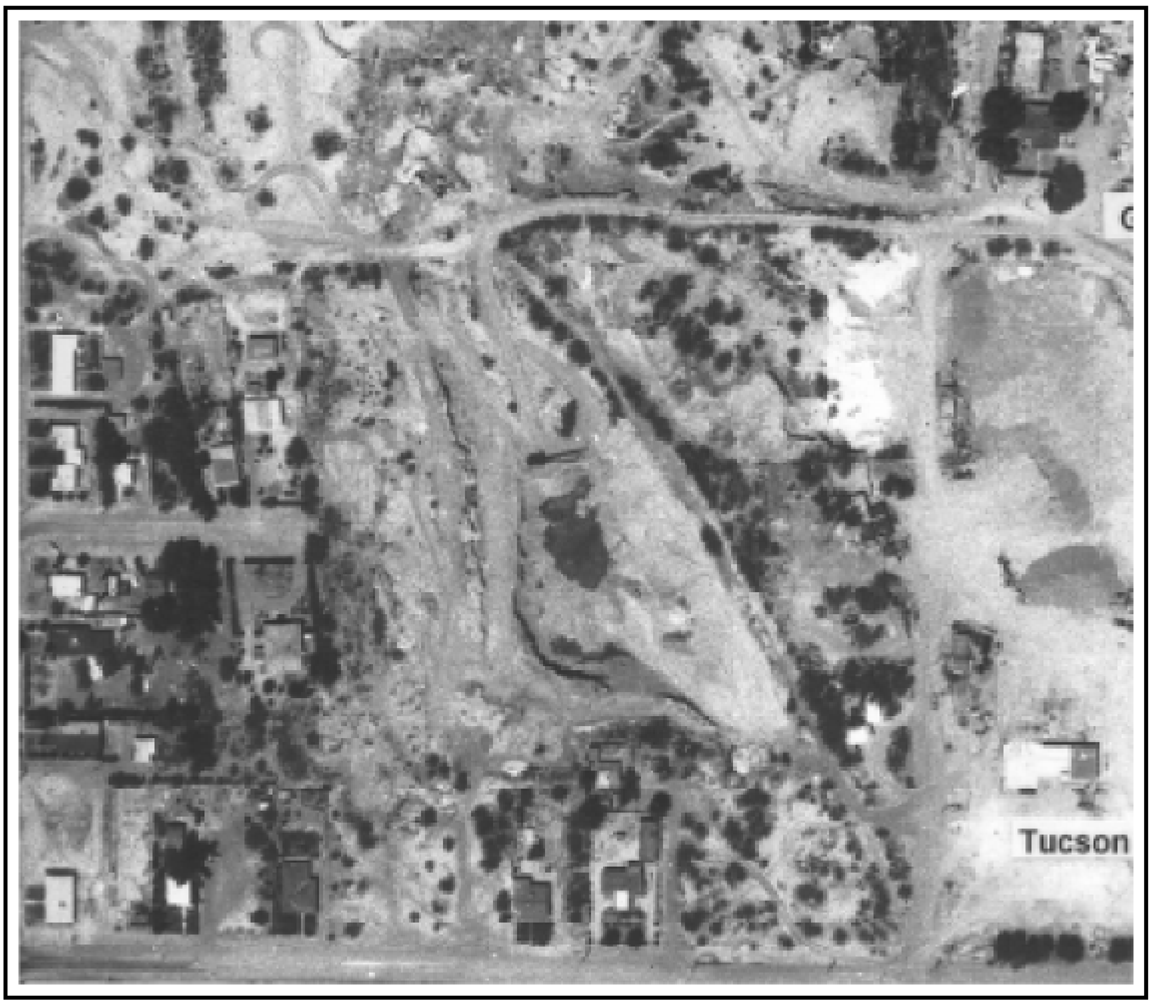
Induced Polarization

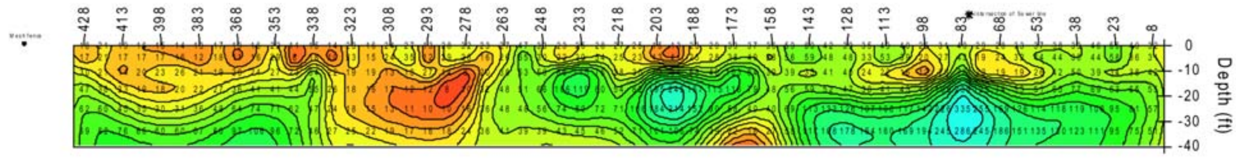
Buried Landfill Delineation

Induced polarization (IP) and resistivity can be very useful tools in mapping environmental features such as buried landfills, but the survey speeds and pseudosection interpretations have been drawbacks. New multichannel receivers with computer-controlled multiplexers now allow extremely fast data acquisition, and two-dimensional smooth-model inversion (with topography) provides realistic geo-electric cross sections.

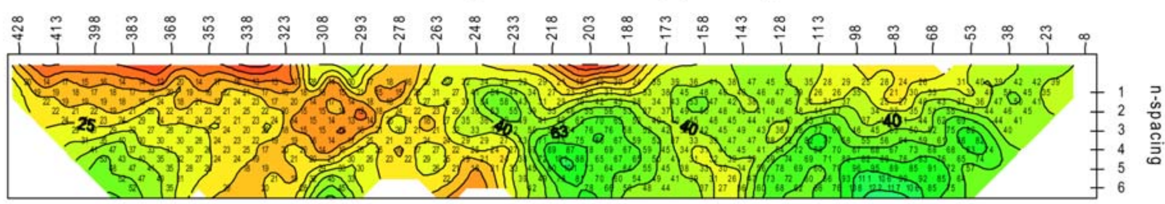


The survey area in this project has been used as a landfill since 1953. Pits or holes left from local brick and clay companies have been filled in with municipal garbage. The location and extent of these pits can only be assumed from aerial photographs. In the early 80's some of the garbage was removed in a random manner. An IP and resistivity survey line was run over the property as a test to determine if the small pits of garbage could be delineated with these methods. To keep expenses to a minimum, Zonge utilized the MX-30 which is a computer-controlled switching interface between a resistivity transmitter, a multichannel receiver such as the GDP-32, and an array of up to 30 electrodes. The data set below consists of three overlapping spreads of dipole-dipole data, each consisting of 236 data points. The reciprocal of each data point was also read (with the transmitter and receiver dipoles reversed), resulting in a total of 1,416 data points, providing measurements at n=0.5 to n=6 at 0.5n increments. A field crew of three was able to acquire this data in about 4 hours.

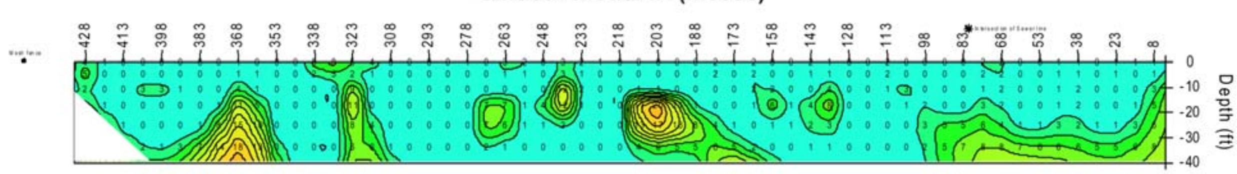
Smooth model Resistivity (ohm-m)



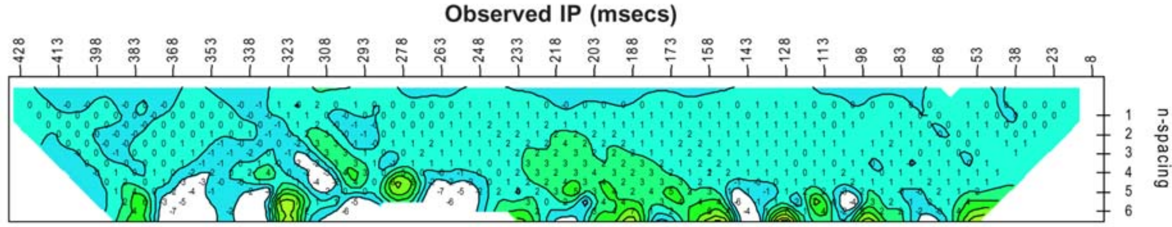
Observed Apparent Resistivity (ohm-m)



Smooth model IP (msecs)

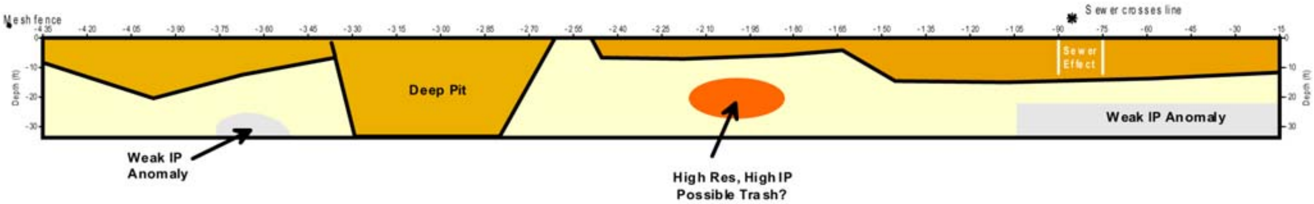


Observed IP (msecs)



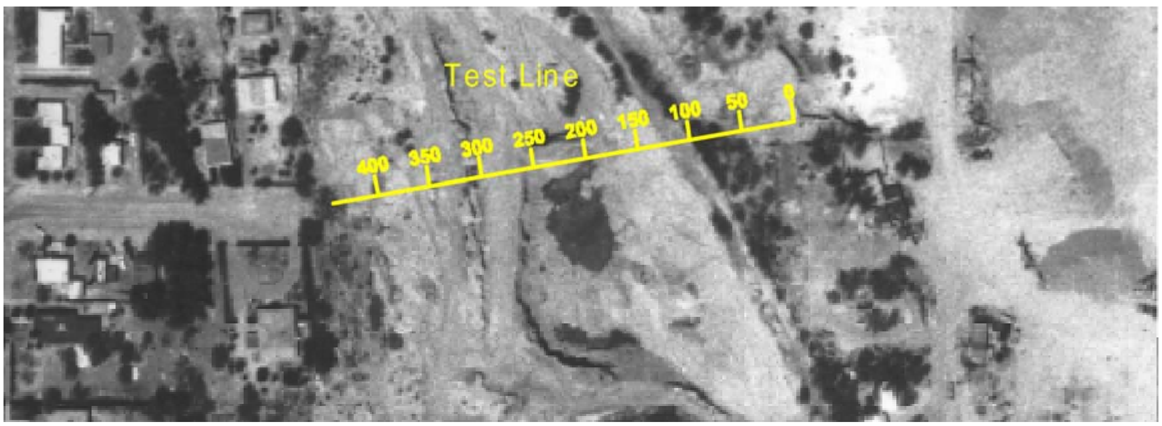
Dipole-dipole IP and resistivity data were inverted to smoothly-varying model cross-sections using a two-dimensional model for each line. The model section depth was based on a multiple of the dipole length. Starting model resistivity and IP phase were estimated using a broad moving-average filter. Model section resistivities were inverted first using an iterative procedure, then model IP phase values were adjusted. The final model reflects a compromise between maintaining a smoothly varying model and generating calculated apparent resistivity and IP phase values that fit observed data as closely as possible.

Interpretation

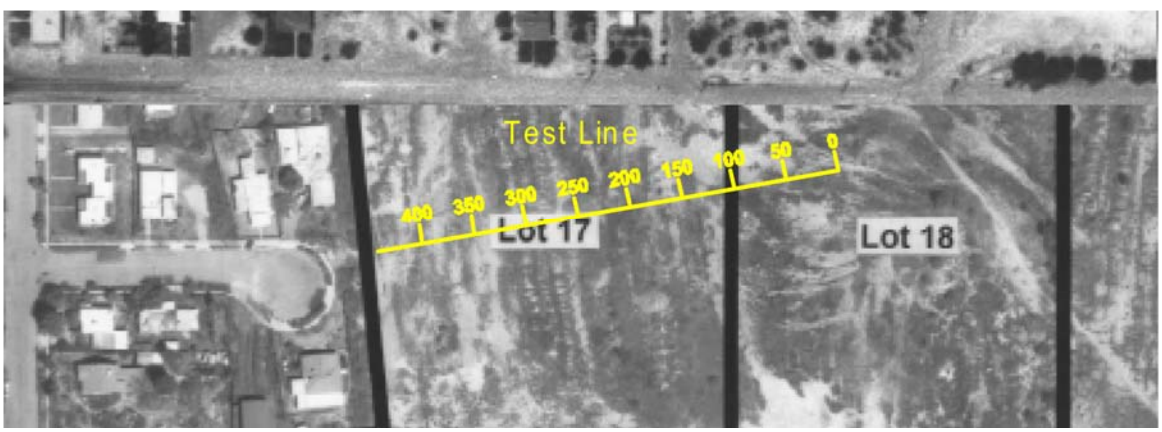


The cross section above is an interpretation based on the IP and resistivity data. Below are two aerial photographs, one from 1953 and the other from 1998. The area marked as the deep pit on the interpreted section correlated well with the location of two scarp-like features seen on the 1953 aerial photograph at approximately stations 320 and 270. The high IP anomaly located under station 203 may be the northern extent of the dark pond or pit also evident in the 1953 photograph. The area around the test line will soon be drilled to verify the results.

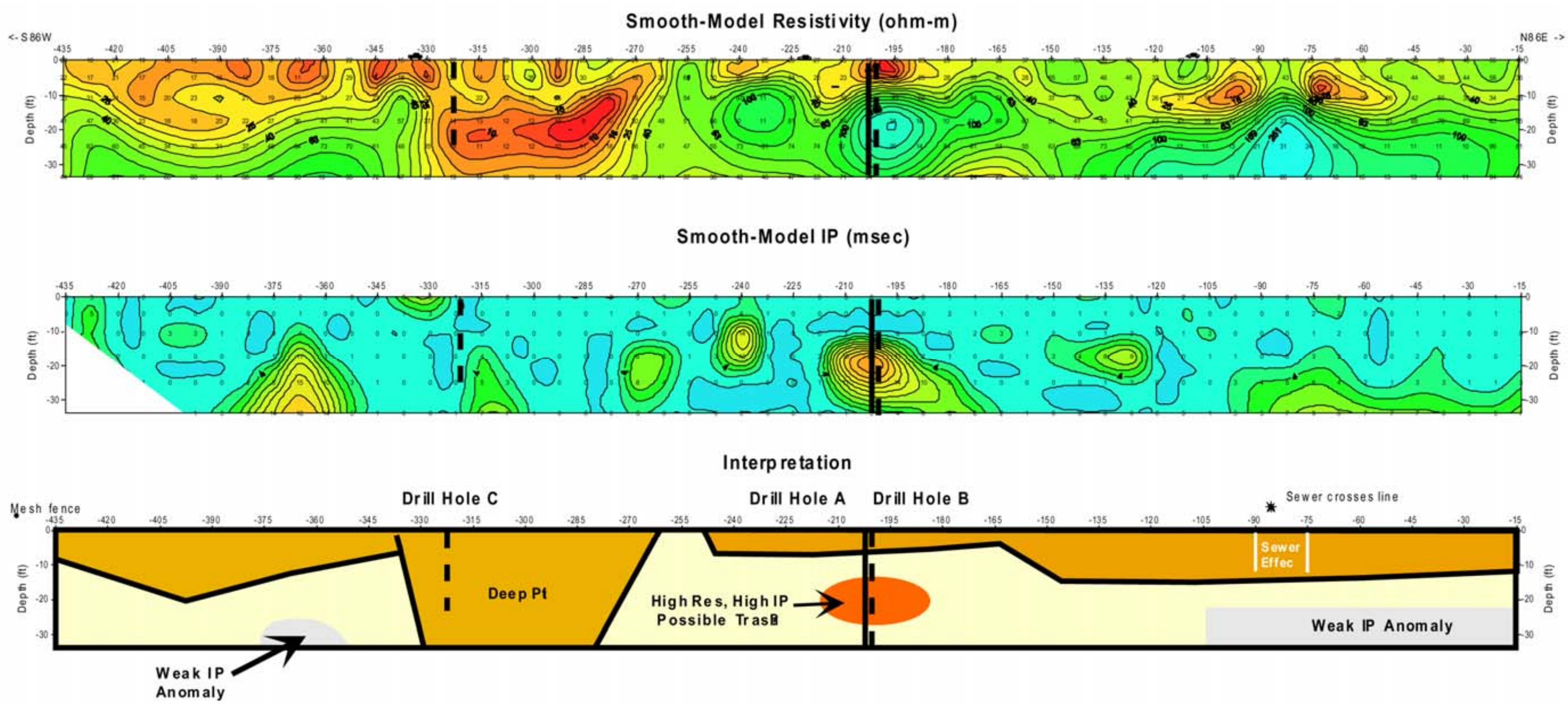
1953 Aerial Photograph

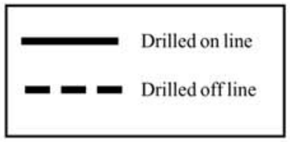


1998 Aerial Photograph

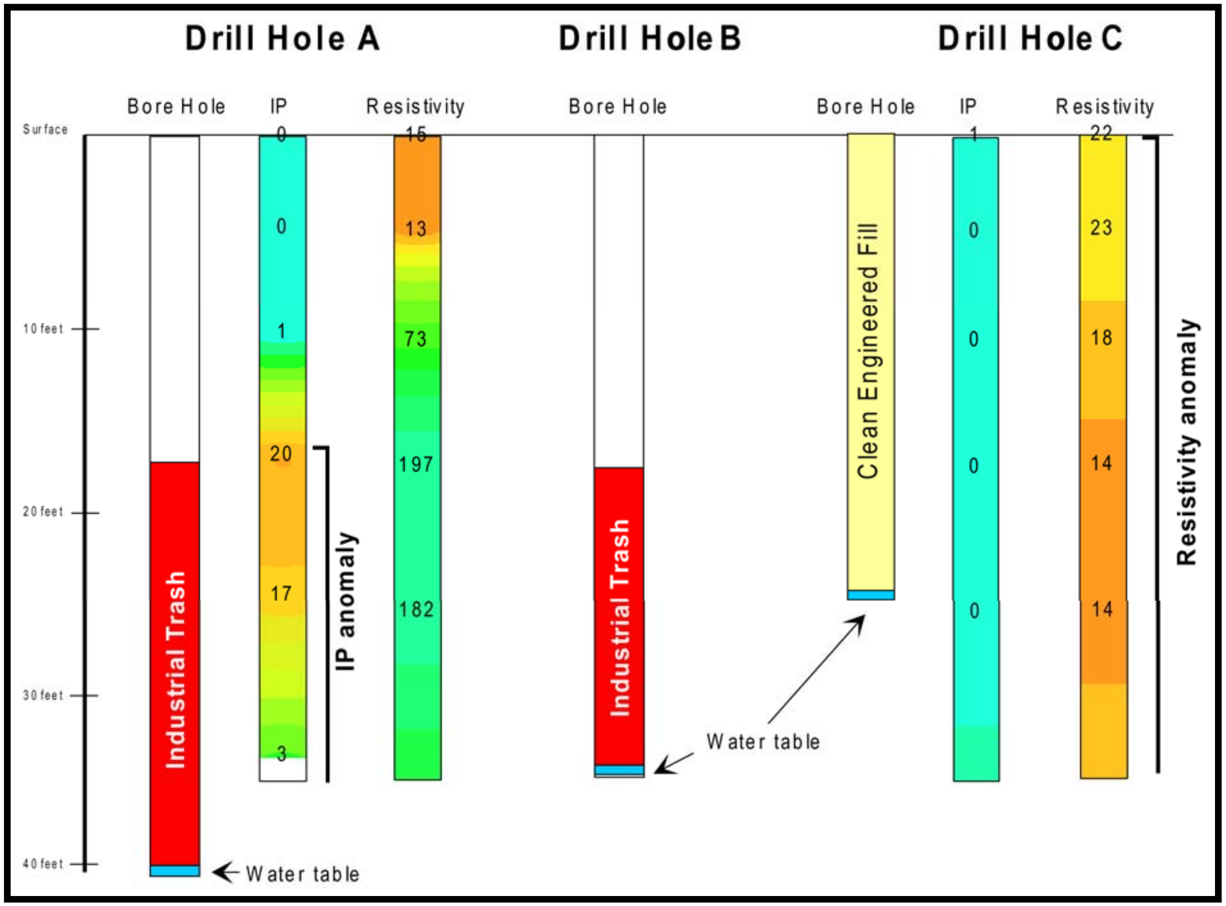


Drill Hole Location





Drill Hole Results



Drill Hole A was positioned over the IP high response noted on the cross section. The correlation between the depth of the industrial trash and the modeled location of the IP is excellent. Note that a resistive high, not a conductor, is associated with the location of the garbage.

Drill Hole B and A show similar drilling results.

Drill Hole C was positioned over the conductive feature labeled as the deep pit structure on the interpretation (20 feet to the south). No IP is associated with the conductor, thus no garbage was expected. The drill hole showed only clean engineered fill, no garbage.

The test line for this project help confirm that Induced Polarization (IP) can help locate landfill garbage. Resistivity results can not help distinguish between areas that contain trash and areas which have been backfilled with clean fill material. Thus it is important to use both IP and resistivity data sets when locating landfills.

Drill Hole A: Directly over the center of the anomaly. Industrial garbage was encountered from 17 to 40 feet.
Drill Hole B: 27 feet south of Drill Hole A. Industrial garbage encountered from 17 to 35 feet.
Drill Hole C: Western edge of deep pit structure, 20 feet south of line (due to dense vegetation). Recovered engineering fill from the surface down to 25 feet.

Due to environmental regulations, all drill holes were terminated once ground water was hit.

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