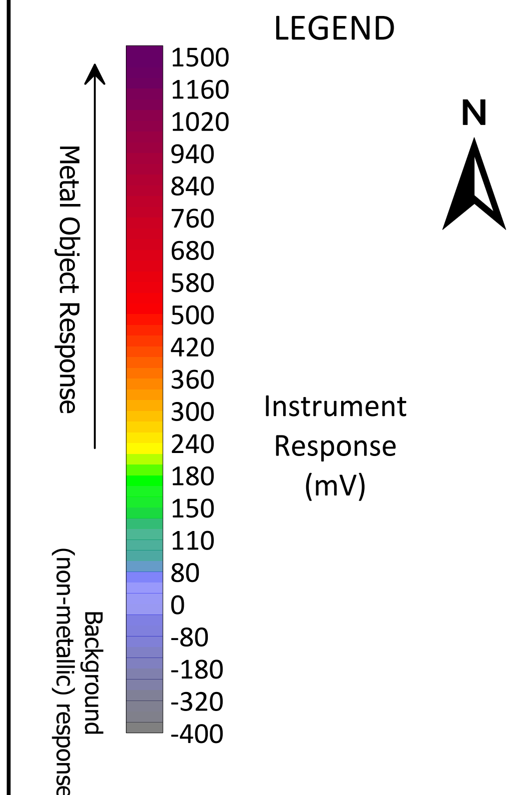

Scale in Feet

0 20 40 60

1" = 30'

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Figure 2

EM61-MK2 Ch Difference Map

Predominantly Deeper Metal Only

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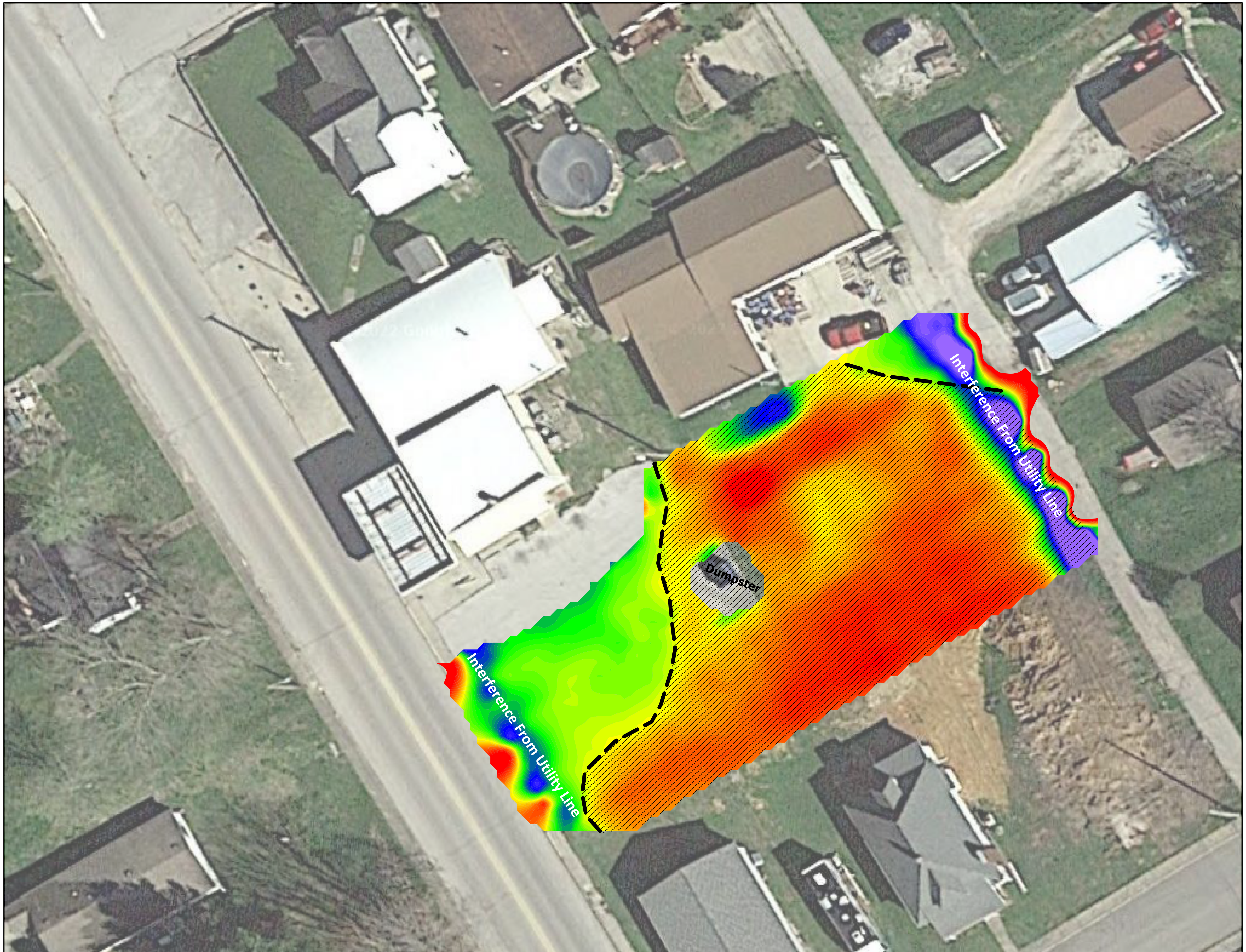

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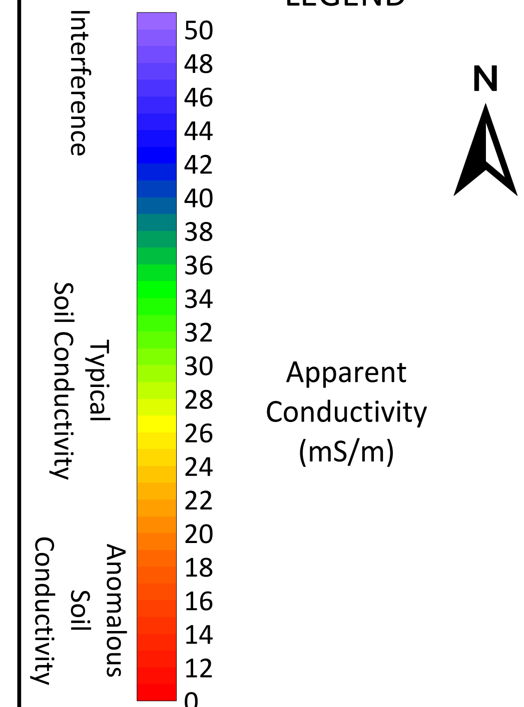

Interpreted Limits of Landfill Material

Scale in Feet

0 20 40 60

1" = 30'

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Figure 3

EM31 Conductivity Map

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Interpreted Limits of Landfill Material

Scale in Feet

0 20 40 60

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Figure 4

Results Summary Map

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