Appendix C: Ground Penetrating Radar Report

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TECHNICAL MEMORANDUM

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SUBJECT: **GRP SURVEY OF RESIN TANK AREA - US ECOLOGY LLW SITE, RICHLAND, WASHINGTON**

DATE: May 23, 2008

1.0 INTRODUCTION

This technical memorandum summarizes work that was conducted to provide supplemental information for a Remedial Investigation/Feasibility Study of the US Ecology Low-Level Radioactive Waste Disposal Facility (LLWRDF) being conducted by VISTA Engineering. This information was initially needed before planned drilling of a number of boreholes at the US Ecology site commenced.

Five steel tanks were buried in the ground at the US Ecology LLRWDF Site in the 1960s. Three large tanks held up to 23,000 gallons of LLRW liquid, and two smaller tanks had a capacity of 1,000 gallons each; the location is shown in Figure 1 and 2. The proposed borehole locations for the resin tank area are provided in Figure 2.

The tanks provided storage for liquid LLRW to be treated by solar evaporation. The LLWRDF was from laundering activities and ion exchange resins from the U.S. Navy nuclear power plants. During the 1985, snow runoff, pooled water entered one of the tanks and filled it to the riser. Changing liquid levels in the tanks indicated liquid release from the tanks, estimated at 100-120 gallons.

In 1985-86, tank liquids were drained, stabilized, and disposed of in Trench 11-A (See Figure 1). The remaining tank bottom liquids were sampled and characterized as an extremely hazardous waste. The two smaller tanks were removed and the larger three tanks left in place after filling with concrete. The tank area was covered with soil on August 12, 1988.

In May 1988, eight soil borings (#1-8), as shown in Figure 3, were installed adjacent to the underground tanks. Ninety-four samples were collected for analysis. One background sample was collected from a boring about 50 feet from the underground tanks; no compounds were detected above the background sample. Composite samples were analyzed from two of the boring locations (#4 and #5) and one background location. One organic compound, Di-n-octylphthalate, was detected in both composite samples at concentrations of 300 ug/kg and 750 ug/kg. Direct radiation level readings on each sample were collected along with a visual inspection for discoloration. Good agreement between radiation levels and extent of discoloration was observed. Five additional boreholes (A-E) yielded another 33 samples; however, these were not submitted for laboratory analyses, and no confirmed quality assurance (QA)/quality control (QC) was in place during any of the sample collection or analysis. A composite sample from borehole #4 was considered representative of Tanks 2 and 3. A composite sample from borehole #5 had the highest radioactivity readings. Figure 4 shows the angle boring approach and depths of individual samples collected for the composite sample. However, composite samples are not appropriate for cleanup verification, and are not defensible for regulatory purposes.

As part of the RI/FS additional boreholes were planned to be drilled in the resin tank area. A non-invasive subsurface investigation was needed to locate the three remaining resin tanks and to identify any potential buried infrastructure, utilities, and other features that could present an obstacle to drilling around these resin tank locations.

2.0 WORK PERFORMED

HGI performed a GPR survey of the resin tank area with the purpose of locating the three individual buried tanks on May 8, 2008. HGI performed all services in a workman-like manner and in accordance with standard geophysical practices.

HGI's deliverable for this work was to provide a plan view map of the site that summarizes the results of the evaluation, including the interpreted centerline and end points of each tank

A brief summary of the key assumptions and approach for this GPR survey are as follows:

- HGI staff initiated the setup and data collection activities on May 8, 2008.
- US Ecology staff provided all site access including arranging a visitor's badge for one HGI staff member.
- US Ecology provided maps showing the estimated location of the tanks, as well as any infrastructure or utilities that would be important to the interpretation of GPR data to HGI staff prior to initial setup.
- HGI established a survey grid encompassing the subject buried resin tanks based on the historical data set provided by US Ecology. Measuring tapes were deployed to ensure an accurate 2 foot spacing interval for data collection.
- HGI performed the survey with a 200 MHz GPR antenna, which was deemed appropriate for the in-situ conditions of the tanks being surveyed.
- Grid corners were located with Survey-grade GPS.
- The original date for the deliverable for this survey was Tuesday, May 13, 2008.

3.0 FINDINGS AND RESULTS OF GPR SURVEY

Interpretation of the GPR data collected during this survey on May 8 were unsuccessful in locating the target resin tanks for a variety of technical issues. During original planning, the assumption was made, based off information provided, that the resin tanks were buried at a depth of 6 to 8 feet. With their large size and thick steel walls the resin tanks, buried in the sandy soil environment, appeared to be very good targets for an application of GPR methods. Contents of the tanks were not considered significant; void, concrete or liquids were not anticipated to make a difference that would be a hindrance to GPR data collection. However, based on historical records provided later to HGI field staff by USE staff, the tanks are found to be deeper than anticipated; between 11 to 12 feet below ground surface.

For the sandy soil conditions and depths that we were concerned with, we assumed that a 200 MHz antenna would be able to provide the required information. Our original proposal included the use of a 100 MHz antenna as a backup in case it was determined on site that a greater depth of investigation was required. A 100 MHz antenna however was not available in the requested time period. (Note: 100 MHz antennas are not readily available since it now requires special circumstances to purchase certain GPR antennas under new FCC regulations).

Analysis of the acquired GPR data showed that the 200 MHz antenna provided reasonable data down to a depth of 6 to 8 feet. The data collected indicated that the on-site soils appeared to absorb the radar signal more than would be expected for sandy soils. Target response can be seen from depths 8 feet below ground surface, but reliable signal return is lost below this depth (Figure 5). The underlying cause of this observation is not clear at this point but it may be related to changes in local-scale moisture conditions or clay content within the backfill material found directly above the resin tanks.

At shallower depths where the GPR data was of higher quality, some smaller-scale anomalies were detected within the upper four feet of the surface of the tank area (Figure 6).

In addition, near the boundaries of the resin tank area, some larger reflectors are apparent but are most likely reflections from native soil conditions or reflections from the side walls of the excavated tank area (Figure 7 and 8). They may represent the occurrence of clastic dikes or inter-bedded sedimentary structures, some of which may preferentially retain more moisture than the adjacent back-filled material within the tank basin.

The quality of data collected appears to have been significantly impacted by the frequency of intermittent radio signals from on-site communications. On-site radio signals were thought to have a large effect in swamping out the weak (low amplitude) reflection information of the deep GPR data collected (Figure 9).

The loud working conditions and ear protection requirement at the site hampered our ability to monitor and detect over-sampling alarms on our GPR instrument during the initial testing. This contributed to discontinuities in data collected during the test phase and slowed data production during portions of the data acquisition phase. The linear vertical features in the GPR data, shown in Figure 9, at lateral distances of 36’, 42’, 49’, and 54’, among others, provide an illustration of the effect of this data skipping on acquired data. The physical restrictions placed on field staff while on site caused by the on-going drilling operation also slowed data acquisition. While we often encounter such conditions and are able to adapt to almost any site requirements, we were unaware of these restrictions at this site prior to mobilization.

4.0 RECOMMENDATION OF OTHER OPTIONS FOR TANK DETECTION

Following are two recommendations for other options to locate the resin tanks.

Resurvey with 100 MHz antenna: Resurveying the resin tank area with a 100 MHz antenna would likely increase the depth of the GPR investigation. However, this approach would need to be field tested to determine whether this method can be used to acquire data down to the depth of the resin tanks. If a clay layer or clay rich layer was added during the burial of the resin tanks, any radar system will be challenged to provide adequate results.

Resurvey with EM and/or Magnetic Methods: Resurveying the resin tank area with EM and/or magnetic methods would be useful in finding the general location of the tanks, but the depth resolution of survey results may not be sufficient to assist in planning the location of angled boreholes, particularly if other metallic objects are buried in the tank area along with the resin tanks.

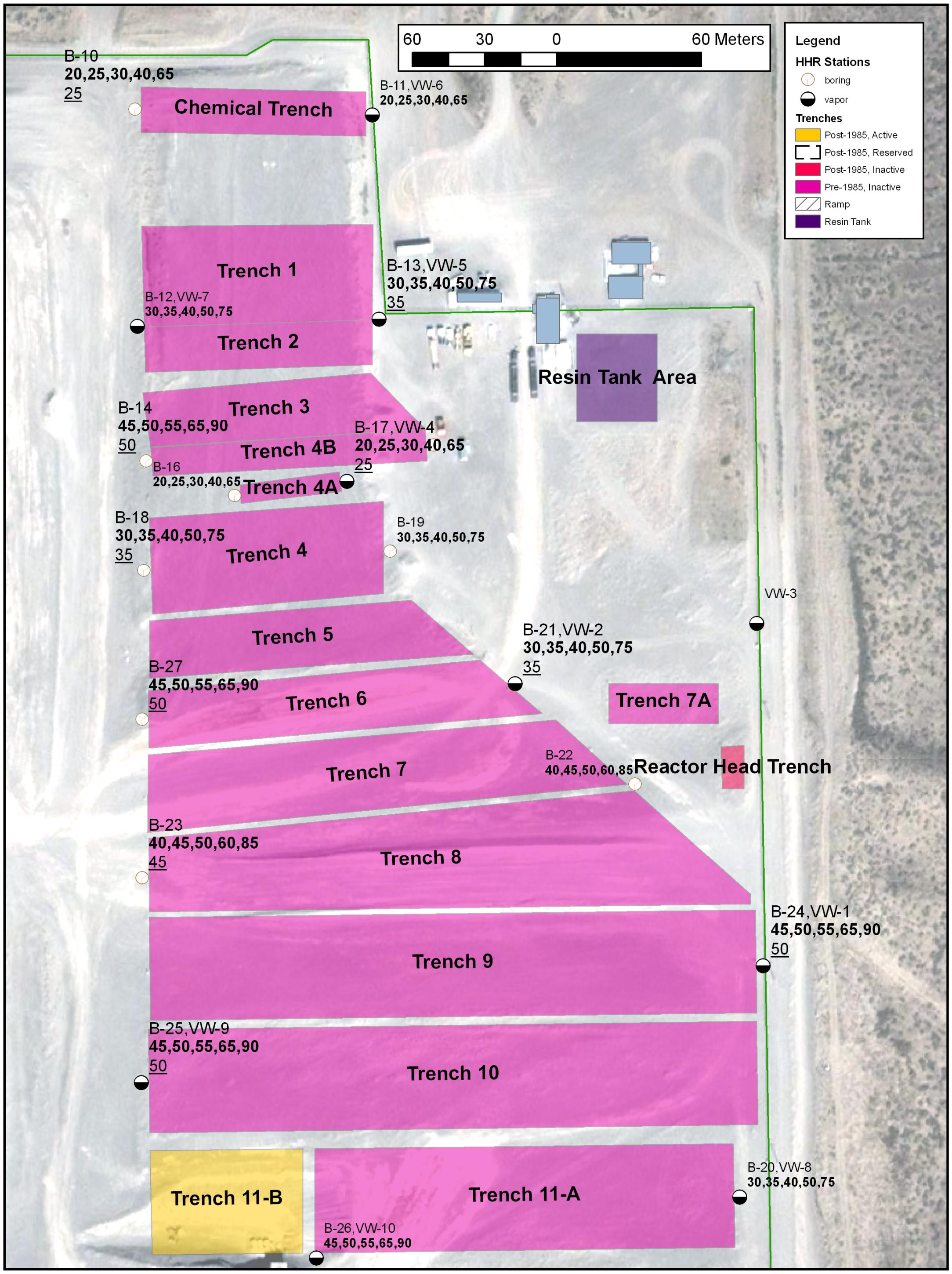

Figure 1. Trench Layout and Resin Tank Area at US Ecology LLWDF.

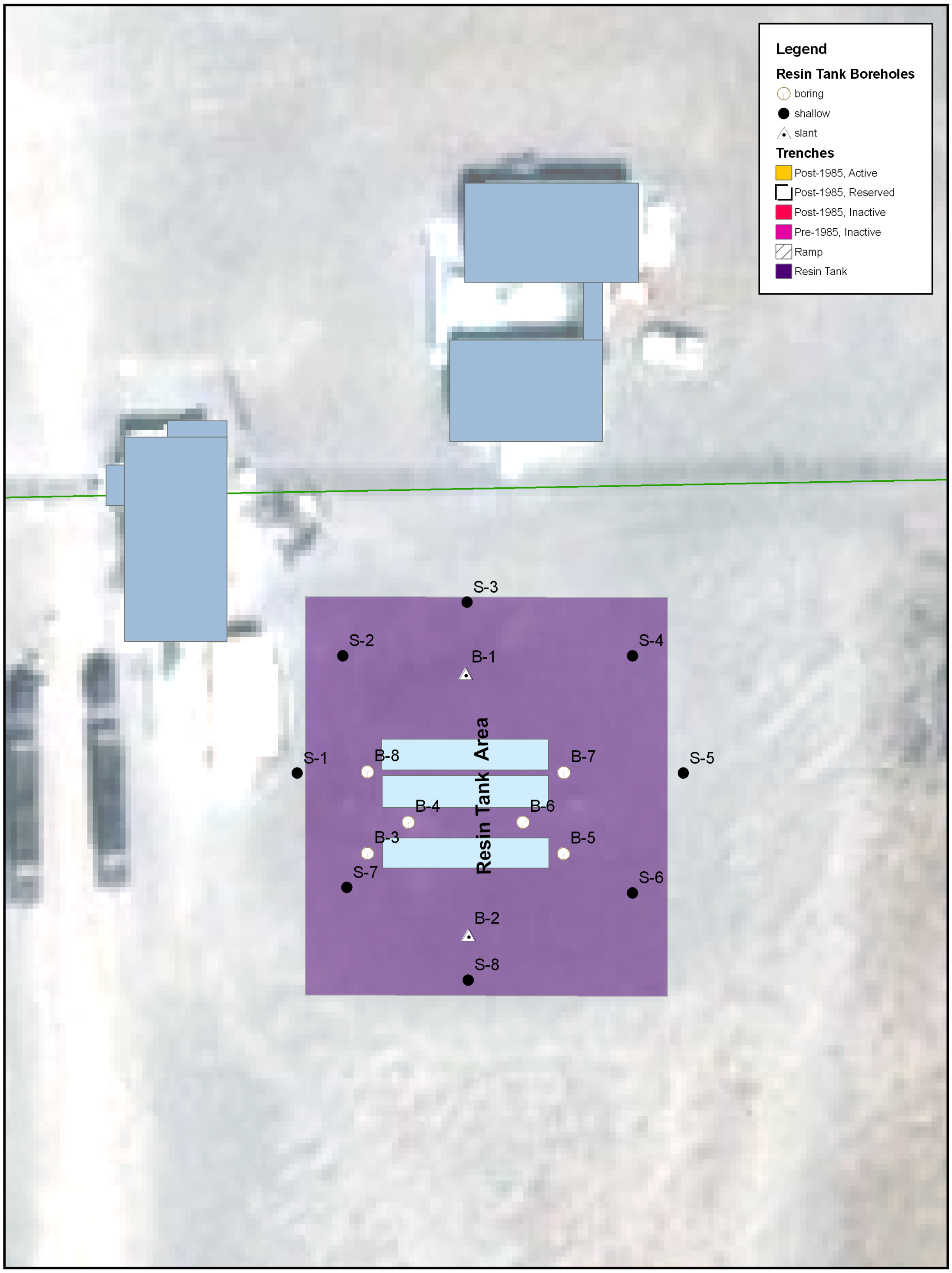

Figure 2. Proposed Location of Boreholes in Vicinity of Resin Tanks.

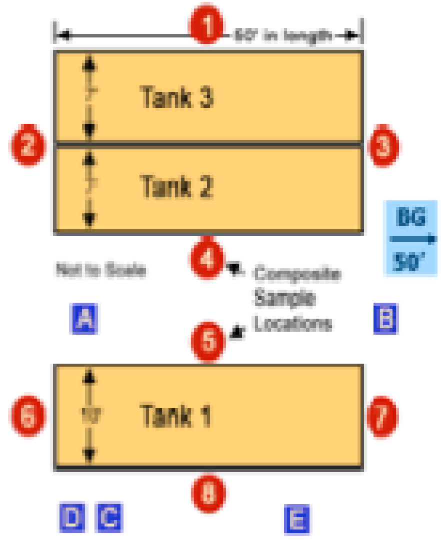

Figure 3. Location of Composite Sampling Sites near Resin Tanks 1 through 3.

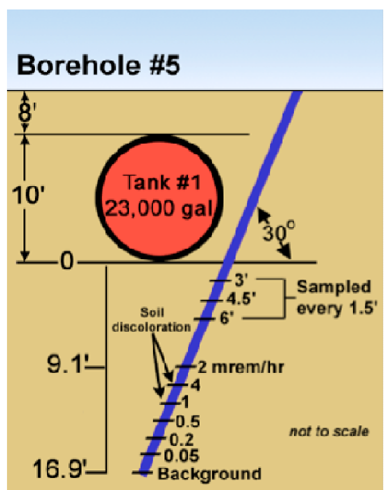

Figure 4. Radiation Rates in Samples from Borehole #5 near Resin Tank #1.

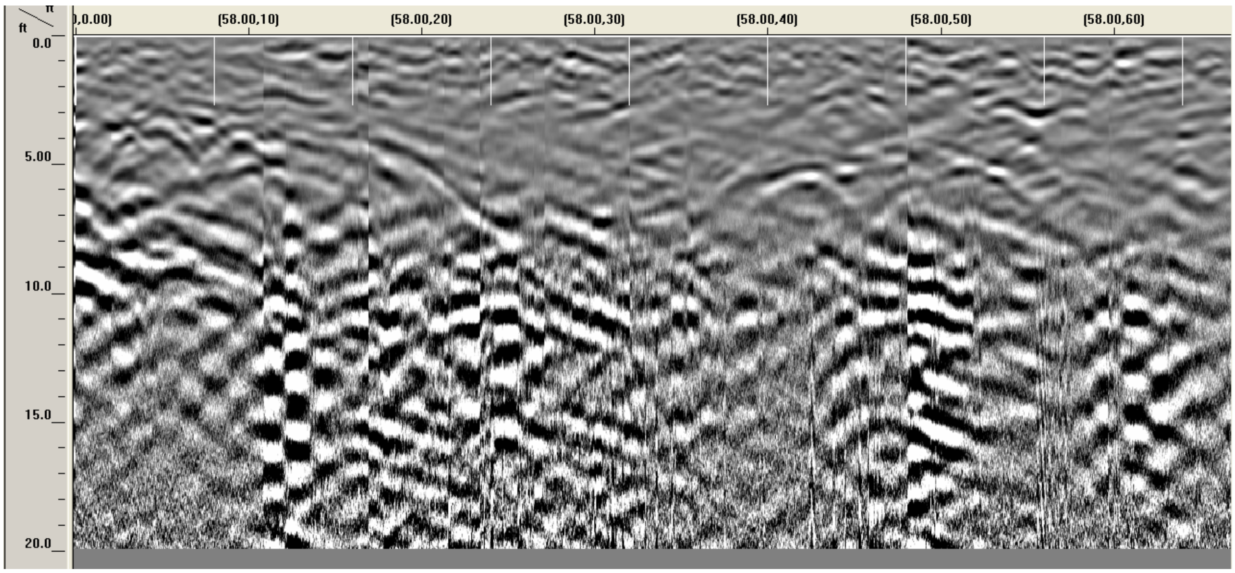

Figure 5. Radargram cross-section showing GPR data collected within GRID ECE02.

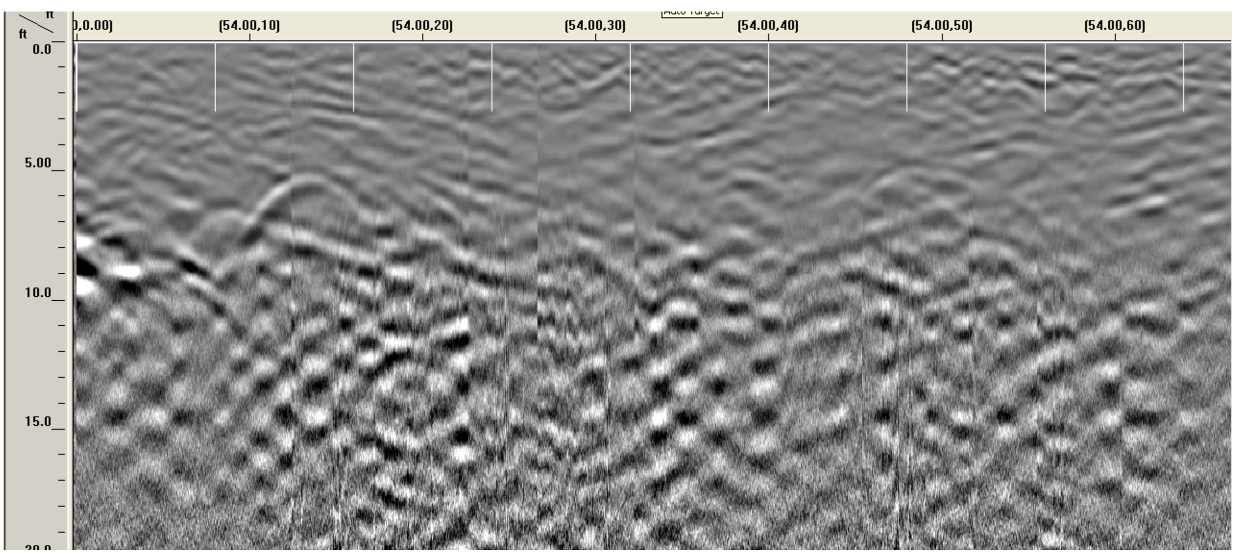

Figure 6. Radargram cross-section showing GPR data collected within GRID ECE02.

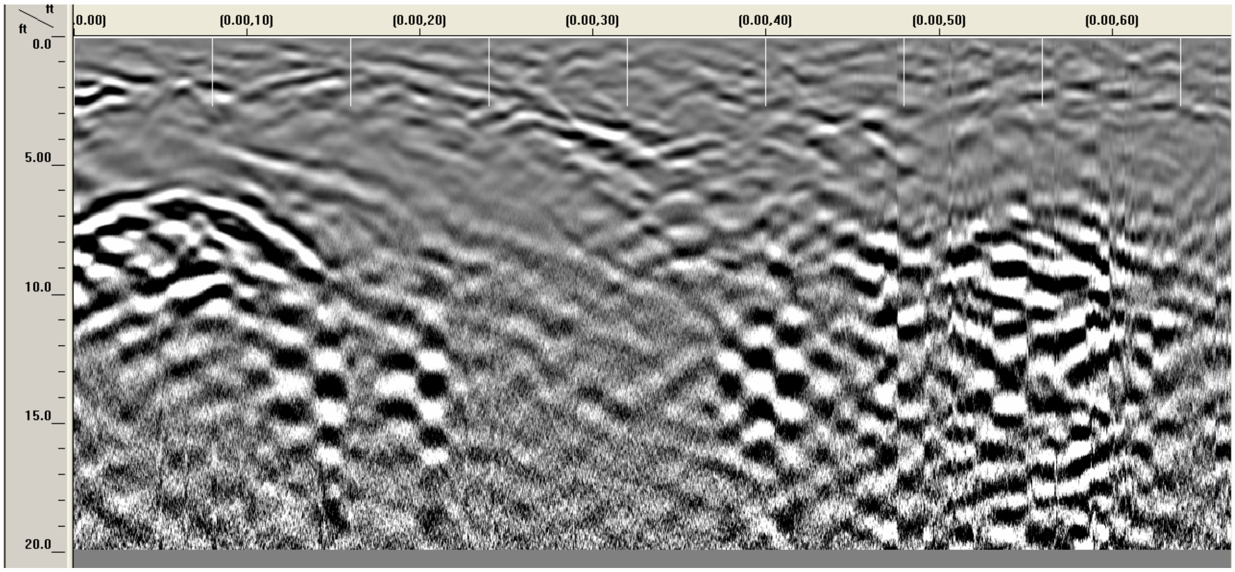

Figure 7. Radargram cross-section showing GPR data collected within GRID ECE02.

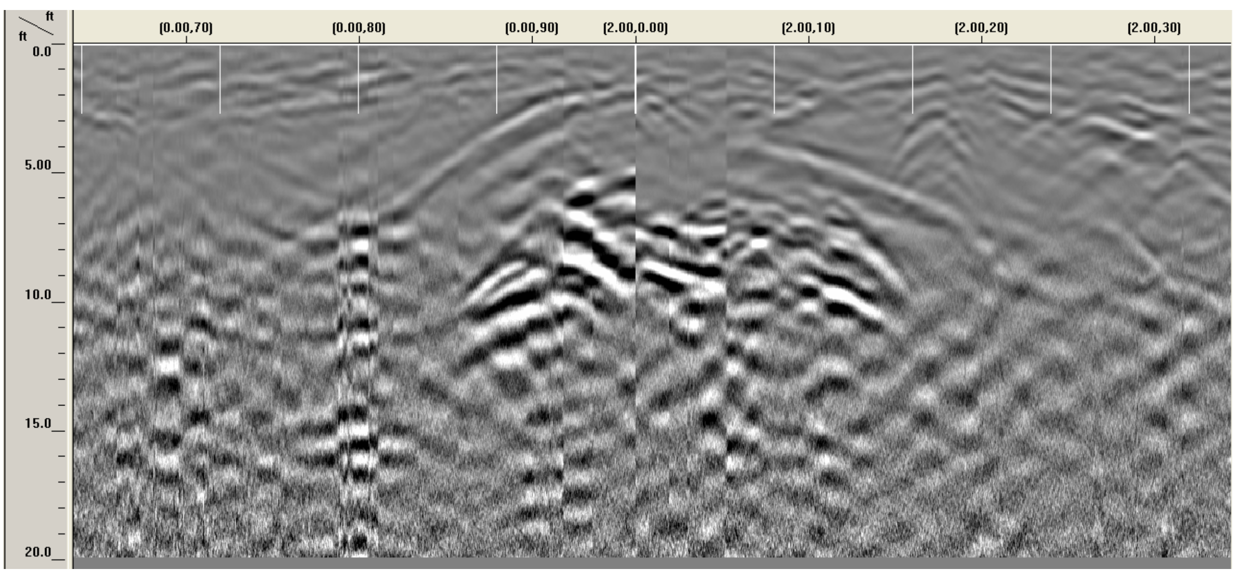

Figure 8. Radargram cross-section showing GPR data collected within GRID ECE02.

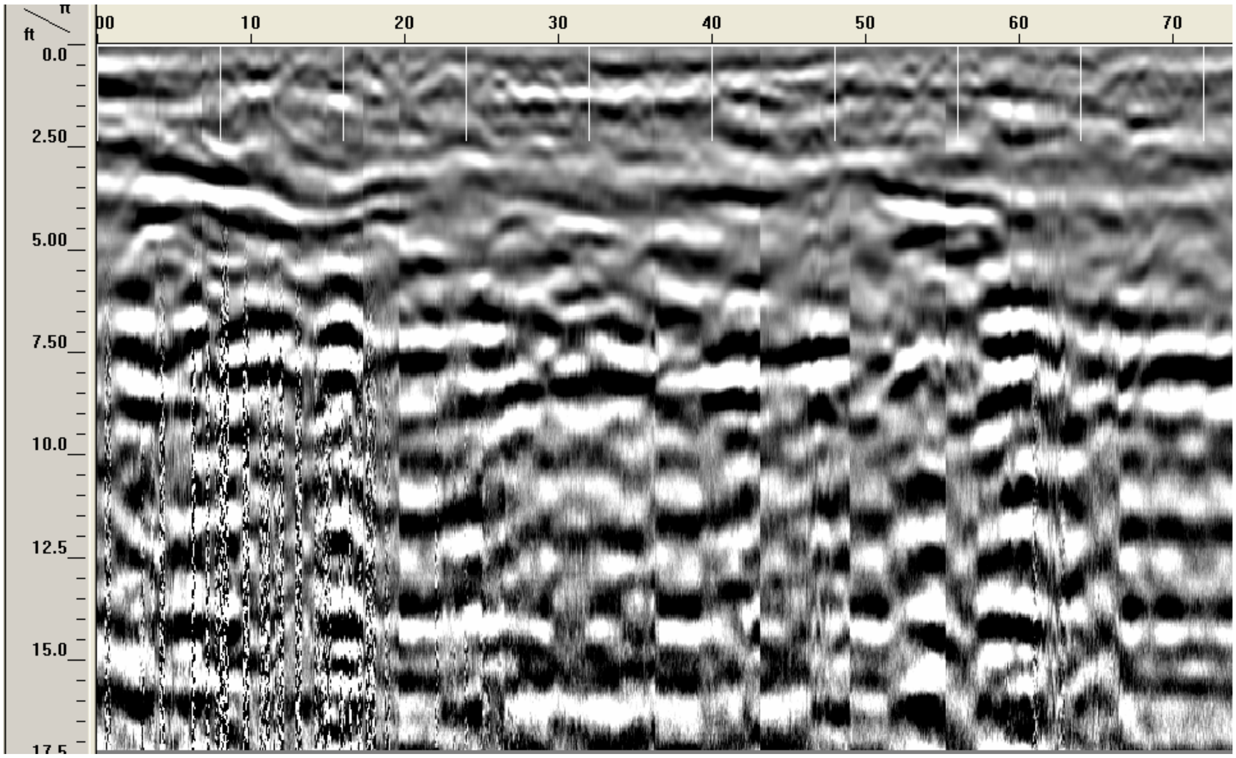

Figure 9. Radargram cross-section showing GPR data collected along profile ECA06.