WESTON SOLUTIONS
Restoring Resource Efficiency

MEMORANDUM

TO: Birch Swamp Road Site File

cc: Melanie Morash, On-Scene Coordinator, U.S. Environmental Protection Agency

FROM: George Mavris, Weston Solutions, Inc., Superfund Technical Assessment and Response Team III

DATE: 18 September 2008

RE: Geophysical Surveys at the Birch Swamp Road Site, Warren, Rhode Island. TDD No. 08-05-0006; Task No. 0416; Document Control No. R-5157

1.0 Introduction

A Geonics Limited EM-31 non-contacting terrain conductivity meter (EM-31) and an EG & G Geometrics Proton Precession Magnetometer (G-856) (Magnetometer) were used to conduct subsurface geophysical screening surveys at the Birch Swamp Road Site (the site) in Warren, Rhode Island. The objective of the geophysical surveys was to investigate whether drums and/or other containers, possibly containing hazardous substances, were buried on site and are the source of lead and polychlorinated biphenyls (PCBs), which were detected previously in soil samples collected at the site. The areas of interest at the site are depicted in Figure 1, Geophysical Grid Location Map.

From 18 through 20 August 2008, Weston Solutions, Inc., Superfund Technical Assessment and Response Team (START) members George Mavris, Dennis Willette, and Bill Mahany conducted geophysical surveys on site at the request of U.S. Environmental Protection Agency (EPA) On-Scene Coordinator (OSC) Melanie Morash. The geophysical surveys were performed as part of a Removal Action currently being conducted by EPA at the site. To achieve the above objective, EM-31 and magnetometer surveys were conducted over a 10-square-foot (ft^2) grid at a large area of the site (former building foundation and areas to the south and east of the building foundation), and random EM-31 surveys were conducted at four other smaller areas of the site (see Figure 1, Geophysical Grid Location Map).

2.0 Electromagnetic Induction Technique

Electromagnetic induction is a geophysical technique designed to measure and locate electrical conductivity and in-phase anomalies that may represent buried metallic materials, such as drums, tanks, etc. The electromagnetic induction method measures electrical properties of subsurface materials (soil, bedrock, groundwater, and/or metal objects) over an area of interest by inducing electrical currents into the ground and measuring the secondary magnetic field produced by these currents [1]. Large fluctuations in instrument response occur when the EM-31 is operated near concentrations of surface or subsurface metal. The EM-31 instrument has a penetration depth of approximately 18 feet when operated in the vertical dipole mode.

The EM-31 instrument operates on the principle of electromagnetic induction. The EM-31 generates an electromagnetic field by sending a low frequency alternating current (AC) along the transmitter wire coil. The AC generates a magnetic dipole perpendicular to the coil and induces an electromagnetic (EM) wave emanating orthogonally to the coil. Based on the orientation of the instrument, the EM-wave propagates through the ground. As the wave moves through the ground, a secondary wave is generated based on the ground properties (e.g., electrical conductivity). A second coil (receiver) on the instrument receives the two EM waves (primary and secondary) and then generates two results [1]. The first result is the quadrature component (out-of-phase with the primary field), which is directly calibrated to the bulk electrical conductivity of the ground and is measured in milliSiemens per meter (mS/m). The second result is the in-phase component (in-phase with the primary field), which is the ratio of the secondary wave to the primary wave amplitude and is measured in parts per thousand (ppt).

The in-phase component is primarily used for the detection of buried metallic objects, although metal objects also affect the quadrature phase measurements. Generally, negative values indicate that the instrument is oriented perpendicular to highly conductive objects, e.g. steel. High positive conductivity values generally indicate that that metal objects are aligned parallel to the orientation of the instrument. Anomaly maps generated from the data indicate general ground conductivity, as well as anomalously large or small bulk ground conductivity (quadrature component) and the presence of large metallic conductors (in-phase component).

Prior to conducting the EM-31 survey, the EM-31 instrument was put through a series of equipment functional checks (battery check, zeroing check of transmitter and receiver, and sensitivity check). Following these functional checks, which indicated that the instrument was functioning properly, the instrument's response was tested by operating it near metallic objects (surface metal debris and tools) and observing the instrument panel. Once this test was completed, the EM-31 was ready for the on-site survey. The MODE switch on the instrument was set to the OPER position, and the COARSE and FINE compensation controls were adjusted so that the in-phase reading was zero. The EM-31 survey was then conducted along a system of grid lines in the main area of interest (former building foundation area and areas to the south and east of the building foundation).

The conductivity and in-phase data were compiled and contour maps were prepared using SURFER computer software, version 8 [4]. These data were contoured using a kriging method. Kriging is a geostatistical gridding method that reveals trends in data. The EM-31 results are shown in Table 1 and are discussed in Section 5.0 of this report.

3.0 Magnetometer Technique

The G-856 Proton Precession Magnetometer (Magnetometer) measures the scalar intensity of the local magnetic field by making use of an induction coil to create a strong magnetic field around a hydrogen-rich fluid such as decane [2]. This causes the hydrogen protons to align their spin axis with the newly applied magnetic field, and when the current producing the polarized field is interrupted, the protons begin to align themselves with the earth’s magnetic field. In doing so, the protons will momentarily precess about the earth’s field at a specific frequency that is proportional to the ambient magnetic field intensity. This precession generates a small magnetic field that induces an alternating voltage in the induction coil that was previously used to generate the polarization field. When the current is interrupted, the precessing protons induce a very weak signal

into the coil, which is connected to an LED console that provides a digital readout of the earth's magnetic field strength in units of nanoTeslas or gammas. The relationship between the precession frequency of the induced voltage and the strength of the earth's magnetic field is called the proton gyromagnetic ratio and is equal to 0.042576 hertz per nanoTesla (Hz/nT) [2].

The presence of any buried steel material, such as drums or tanks, will result in deviations (positive or negative) from the earth's magnetic field. Small, discrete objects at hazardous waste sites typically have anomalies ranging from one to several hundred nTs. Massive concentrations of buried drums or other large metal objects will produce anomalies ranging from 100 to over 1,000 nTs [3].

The G-856 Magnetometer is sensitive to one nT unit; however, its response may be affected by diurnal variations in the earth's magnetic field, spatial variations caused by magnetic minerals in the soil or bedrock, geologic structures, and man-made structures. Therefore, prior to conducting the magnetic survey, the instrument was tuned for accuracy and site conditions. Readings were taken in areas adjacent to metal objects on the surface and in areas which appeared to be free of any ferrous metal objects in order to check the instrument's response. The instrument was also tested for repeatability in these areas. Ten background readings were obtained, and an average of 52,640 nT was calculated for the site. A reconnaissance magnetometer survey was then conducted along a system of grid lines in the main area of interest (former building foundation area and areas to the south and east of the building foundation).

The magnetometer was operated in the survey mode, and at least two readings were taken at each grid node over a 10-ft^2 grid system (see Table 1). The magnetometer data were compiled; background values were subtracted from actual field values; and magnetic contour intensity maps were prepared using SURFER computer software, version 8 [4]. These data were also contoured using a kriging method. Magnetometer results are discussed in Section 5.0 of this report.

4.0 Surveys

4.1 Main Area of Interest (Former Building Foundation Area)

In the main area of interest, the former building foundation and areas to the south and east, a grid system consisting of 10-foot squares was established on the site on 18 and 19 August 2008 using a compass and tape measure. Extensive brush clearing was required prior to establishing the grid system. One baseline of the grid system was established in a north-south direction, along the western wall of the building foundation, which measured 140 feet. This baseline was extended 80 feet beyond the southern wall of the building foundation, and measured 220 feet. A wooden stake was used to mark the end of the baseline. Each 10-foot (ft) interval was then marked along this baseline. The baseline was labeled as Line 0 (L0) and the 10-ft points along the baseline were labeled as P0 through P220 (see Figure 2, Conductivity Contour Map). A second baseline was established parallel to the first baseline, along the eastern wall of the building foundation, and extended southward. This baseline also extended 80 feet beyond the southern wall of the building foundation, and measured 220 feet. A wooden stake was used to mark the end of this baseline. Each 10-ft interval was then marked along this baseline. The baseline was labeled as L8 and the 10-ft points along the baseline were labeled as P0 through P220. Twenty-three additional lines were established across the two baselines in an east-west direction and marked in 10-ft intervals. The east-west lines extended anywhere from 80 to 150 feet eastward from the western foundation wall.

Extensive vegetation cover and swamp conditions prevented extension of these lines into some of the areas of the site. Where possible, samples points were placed along the 10-foot grid line system and marked with wooden stakes or spray paint. Fifteen lines, labeled L0 through L15 were established on site for the geophysical surveys. The grid system encompassed an area of approximately 22,800 ft^2.

On 19 August 2008, a continuous EM-31 survey was conducted over the entire grid system, beginning on Line 0 and proceeding north from Point 0 to Point 220, stopping at each grid node and recording both conductivity and in-phase measurements. The instrument was rotated 90^o at points where either elevated positive or negative readings were noted. The survey then proceeded to the south along Line 1 from Point 220 to Point 0, stopping at each grid node and recording both conductivity and in-phase measurements, again rotating the instrument 90^o at points where either elevated positive or negative readings were noted. This procedure was continued until the entire grid system was covered. A total of 266 conductivity and in-phase readings were recorded during this survey (see Table 1). On 19 August 2008, a magnetometer survey was conducted over the same established grid system, except for the portion of the grid system between Lines L0 through L8 and Points 0 - 50 (see Figure 2). The magnetometer was operated in the survey mode. An initial reading was taken at each grid node, and the instrument was tested for repeatability by taking a second reading. The magnetometer survey began along the eastern end of the grid system, along L15, P130, and proceeded in an alternating north and south direction until readings were recorded at each grid node along Lines L14 through L0, with the exception of the area lying between Lines L0 through L8 and Points 0 - 50. A total of 210 magnetometer readings were recorded during this survey (see Table 1).

4.2 Other Areas of Interest

Random EM-31 surveys were conducted over four other areas of the site where previous soil sample results indicated elevated concentrations of lead and PCBs (see Figure 1). These areas are located: southwest of the building foundation near a drum carcass and soil sample location SS-23; southeast of the building foundation near soil sample location SS-53; east of the building foundation on Lot 175 near sample location SS-18; and east of the building foundation on Lot 175 near sample location SS-19. Terrain conductivity and magnetometer results of the surveys are discussed in the following sections.

5.0 Former Building Foundation and Surrounding Area Results

Terrain conductivity and magnetometer results of the surveys are discussed below.

5.1 Conductivity Results

EM-31 conductivity data for the former building foundation and areas south and east of the building foundation are presented in Figures 2 (Conductivity Contour Map, Complete Data) and Figure 2A (Conductivity Contour Map, Partial Data). The conductivity contour maps, Figures 2 and 2A, as well as the contour maps in Figures 3, 3A, 4, and 4A, were prepared using SURFER computer software, version 8.

Generally, very high metallic responses will cause negative values in the conductivity data. Ground conductivity values obtained during the survey ranged from -88.70 to 12.00 mS/m. This is a wide

range and represents significant conductivity variations within this area. Conductivity readings within the building foundation area may have been influenced by metal (i.e. rebar) within the concrete, since some anomalies were centered on the foundation walls. In an attempt reduce the influence of any metal within the foundation walls, two conductivity contour maps were prepared. One contour map included use of all the data (Figure 2) and another one (Figure 2A) was prepared using conductivity data that was at least 10 feet away from the foundation walls. After comparison between the two maps, it appears that Figure 2A is a more representative map since interference with metal within the foundation walls was reduced or eliminated.

Several negative anomalous areas were mapped and are shown in Figure 2A. The contour interval is 1 and 5 mS/m. Six of these are located within the perimeter of the building foundation and are centered at L1, P150; L1, P210; L4, P130; L5, P100; L7, P125; and L7, P200 (see Figure 2A). Four negative anomalies are located south of the building foundation and are centered at L1, P70; L4, P10; L4, P40; and L6, P70. One negative anomaly is located east of the building foundation and centered along L9, P190. Two large negative anomalies and one positive anomaly were identified approximately 30 feet east of the eastern building foundation wall. The negative anomalies are centered at L12, P120 and L13, P80; and the positive anomaly is centered at L13, P130 (see Figure 2A).

5.2 In-Phase Results

EM-31 in-phase data for former building foundation and areas south and east of the building foundation are presented in Figures 3 (In-Phase Contour Map, Complete Data) and Figure 3A (In-Phase Contour Map, Partial Data). Typical in-phase response for a well-tuned instrument in the absence of surface or subsurface metal should be on the order of +/- 0.20 ppt. The observed in-phase response ranged from -19.9 to 8.76 ppt, indicating that subsurface metallic objects may be present. In-phase readings within the building foundation area may also have been influenced by metal within the concrete, as some in-phase anomalies were also centered on the foundation walls. As with the conductivity contour maps, in attempt reduce the influence of any metal within the foundation walls, two in-phase contour maps were prepared. One contour map included use of all the data (Figure 3) and another one (Figure 3A) was prepared using in-phase data that was at least 10 feet away from the foundation walls. After comparison between the two maps, it appears that Figure 3A is a more representative map since interference with metal within the foundation walls was reduced or eliminated.

Several negative and positive anomalous areas were mapped and are shown in Figure 3A. The contour interval is 1 and 5 mS/m. Six negative anomalies and one positive anomaly are located within the perimeter of the building foundation and are centered at L5, P120; L5, P210; L6, P150; L7, P95; L7, P130; L7, P175; and L7, P200 (see Figure 3A). Three of these anomalies coincide with the conductivity anomalies. Four in-phase anomalies are located south of the building foundation and are centered at L1, P10; L4, P50; L6, P10; and L7, P70. One negative anomaly is located east of the building foundation and centered along L9, P190. Two large negative anomalies and one positive anomaly were identified approximately 30 feet east of the eastern building foundation wall. The negative anomalies are centered at L12, P120 and L13, P85; and the positive anomaly is centered at L14, P130 (see Figure 3A). The in-phase anomalies located east of the building foundation and some located south of the building foundation also coincide with conductivity anomalies and appear to corroborate the anomalies observed in conductivity data.

5.3 Magnetometer Results

Magnetometer data for the former building foundation and the area east of the building foundation are presented in Figures 4 [Magnetometer (Residual) Contour Map, Complete Data) and Figure 4A (Magnetometer (Residual) Contour Map, Partial Data). Magnetometer readings within the building foundation area may also have been influenced by metal within the concrete, as some magnetic anomalies were centered on the foundation walls. As with the conductivity and in-phase contour maps, in attempt reduce the influence of any metal within the foundation walls, two magnetometer contour maps were prepared. One contour map included use of all the data (Figure 4) and another one (Figure 4A) was prepared using magnetometer data that was at least 10 feet away from the foundation walls. After comparison between the two maps, it appears that Figure 4A is a more representative map since interference with metal within the foundation walls was reduced or eliminated.

The magnetometer was operated in the survey mode, and readings were noted (see Table 1) at each sample point (10-foot intervals). The magnetometer survey was not conducted south of P60 between L0 and L130. Magnetometer data were compiled; background values were subtracted from actual field values; and residual magnetic contour intensity maps was prepared. A contour interval of 50 and 100 nT were used to construct these maps. Magnetometer readings ranged from 51,347 to 54,185 nT, indicating that subsurface metallic objects may be present.

Several negative and positive anomalous areas were mapped and are shown in Figure 4A. Three positive and three negative anomalies are located within the perimeter of the building foundation and are centered at L1, P150; L1, P160; L2, P90; L5, P145; L6, P200; and L7, P200 (see Figure 4A). Two of these anomalies coincide with the in-phase anomalies. One negative anomaly is located east of the building foundation and centered along L9, P190. One large positive and one large negative anomalies were identified approximately 30 feet east of the eastern building foundation wall. The negative anomaly is centered at L11, P120 and the positive anomaly is centered at L13, P90 (see Figure 4A). The magnetic anomalies located east of the building foundation also coincide with conductivity and in-phase anomalies and appear to corroborate these anomalies.

Based on the results of the EM-31 and magnetometer surveys, it appears likely that buried metallic objects, possibly drums or metal containers, may be present in the subsurface in several locations both within the perimeter of the foundation walls as well as areas east and south of the building foundation walls.

6.0 Other Areas of Interest

Random EM-31 surveys were conducted over four other areas of the site where previous soil sample results indicated elevated concentrations of lead and PCBs (see Figure 1). Where possible, the perimeter of the soil sample location, approximately 10 feet from the location, was surveyed Conductivity readings in the area near SS-23 ranged from -2.34 to 0.82 mS/m, and in-phase readings ranged from 0.12 to 0.34 ppt. Near SS-53, conductivity readings ranged from 1.30 to 3.50 mS/m, and in-phase readings ranged from -.03 to -0.15 ppt. Conductivity readings in the area near SS-18 ranged from -0.43 to 2.94 mS/m, and in-phase readings ranged from -0.02 to -0.08 ppt. Near SS-19, conductivity readings ranged from 2.11 to 3.34 mS/m, and in-phase readings ranged from -0.23 to

0.63 ppt. EM-31 readings recorded in these four areas are indicative of typical background levels, and not buried metal debris.

7.0 Conclusions

This investigation has identified geophysical anomalies which may be indicative of buried metallic debris. Several anomalies were identified during the EM-31 and magnetometer surveys within the building foundation area, as well as areas south and east of the building foundation. The most significant anomalies were identified approximately 30 feet east of the building foundation and cover an approximate 4,000-ft^2 area. This area is located between Lines L11 and L16, Points P70 and P150 (see Figure 5 and 6). Following the geophysical surveys, new information became available regarding historical use of the site. Conversations with the owner of the property revealed that an area east of the former building was excavated as an open pit and was used for the disposal of military ordnance and other types of materials. This may be the same area as that identified during the geophysical surveys.

Random EM-31 conducted over four other areas of the site where previous soil sample results indicated elevated concentrations of lead and PCBs were not indicative of buried metal debris.

Based on data obtained from the EM-31 and magnetometer surveys, it appears likely that buried metallic debris, possibly drums, may be present in the subsurface of the site within the building foundation area, as well as areas south and east of the building foundation. The presence of subsurface metallic debris cannot be ruled out without further investigations, such as test pitting, and removal of any metallic debris found within these areas of interest.

Suggested test pit locations, to identify any metallic debris in the subsurface, are shown in Figures 5 and 6. Figure 5 shows the test pit locations superimposed on the in-phase contour map, and Figure 6 shows the test pit locations without the in-phase contour map. Suggested test pit locations numbered 1 - 14 are more pronounced than those numbered 15 - 18. Although four test pits are suggested to investigate the suspected disposal area, the area within outline on Figures 5 and 6 should be investigated in a phased approached.

8.0 REFERENCES

[1] Geonics Limited, 1994, *EM-31 Operating Manual (for Models with Two Digital Meters)*

[2] Geometrics, 2007. *G-856-AX Memory-Mag™ Proton Precession Magnetometer, P/N 18101-02 Rev. D, Operation Manual*.

[3] Benson, R.C., Glaccum, R.A. and Noel, M.R., 1982, *Geophysical Techniques of Sensing Buried Wastes and Waste Migration*.

[4] Golden Software, Inc., 2002, *SURFER, Version 8*.

TABLE 1

BIRCH SWAMP ROAD SITE
WARREN, RHODE ISLAND
GEOPHYSICAL SURVEY DATA

Line/Point No.	Cond.*	Cond (90)	In-Phase**	In-Phase (90)	Magnet. (1)	Magnet. (2)	Comments
LINE 0							
L0 P0	3.40	-----	0.50	-----	-----	-----	Next to western foundation wall.
L0 P10	3.46	-----	1.40	-----	-----	-----	Next to western foundation wall.
L0 P20	5.02	19.20	2.26	-20.00	-----	-----	Next to western foundation wall.
L0 P30	1.05	-----	1.16	-----	-----	-----	Next to western foundation wall.
L0 P40	-2.69	3.38	1.80	0.97	-----	-----	Next to western foundation wall.
L0 P50	-0.08	-----	-0.12	-----	-----	-----	Next to western foundation wall.
L0 P60	-0.46	2.36	2.48	2.31	52690	52690	Next to western foundation wall.
L0 P70	-5.20	-3.09	2.89	3.87	52783	52784	Next to western foundation wall.
L0 P80	-15.30	17.00	2.90	-3.00	52687	52682	Southwestern corner of building foundation.
L0 P90	-10.60	-----	-17.40	-----	52572	52570	Next to western foundation wall.
L0 P100	-2.75	-----	0.35	-----	52652	52653	Next to western foundation wall.
L0 P110	-3.65	-----	1.28	-----	52569	52570	Next to western foundation wall.
L0 P120	1.52	-----	0.69	-----	52562	52563	Next to western foundation wall.
L0 P130	6.60	-----	5.27	-----	52804	52802	Drum located west of foundation at P135.
L0 P140	4.35	-----	4.12	-----	52839	52841	Next to western foundation wall.
L0 P150	-16.20	20.10	2.08	2.67	53047	53038	Next to western foundation wall.
L0 P160	-3.80	-----	-1.13	-----	51347	51339	Next to western foundation wall.
L0 P170	-0.53	-----	0.54	-----	52490	52480	Next to western foundation wall.
L0 P180	-2.56	-0.85	0.11	0.52	52633	52630	Next to western foundation wall.
L0 P190	-7.34	-4.67	-0.76	0.81	52566	52567	Next to western foundation wall.
L0 P200	-18.70	-10.60	-2.40	-0.04	52797	52797	Next to western foundation wall.
L0 P210	-27.20	-9.80	-5.93	0.81	52710	52717	Next to western foundation wall.
L0 P220	-16.50	-----	2.01	-----	52435	52438	Northwestern corner of building foundation.
LINE 1							
L1 P0	3.68	-----	0.51	-----	-----	-----	
L1 P10	4.07	-4.02	3.69	-11.40	-----	-----	
L1 P20	1.98	-----	2.53	-----	-----	-----	
L1 P30	2.79	-----	1.26	-----	-----	-----	
L1 P40	2.32	-----	-0.27	-----	-----	-----	
L1 P50	1.49	-----	0.27	-----	-----	-----	
L1 P60	-2.50	-----	3.08	-----	52786	52786	
L1 P70	-10.40	-0.58	-0.87	-2.20	52814	52814	
L1 P80	-8.60	-----	-4.42	-----	52795	52794	Next to southern foundation wall.
L1 P90	-2.01	-----	-0.51	-----	52503	52505	

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Line/Point No.	Cond.*	Cond (90)	In-Phase**	In-Phase (90)	Magnet. (1)	Magnet. (2)	Comments
LINE 1 (continued)							
L1 P100	-0.59	-----	1.32	-----	52605	52606	
L1 P110	-1.68	-----	0.20	-----	52542	52546	
L1 P120	0.32	-----	0.51	-----	52586	52586	
L1 P130	1.50	-----	1.23	-----	52686	52685	
L1 P140	-5.70	-----	-0.33	-----	52982	52974	
L1 P150	-24.30	-33.60	0.22	3.81	53653	53673	
L1 P160	-2.06	-----	-0.89	-----	51745	51489	Third magnetometer reading = 51414.
L1 P170	-3.12	-----	2.60	-----	52414	52416	
L1 P180	3.36	-----	0.43	-----	52784	52783	
L1 P190	-9.71	-----	3.23	-----	52650	52649	
L1 P200	-2.90	-----	1.17	-----	52759	52755	
L1 P210	-16.60	-13.30	-3.95	1.56	52836	52838	
L1 P220	-10.10	-----	-4.70	-----	52944	52943	Near long, metal rods.
LINE 2							
L2 P0	2.31	-----	0.23	-----	-----	-----	
L2 P10	3.66	5.29	-0.19	0.91	-----	-----	
L2 P20	0.94	-----	1.50	-----	-----	-----	
L2 P30	1.32	-----	0.87	-----	-----	-----	
L2 P40	1.39	-----	1.49	-----	-----	-----	
L2 P50	-1.32	-----	2.91	-----	-----	-----	
L2 P60	0.99	-----	1.01	-----	52826	52827	
L2 P70	-7.03	-4.01	4.23	7.02	52922	52919	
L2 P80	-17.40	-----	-20.00	-----	53034	53050	Next to southern foundation wall.
L2 P90	0.65	-----	0.57	-----	52466	52465	
L2 P100	2.13	-----	0.61	-----	52550	52550	
L2 P110	0.62	-----	0.97	-----	52588	52589	
L2 P120	0.49	-----	1.98	-----	52617	52616	
L2 P130	1.94	-----	0.74	-----	52661	52662	
L2 P140	-1.80	-5.26	1.31	1.32	52902	52904	
L2 P150	-9.85	-11.50	1.60	1.83	52966	52966	
L2 P160	-0.48	-----	1.12	-----	52417	52422	
L2 P170	2.24	-----	0.79	-----	52606	52605	
L2 P180	1.22	-2.83	0.91	1.07	52869	52871	
L2 P190	-4.98	-15.00	0.95	-2.50	52913	52907	

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Line/Point No.	Cond.*	Cond (90)	In-Phase**	In-Phase (90)	Magnet. (1)	Magnet. (2)	Comments
LINE 2 (continued)							
L2 P200	-10.40	-6.94	3.72	4.99	52709	52708	
L2 P210	-5.98	-6.81	3.99	4.02	52646	52646	
L2 P220	-9.84	-14.30	1.62	-7.02	52741	52742	90° reading taken on foundation wall.
LINE 3							
L3 P0	-1.48	-----	0.07	-----	-----	-----	
L3 P10	0.27	-----	-0.38	-----	-----	-----	
L3 P20	-3.99	-2.92	-1.63	3.80	-----	-----	
L3 P30	2.65	-----	1.65	-----	-----	-----	
L3 P40	-2.72	-----	3.30	-----	-----	-----	
L3 P50	1.87	-----	2.80	-----	-----	-----	
L3 P60	5.23	4.56	2.37	2.43	52732	52730	
L3 P70	1.28	-----	3.91	-----	52727	52731	
L3 P80	0.52	-4.96	0.62	-20.00	52795	52795	Next to southern foundation wall.
L3 P90	1.60	-----	0.62	-----	52513	52512	
L3 P100	2.57	-----	0.84	-----	52575	52575	
L3 P110	2.06	1.62	1.34	1.65	52627	52626	
L3 P120	2.84	-----	1.44	-----	52655	52657	
L3 P130	0.28	-----	2.37	-----	52683	52683	
L3 P140	1.74	-----	0.92	-----	52721	52720	
L3 P150	-1.56	-----	-0.05	-----	52688	52688	
L3 P160	-0.11	-----	-0.16	-----	52570	52570	
L3 P170	2.74	1.70	0.99	0.26	52597	52596	
L3 P180	4.58	-----	0.49	-----	52935	52922	
L3 P190	-11.00	-8.30	3.97	3.90	52874	52874	
L3 P200	-5.97	-5.12	3.92	2.50	52651	52649	
L3 P210	-0.19	-----	1.42	-----	52637	52637	
L3 P220	-15.00	-7.95	1.03	3.17	52784	52783	90° reading taken on foundation wall.
LINE 4							
L4 P0	-2.61	-----	0.49	-----	-----	-----	
L4 P10	-19.90	-19.80	-1.36	-7.35	-----	-----	Near metal cable.
L4 P20	-6.03	-4.91	1.85	2.47	-----	-----	
L4 P30	-0.71	-----	2.49	-----	-----	-----	L4 P36 = C 8.03/I -20; 90 = C 0/I 2
L4 P40	-3.01	-----	3.80	-----	-----	-----	
L4 P50	-1.65	3.35	-8.35	3.62	-----	-----	

TABLE 1

BIRCH SWAMP ROAD SITE
WARREN, RHODE ISLAND
GEOPHYSICAL SURVEY DATA

Line/Point No.	Cond.*	Cond (90)	In-Phase**	In-Phase (90)	Magnet. (1)	Magnet. (2)	Comments
LINE 4 (continued)							
L4 P60	2.91	-----	2.35	-----	52714	52714	
L4 P70	3.05	-----	3.20	-----	52706	52706	
L4 P80	1.96	0.17	-0.90	-4.52	52722	52724	Next to southern foundation wall.
L4 P90	-0.28	-----	-0.67	-----	52565	52567	
L4 P100	-1.00	-----	1.70	-----	52568	52569	
L4 P110	-0.32	-----	1.70	-----	52610	52610	
L4 P120	-1.61	-----	-0.35	-----	52695	52695	
L4 P130	-5.62	-11.00	1.40	-10.68	52599	52596	
L4 P140	2.60	-----	0.98	-----	52546	52547	
L4 P150	-5.58	-2.88	0.14	1.02	52666	52667	
L4 P160	-6.06	-7.01	0.94	1.63	52712	52711	
L4 P170	0.92	-----	1.21	-----	52589	52587	
L4 P180	4.09	0.93	0.69	0.87	52676	52675	
L4 P190	-3.80	-----	1.64	-----	53021	53032	
L4 P200	-4.01	-----	1.62	-----	52613	52613	
L4 P210	1.19	0.13	2.39	0.97	52632	52632	
L4 P220	-41.00	2.26	2.76	5.02	53405	52408	Metal cable straddling southern wall.
LINE 5							
L5 P0	0.69	-----	0.10	-----	-----	-----	
L5 P10	-3.18	-----	1.83	-----	-----	-----	Metal cable straddling northern foundation wall.
L5 P20	0.86	-----	0.62	-----	-----	-----	
L5 P30	1.96	-----	1.52	-----	-----	-----	
L5 P40	-0.30	-----	2.45	-----	-----	-----	
L5 P50	0.90	-----	2.54	-----	-----	-----	
L5 P60	-1.89	6.41	1.97	2.30	52725	52723	
L5 P70	1.66	-----	2.93	-----	52657	52657	
L5 P80	-1.61	-----	3.19	-----	52726	52721	Next to southern foundation wall.
L5 P90	-0.47	-----	2.89	-----	52622	52622	
L5 P100	-8.87	-7.41	3.08	2.67	52600	52602	
L5 P110	1.18	-----	1.30	-----	52689	52689	
L5 P120	-1.47	2.28	-3.06	1.06	52769	52771	
L5 P130	-3.70	-8.08	2.03	-5.00	52581	52588	
L5 P140	-1.28	-2.90	2.27	1.53	52446	52453	
L5 P150	0.19	-----	1.16	-----	52458	52459	

TABLE 1

BIRCH SWAMP ROAD SITE
WARREN, RHODE ISLAND
GEOPHYSICAL SURVEY DATA

Line/Point No.	Cond.*	Cond (90)	In-Phase**	In-Phase (90)	Magnet. (1)	Magnet. (2)	Comments
LINE 5 (continued)							
L5 P160	1.11	-----	0.78	-----	52543	52537	
L5 P170	-0.30	-----	1.08	-----	52556	52553	
L5 P180	0.38	-----	-2.17	-----	52542	52540	
L5 P190	-6.19	-5.26	-3.02	-0.73	52451	52454	
L5 P200	-10.80	-2.09	-14.00	-0.58	52746	52747	
L5 P210	-4.70	-1.52	-7.03	2.43	52579	52584	
L5 P220	6.01	0.58	-3.57	-0.50	52907	52881	Next to northern foundation wall.
LINE 6							
L6 PO	-1.47	-----	1.26	-----	-----	-----	
L6 P10	-9.24	-5.60	6.47	4.11	-----	-----	Metal cable hanging from pole.
L6 P20	-3.98	-----	3.43	-----	-----	-----	
L6 P30	-0.36	-----	2.09	-----	-----	-----	
L6 P40	-3.65	-----	2.31	-----	-----	-----	
L6 P50	-0.38	-----	1.64	-----	-----	-----	
L6 P60	4.86	-----	1.00	-----	52871	52872	
L6 P70	-23.00	-23.20	8.76	4.57	52700	52700	
L6 P80	-2.37	-----	2.51	-----	52542	52542	Southeastern corner of building foundation.
L6 P90	-5.87	-6.63	-1.63	2.67	52647	52627	
L6 P100	-2.62	-----	-1.42	-----	52517	52521	
L6 P110	2.14	-----	-0.67	-----	52636	52619	
L6 P120	-0.14	-----	1.61	-----	52753	52748	
L6 P130	1.98	-5.99	5.76	-10.88	52656	52643	
L6 P140	1.37	-----	0.91	-----	52637	52434	
L6 P150	-1.58	-2.07	-6.83	-5.24	52644	52626	
L6 P160	-7.01	-6.58	-0.30	-2.39	52537	52523	
L6 P170	1.07	-----	1.91	-----	52601	52598	
L6 P180	0.48	-----	0.65	-----	52389	52385	
L6 P190	-1.80	-7.00	1.87	-0.96	52850	52806	
L6 P200	-5.08	-2.80	2.77	3.98	53156	53147	
L6 P210	-15.20	-7.03	-12.77	3.25	52564	52605	
L6 P220	-6.90	9.90	-0.93	1.19	52337	52337	Next to northern foundation wall.
LINE 7							
L7 P0	1.68	-----	1.62	-----	-----	-----	
L7 P10	-4.74	-----	4.76	-----	-----	-----	

TABLE 1

BIRCH SWAMP ROAD SITE
WARREN, RHODE ISLAND
GEOPHYSICAL SURVEY DATA

Line/Point No.	Cond.*	Cond (90)	In-Phase**	In-Phase (90)	Magnet. (1)	Magnet. (2)	Comments
LINE 7 (continued)							
L7 P20	-5.02	-8.89	2.50	1.23	-----	-----	
L7 P30	-1.41	-----	0.48	-----	-----	-----	
L7 P40	-0.04	-----	1.68	-----	-----	-----	
L7 P50	2.12	-----	2.15	-----	-----	-----	
L7 P60	6.40	9.00	2.21	2.85	52648	52648	
L7 P70	-1.03	8.06	-6.99	5.03	52663	52668	
L7 P80	1.99	-----	1.91	-----	52564	52560	
L7 P90	12.00	-2.43	-8.08	4.53	52778	52778	
L7 P100	-5.60	0.60	-6.28	-1.54	52713	52701	
L7 P110	-4.30	-----	2.72	-----	52574	52564	
L7 P120	-10.40	-8.23	-0.46	1.02	52656	52668	
L7 P130	-17.00	-21.00	-20.00	-20.00	52777	52771	
L7 P140	-0.70	-----	0.87	-----	52474	52493	
L7 P150	-3.68	-8.98	-0.22	-6.80	53116	53125	
L7 P160	-7.30	-----	0.18	-----	52954	52949	
L7 P170	-10.10	-----	-5.90	-----	53049	53035	
L7 P180	-12.10	32.30	-5.24	-20.00	52381	52364	
L7 P190	-3.85	-----	2.03	-----	52506	52514	
L7 P200	-19.70	-10.40	6.04	7.01	52889	52907	
L7 P210	-6.08	-----	3.06	-----	52584	52583	
L7 P220	-3.99	-4.11	2.40	-1.50	52525	52518	Next to northern foundation wall.
LINE 8							
L8 P0	0.85	-----	0.80	-----	-----	-----	
L8 P10	-8.90	-----	-1.82	-----	-----	-----	
L8 P20	-8.67	-7.51	1.35	3.01	-----	-----	
L8 P30	1.21	-----	0.02	-----	-----	-----	
L8 P40	0.95	-----	1.12	-----	-----	-----	
L8 P50	2.36	-----	-0.21	-----	-----	-----	
L8 P60	-5.05	-1.75	3.51	3.41	-----	-----	
L8 P70	1.95	-----	4.25	-----	-----	-----	
L8 P80	-1.21	-----	-0.35	-----	52770	52768	
L8 P90	3.42	-----	2.11	-----	52765	52766	
L8 P100	-2.15	0.55	1.62	0.83	52758	52760	
L8 P110	-2.05	-----	-2.15	-----	52515	52515	

TABLE 1

BIRCH SWAMP ROAD SITE
WARREN, RHODE ISLAND
GEOPHYSICAL SURVEY DATA

Line/Point No.	Cond.*	Cond (90)	In-Phase**	In-Phase (90)	Magnet. (1)	Magnet. (2)	Comments
LINE 8 (continued)							
L8 P120	-4.35	-2.05	0.41	1.15	52773	52777	
L8 P130	-20.00	-9.92	-7.15	-4.51	52972	52998	
L8 P140	-6.35	-2.85	-9.75	1.50	52583	52582	
L8 P150	-4.71	-----	-1.05	-----	52980	52982	
L8 P160	-20.90	-15.80	2.75	-1.91	53130	53128	
L8 P170	-6.15	-1.25	-5.56	-1.73	53384	53556	
L8 P180	-40.00	-19.50	-20.00	-10.25	52558	52566	
L8 P190	-51.20	-16.50	-20.00	-3.45	51883	51888	
L8 P200	-4.15	1.53	-9.25	-0.05	52523	52551	
L8 P210	-9.95	-----	-0.24	-----	52718	52709	
L8 P220	-0.71	-----	1.15	-----	52423	52425	Northeastern corner of building foundation.
LINE 9							
L9 P80	3.65	-----	1.73	-----	52610	52608	
L9 P90	1.57	-----	1.45	-----	52621	52614	
L9 P100	0.85	-----	0.63	-----	52546	52541	
L9 P110	2.73	-----	0.61	-----	52537	52537	
L9 P120	1.92	-----	0.95	-----	52822	52843	
L9 P130	2.32	-----	0.67	-----	52623	52620	
L9 P140	2.39	-----	0.31	-----	52692	52690	
L9 P150	3.01	-----	0.28	-----	52722	52718	
L9 P160	2.25	-----	0.21	-----	52852	52844	
L9 P170	2.79	-----	0.40	-----	52831	52831	
L9 P180	-9.51	3.91	-1.55	3.38	52550	52552	Near metal screen.
L9 P190	-18.50	-1.45	-5.75	-5.18	52263	52293	Near metal screen.
L9 P200	-0.85	-----	-0.30	-----	52503	52501	
L9 P210	3.06	-----	0.44	-----	52565	52564	
L9 P220	0.18	-----	0.74	-----	52368	52365	
LINE 10							
L10 P80	0.95	-----	1.47	-----	52505	52511	
L10 P90	1.11	-----	1.86	-----	52499	52496	
L10 P100	2.43	-----	1.51	-----	52458	52463	
L10 P110	1.12	-----	-0.15	-----	52419	52424	
L10 P120	1.96	-----	1.14	-----	52370	52377	
L10 P130	2.34	-----	0.20	-----	52454	52460	

TABLE 1

BIRCH SWAMP ROAD SITE
WARREN, RHODE ISLAND
GEOPHYSICAL SURVEY DATA

Line/Point No.	Cond.*	Cond (90)	In-Phase**	In-Phase (90)	Magnet. (1)	Magnet. (2)	Comments
LINE 10 (continued)							
L10 P140	2.14	-----	0.32	-----	52585	52580	
L10 P150	1.91	-----	0.33	-----	52628	52631	
L10 P160	2.65	-----	0.14	-----	52683	52683	
L10 P170	2.51	-----	0.69	-----	52719	52719	
L10 P180	3.21	-----	1.10	-----	52588	52590	
L10 P190	2.95	-----	-0.44	-----	52538	52545	
L10 P200	1.79	-----	0.08	-----	52550	52550	
L10 P210	2.81	-----	1.39	-----	52555	52555	
L10 P220	1.54	-----	1.23	-----	52517	52515	
LINE 11							
L11 P80	2.05	-----	1.82	-----	52586	52592	
L11 P90	0.25	-----	2.51	-----	52465	52464	
L11 P100	3.96	-----	2.17	-----	52416	52415	
L11 P110	6.11	4.11	2.25	-1.11	52249	52252	
L11 P120	5.61	4.42	1.62	-0.91	51730	51735	
L11 P130	6.21	5.95	1.45	-0.58	52057	52025	
L11 P140	3.12	-----	0.44	-----	52452	52453	
L11 P150	2.41	-----	0.22	-----	52560	52560	
L11 P160	2.07	-----	0.25	-----	52634	52634	
L11 P170	2.51	-----	0.34	-----	52657	52658	
L11 P180	2.11	-----	-0.03	-----	52646	52651	
L11 P190	2.67	-----	0.59	-----	52595	52594	
L11 P200	1.25	-----	0.84	-----	52583	52583	
L11 P210	1.81	-----	0.63	-----	52595	52595	
L11 P220	2.32	-----	0.49	-----	52586	52586	
LINE 12							
L12 P80	-4.80	-1.85	4.11	5.95	52684	52682	
L12 P90	-7.21	-15.10	-2.93	-6.22	52845	52855	
L12 P100	-8.84	-9.85	1.73	-2.16	52737	52734	
L12 P110	-4.43	-----	0.06	-----	52473	52476	
L12 P120	-39.20	-29.50	-12.63	-17.10	52049	51947	
L12 P130	-18.90	-29.10	-10.33	-12.93	51968	51966	

TABLE 1

BIRCH SWAMP ROAD SITE
WARREN, RHODE ISLAND
GEOPHYSICAL SURVEY DATA

Line/Point No.	Cond.*	Cond (90)	In-Phase**	In-Phase (90)	Magnet. (1)	Magnet. (2)	Comments
LINE 13							
L13 P80	-88.70	-65.10	-20.00	-20.00	52409	52501	
L13 P90	-71.20	-41.50	-20.00	-20.00	54185	54170	
L13 P100	-33.30	-31.20	-0.63	10.48	52363	52361	
L13 P110	-21.70	-14.10	-7.60	0.34	53005	52995	
L13 P120	-1.68	-----	3.34	-----	53089	53089	
L13 P130	10.95	-----	1.12	-----	52840	52840	Truck tire pile moved from foundation.
LINE 14							
L14 P130	-5.63	-39.50	7.12	-9.18	52227	52253	
LINE 15							
L15 P130	-8.55	-14.00	1.34	-1.91	52373	52378	

Notes:

* Conductivity units reported in milliSiemens/meter (mS/m).

** In-phase units reported in parts per thousand (ppt).

Magnetometer units reported in gammas.

Cond (90) = Conductivity reading where instrument is rotated 90 degrees.

In-Phase (90) = In-Phase reading where instrument is rotated 90 degrees.

Magnet. (1) = Initial magnetometer reading.

Magnet. (2) = Second (repeated) magnetometer reading.

----- = No measurements made.

Average background magnetometer readings = 52640 gammas or nano Teslas (nT).

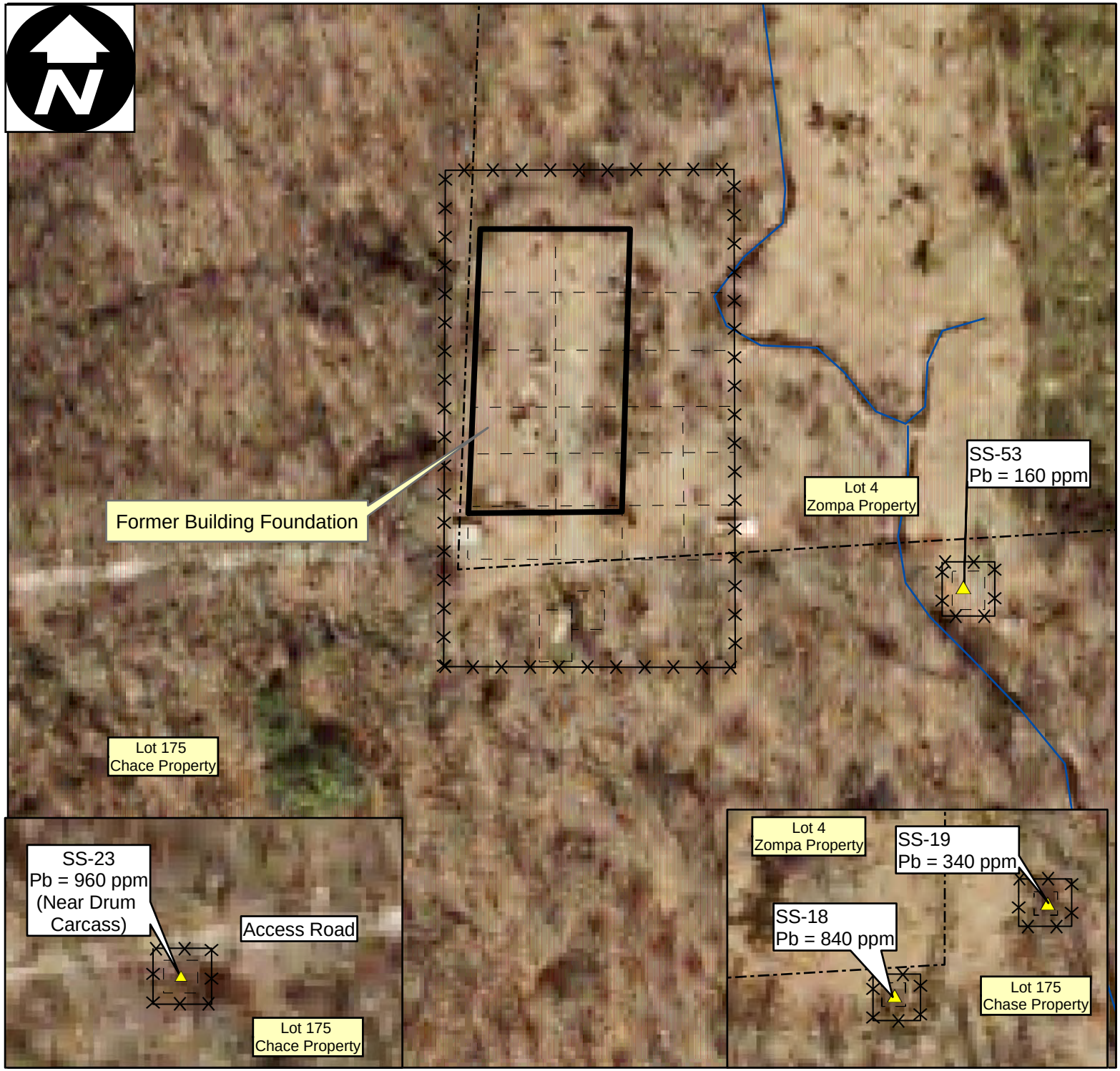

Figure 1
Geophysical Areas
Location Map

Birch Swamp Road Site
Birch Swamp Road
Warren, Rhode Island

EPA Region I
Superfund Technical Assessment and Response Team (START) III
Contract No. EP-W-05-042

TDD Number: 08-05-0006
Created by: B. MACE
Created on: 30 April 2008
Modified by: G. MAVRIS
Modified on: 17 September 2008

LEGEND

- Lot Boundaries
- Former Foundation
- Excavation grids
- Fence
- Streams

Pb Lead
ppm parts per million

0 25 50 75 100 Feet

Data Sources:
Imagery: RI DOT
Topos: MicroPath
All other data: START

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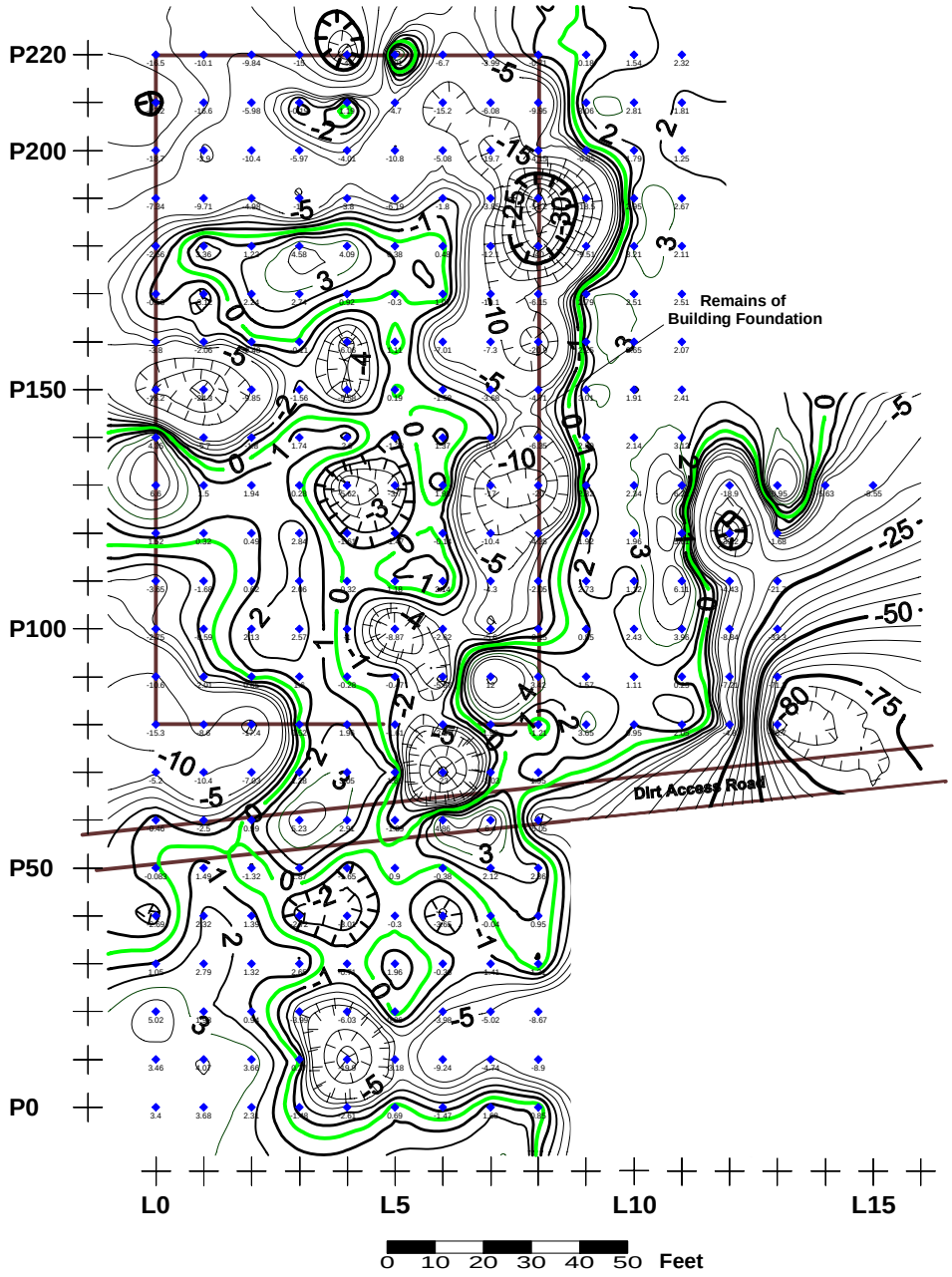
E:\RI_gis\Birch Swamp Road\Geophysical Map.mxd



NOTES:

Contour Interval = 1 and 5 milliSiemens per meter (mS/m)

Map includes data from points located adjacent to building foundation.

R:_08050006_Geophysics_Figure 2 - Complete Conductivity Map Mounted

Figure 2

Conductivity Contour Map
Birch Swamp Road Site
Warren, Rhode Island

EPA Region I
Superfund Technical Assessment and Response Team (START III)
Contract No. EP-W-05-042

TDD No.: 08-05-0006

Created by: George Mavris

Created on: 24 August 2008

Modified by:

Modified on:

Data Sources:

SURFER Ver 8.0

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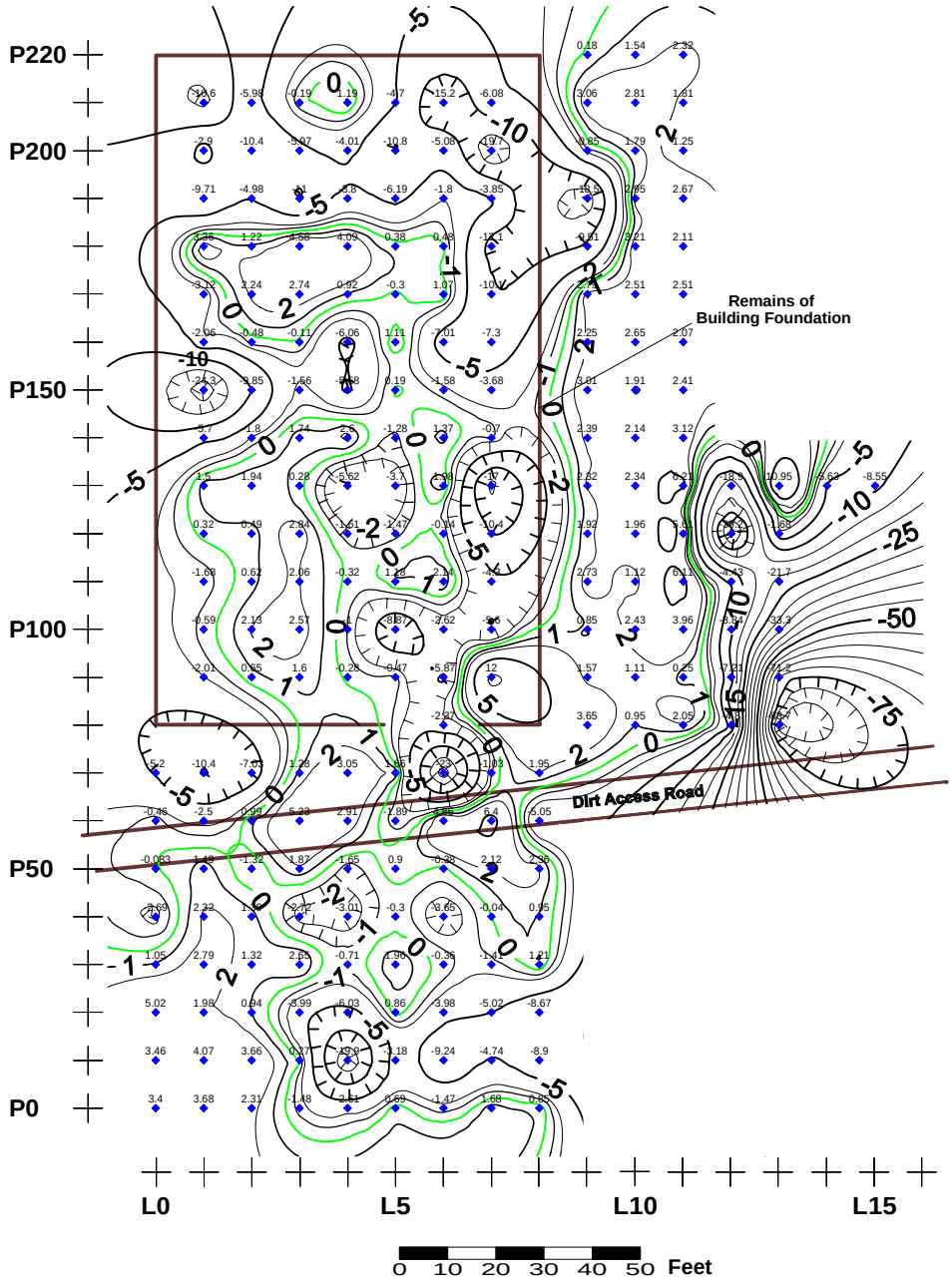

NOTES:

Contour Interval = 1 and 5 milliSiemens per meter (mS/m)

Map does NOT include data from points located adjacent to building foundation.

R:_08050006_Geophysics_Figure 2A - Partial Conductivity Map Mounted

Figure 2A

Conductivity Contour Map (Partial)
Birch Swamp Road Site
Warren, Rhode Island

EPA Region I
Superfund Technical Assessment and Response Team (START III)
Contract No. EP-W-05-042

TDD No.: 08-05-0006
Created by: George Mavris
Created on: 24 August 2008
Modified by:
Modified on:

Data Sources:

SURFER Ver 8.0

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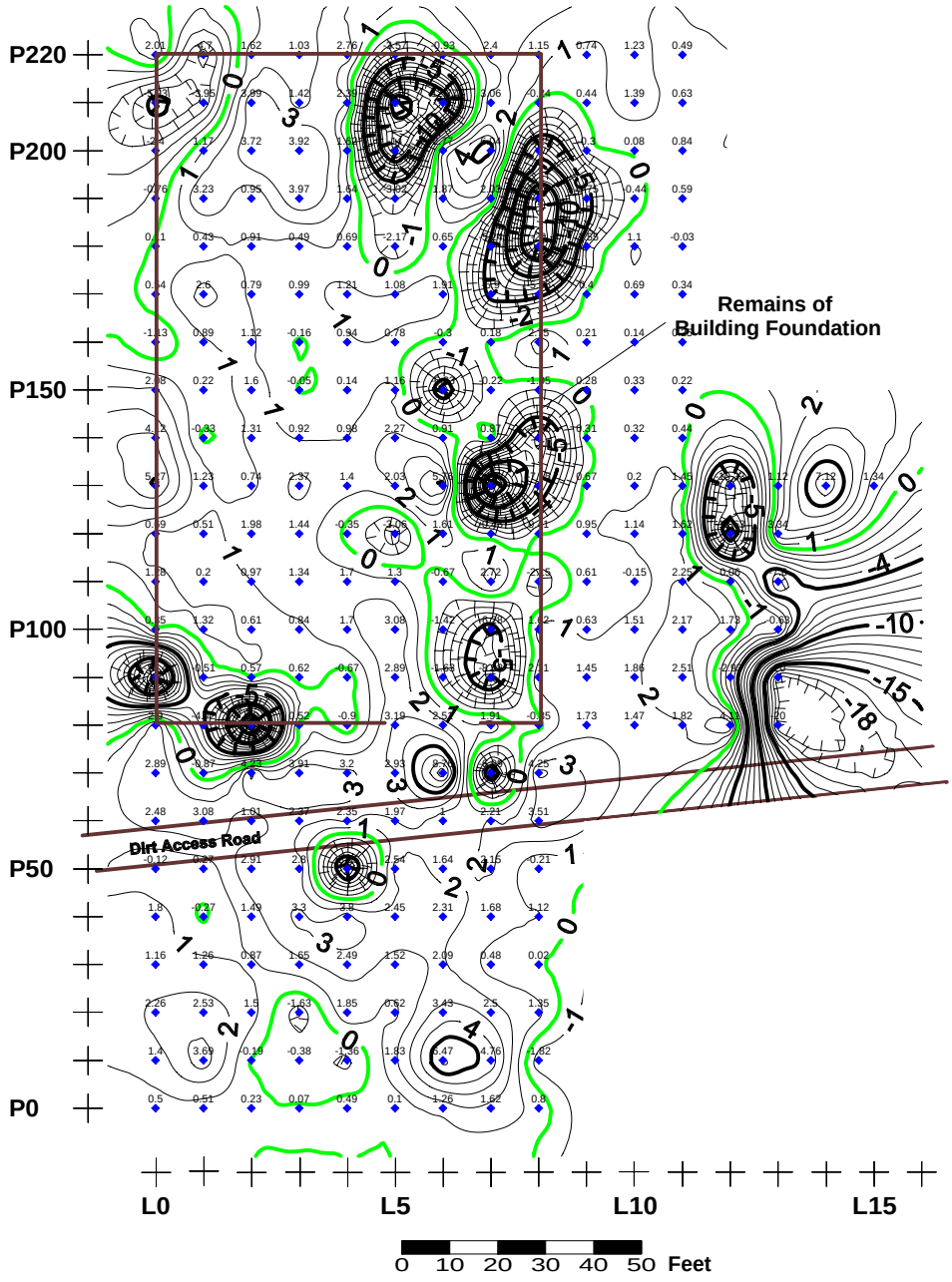

NOTES:

Contour Interval = 1 and 5 parts per thousand (ppt)

Map includes data from points located adjacent to building foundation.

R:_08050006_Geophysics_Figure 3 - Complete In-Phase Map Mounted

Figure 3

In-Phase Contour Map Birch Swamp Road Site Warren, Rhode Island

EPA Region I
Superfund Technical Assessment
and Response Team (START III)
Contract No. EP-W-05-042

TDD No.:	08-05-0006
Created by:	George Mavris
Created on:	28 August 2008
Modified by:	
Modified on:	

Data Sources:

SURFER Ver 8.0

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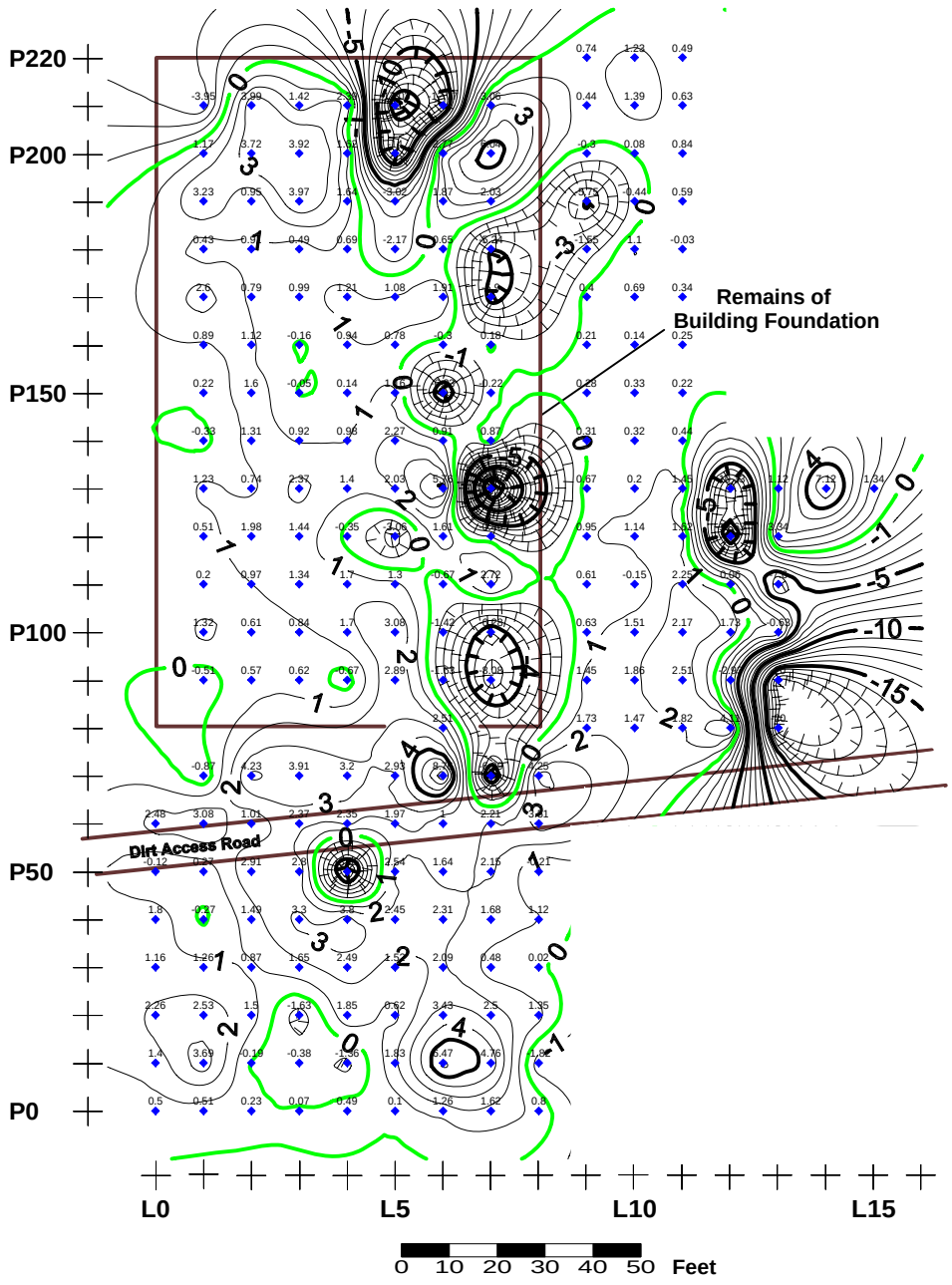

NOTES:

Contour Interval = 1 and 5 parts per thousand (ppt)

Map does not include data from points located adjacent to building foundation.

R:_08050006_Geophysics_Figure 3A - Partial In-Phase Map Mounted

Figure 3A

In-Phase Contour Map (Partial)
Birch Swamp Road Site
Warren, Rhode Island

EPA Region I
Superfund Technical Assessment
and Response Team (START III)
Contract No. EP-W-05-042

TDD No.:	08-05-0006
Created by:	George Mavris
Created on:	28 August 2008
Modified by:	
Modified on:	

Data Sources:

SURFER Ver 8.0

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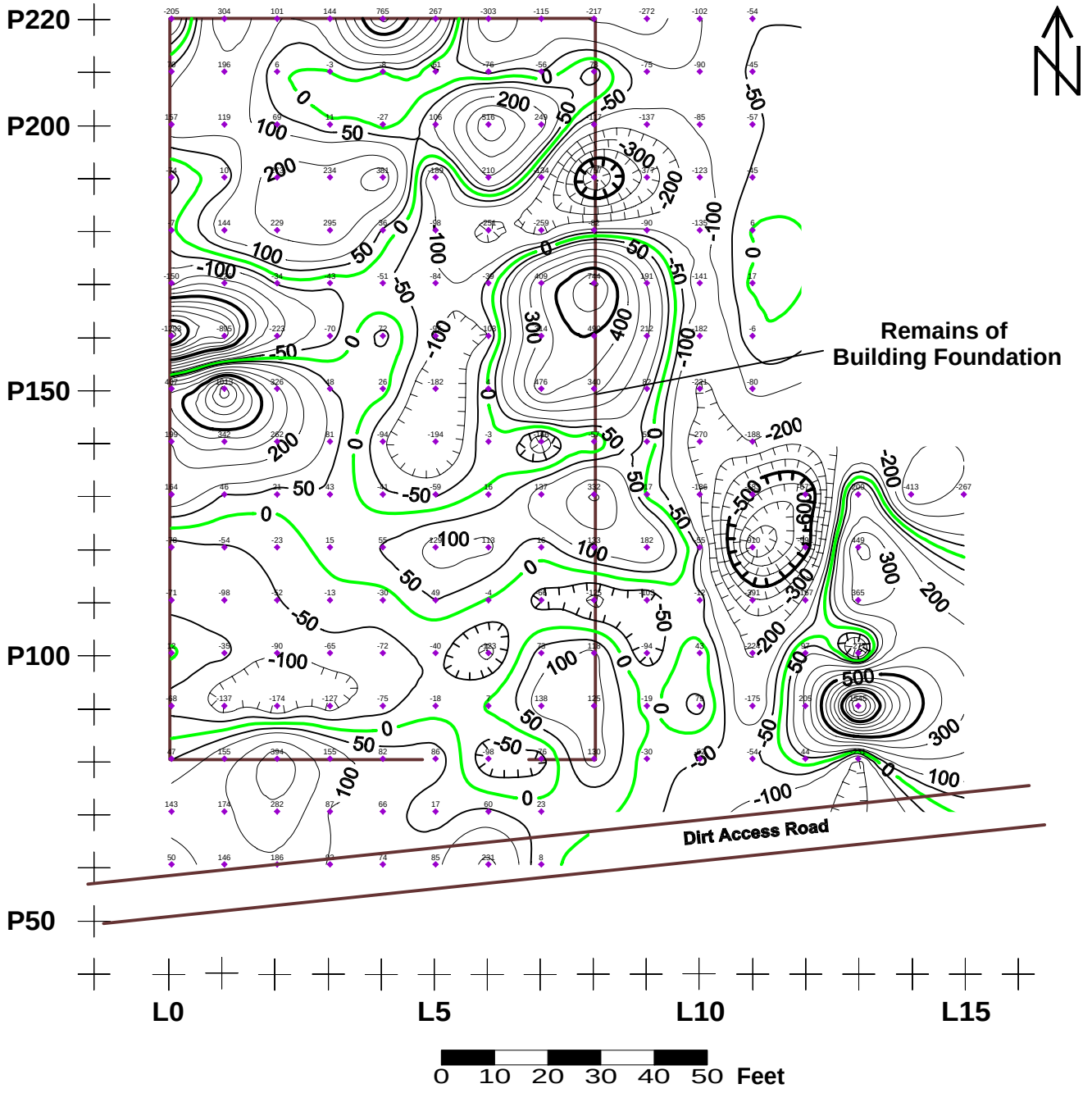

NOTES:

Contour Interval = 50 and 100 nanoTeslas (nT)

Map includes data from points located adjacent to building foundation.

R:_08050006_Geophysics_Figure 4A - Magnetometer Map Mounted

Figure 4

Magnetometer (Residual) Contour Map
Birch Swamp Road Site
Warren, Rhode Island

EPA Region I
Superfund Technical Assessment and Response Team (START III)
Contract No. EP-W-05-042

TDD No.: 08-05-0006
Created by: George Mavris
Created on: 28 August 2008
Modified by:
Modified on:

Data Sources:

SURFER Ver 8.0

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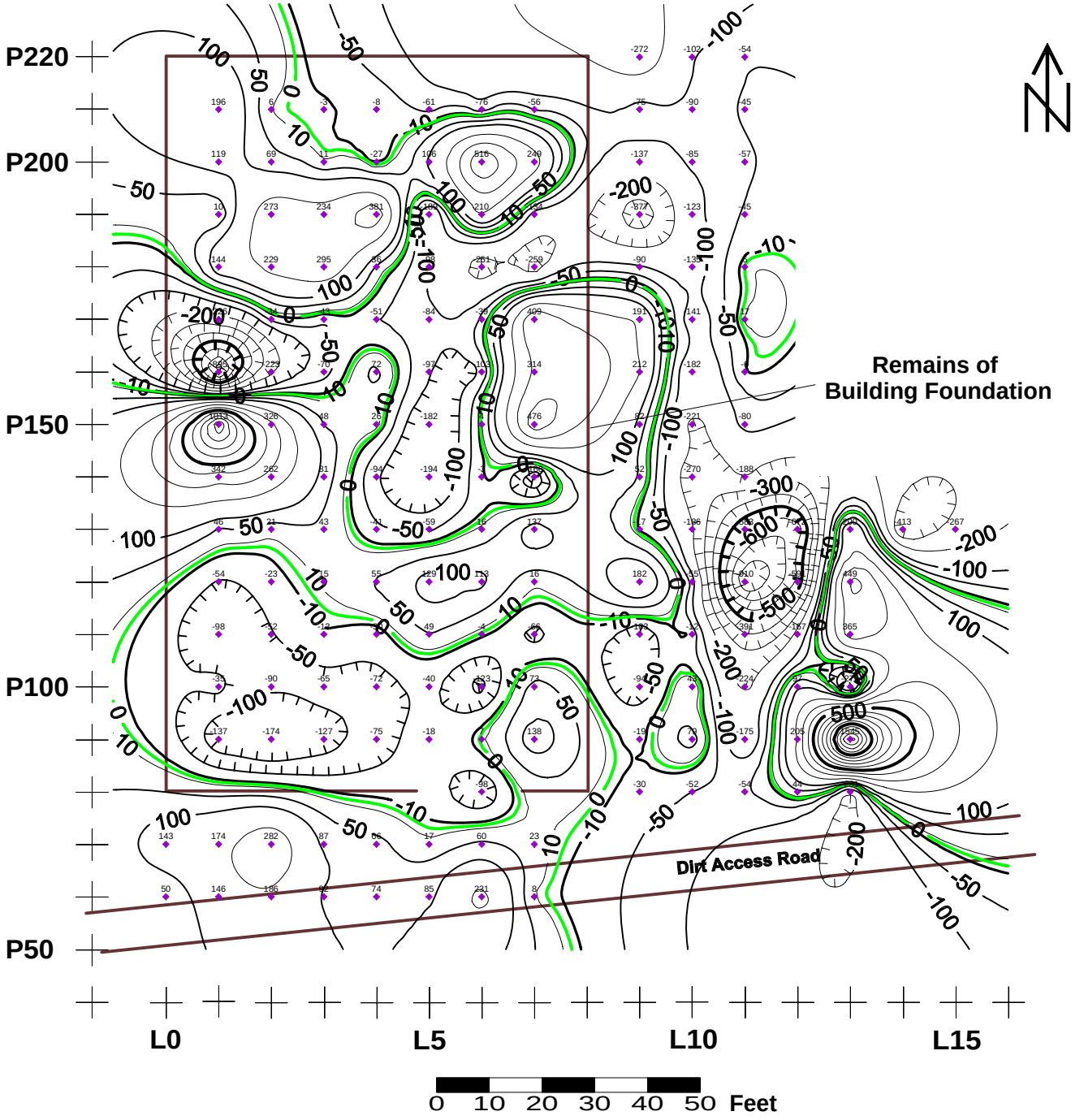

NOTES:

Contour Interval = 50 and 100 nanoTeslas (nT)

Map does not include data from points located adjacent to building foundation.

R:_08050006_Geophysics_Figure 4A - Partial Magnetometer Map Mounted

Figure 4A

Magnetometer (Residual) Contour Map (Partial) Birch Swamp Road Site Warren, Rhode Island

EPA Region I
Superfund Technical Assessment and Response Team (START III)
Contract No. EP-W-05-042

TDD No.: 08-05-0006

Created by: George Mavris

Created on: 28 August 2008

Modified by:

Modified on:

Data Sources:

SURFER Ver 8.0

WESTON SOLUTIONS
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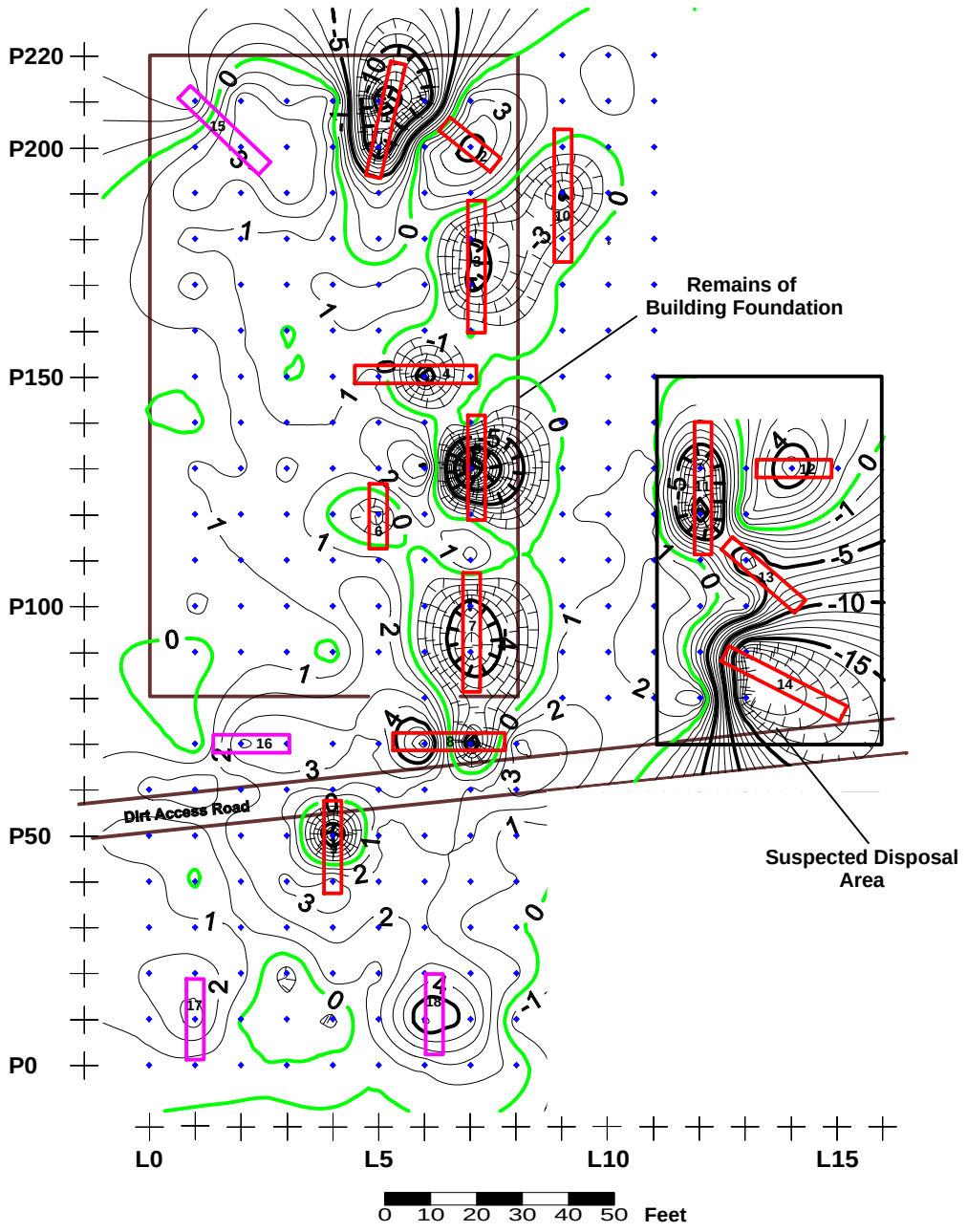


NOTES:

Contour Interval = 1 and 5 parts per thousand (ppt)

Map does not include data from points located adjacent to building foundation.

XX Proposed test pit locations and numbers for pronounced anomalies

XX Proposed test pit locations and numbers for subtle anomalies

R:_08050006_Geophysics_Figure 5 - Proposed Test Pit Locations

Figure 5

In-Phase Contour Map with Proposed Test Pit Locations Birch Swamp Road Site Warren, Rhode Island

EPA Region I
Superfund Technical Assessment
and Response Team (START III)
Contract No. EP-W-05-042

TDD No.: 08-05-0006

Created by: George Mavris

Created on: 18 September 2008

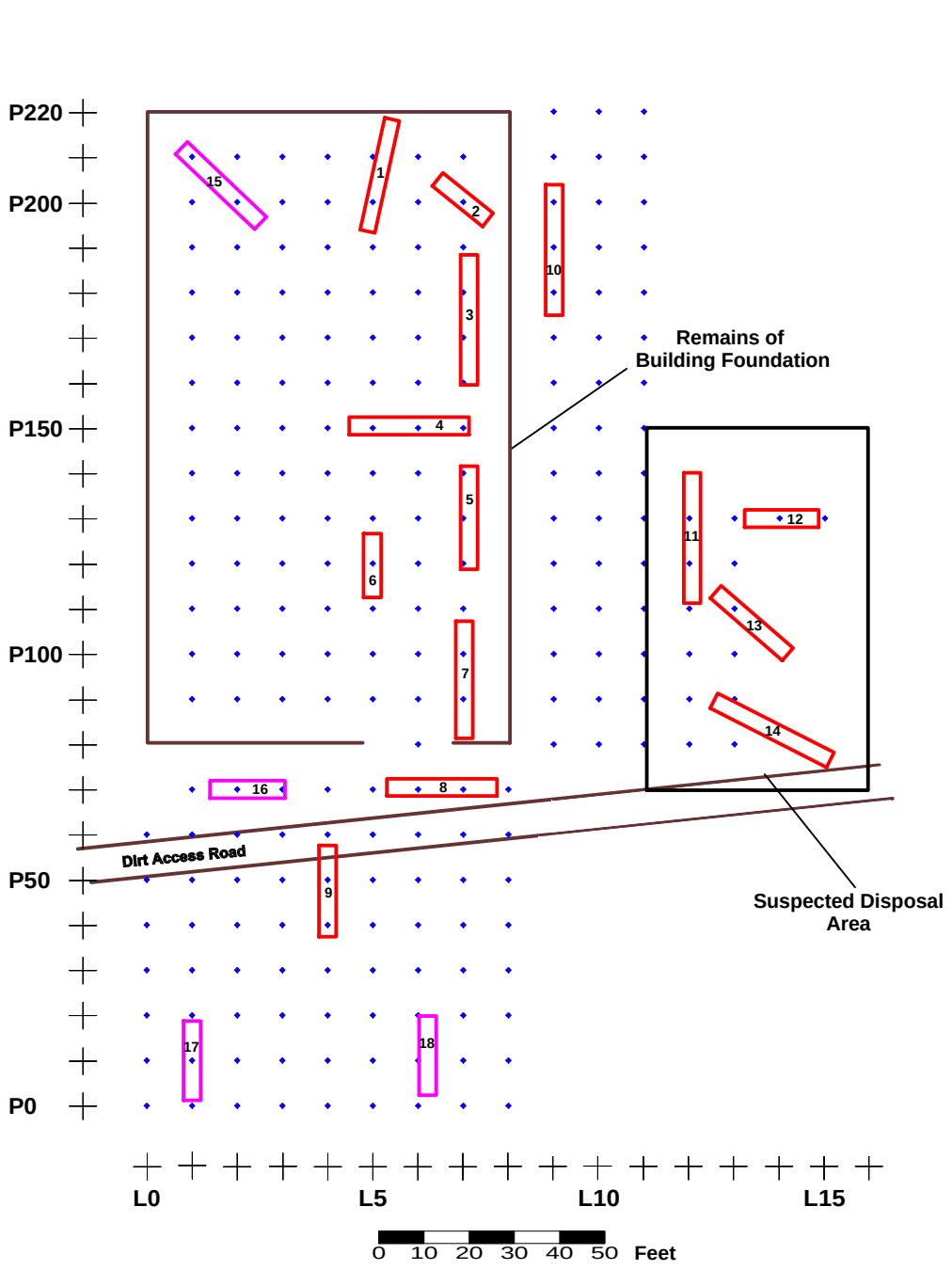
Modified by:

Modified on:

Data Sources:

SURFER Ver 8.0

WESTON SOLUTIONS
Restoring Resource Efficiency



NOTES:

XX Proposed test pit locations and numbers for pronounced anomalies

XX Proposed test pit locations and numbers for subtle anomalies

R:_08050006_Geophysics_Figure 6 - Proposed Test Pit Locations

Figure 6

Proposed Test Pit Locations
Birch Swamp Road Site
Warren, Rhode Island

EPA Region I
Superfund Technical Assessment
and Response Team (START III)
Contract No. EP-W-05-042

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