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Geophysical Survey of Wisconsin Burial Site BRO-0033 Wixom Cemetery, Rock County, Wisconsin

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Introduction

Lawrence University was asked by a group of citizens in Fulton Township, Rock County, Wisconsin, to determine whether interments were present in the Wixom Cemetery, BRO-0033 (Figure 1). The cemetery land had been willed to Fulton Township in the mid-19th century, and is shown on an 1873 plat map of the township (Figure 2). However, there are no records of anyone being interred in the cemetery, and Fulton Township has no record of ever formally accepting the willed property. Local residents recall the presence of headstones on the property, and neighboring landowners have been told that the plot is a cemetery for generations. The area is currently planted in hay, and apparently has been for some time (Figure 3). A 1937 aerial photograph shows the area not only planted in hay, but with a large tree growing in it (Figure 4). The Wixom Cemetery, then, has been historically identified as a cemetery and treated by residents as a cemetery, but no formal evidence of interments is present. The purpose of the geophysical survey was to identify whether any interments do exist in the Wixom Cemetery.

Methods

Initial geomagnetic survey of the Wixom Cemetery took place on May 30, 2015. Three Lawrence University students and I collected geomagnetic data from a 40 meter by 40 meter grid covering the main area of the cemetery plot as determined by a local surveyor. Initial processing of the data showed several areas that appeared characteristic of casket interments; however, one appeared to extend west of the surveyed area and an unidentified linear feature continued to the north of the surveyed area. Thus the students and I returned on June 6, 2015 and extended the surveyed area five meters to the west and ten meters to the north. Soil resistivity and compaction data were also collected in single transects across eight of the possible interments.

The data themselves were collected using a Geoscan FM256 differential gradiometer. This instrument consists of two magnetometers arranged one atop the other with a 0.5 meter separation. Each magnetometer measures the earth's magnetic field and the difference between the two readings, which is equivalent to the vertical gradient of the earth's magnetic field, is recorded. The instrument is sensitive enough to measure tiny variations in the earth's magnetic field, variations that might be caused by subtle soil changes or the presence of buried materials. For this application sensitivity of the FM256 was set at 1.0 nanotesla, or about 1/25,000th of the earth's total magnetic field. Data were collected at 0.5 meter intervals along 0.5 meter spaced parallel north-south lines. Complete grid units were each collected at a single time, without interruption. Zero logging was conducted before and after every grid to correct for diurnal variation in the earth's magnetic field.

The raw magnetic data were downloaded from the FM256 into the Geoplot 3.0 software package. Analyses conducted on the data involved (in the following order) (1) “clipping” to remove high and low data points more than one standard deviation from the mean; “desloping” to remove effects from deep geological features; (3) “zero mean traverse” to balance the data values across the separate grids: (4) “despiking” to remove highs and lows more than two standard deviations from the mean, and (5) “interpolation” conducted twice in both the X and Y directions to improve the resolution of the data. The image resulting from this processing is presented as Figure 5. Magnetic highs appear here as darker grays; magnetic lows as lighter grays. A variance map of the magnetic data, which highlights areas with magnetic readings that are significantly lower or higher than the average values of the data, is presented as Figure 6.

Soil resistivity and soil compaction transects were conducted across eight of the areas identified as possible interments. Two of those areas (marked C on Figure 7) are interpreted as being associated with a large tree that used to stand in the cemetery area (see Figure 4). Soil resistivity surveying employs two sets of dipoles to measure the resistance to a current run through the ground. Differing soils have differing resistivity (largely due to water content), as do objects such as stone, concrete, and, in this case, caskets. One of the major drawbacks to soil resistivity surveying is that it is a much slower process than geomagnetic surveying, taking roughly five times as long to cover the same area. For this reason, only transects across suspected interments were conducted. A Duoyi DY4300 soil resistivity meter was used for these transects, employing a twin electrode array (one stationary pair of electrodes, one mobile). Each transect was 10 meters long, and readings were taken every 0.5 meters.

Soil compaction was also measured in single transects across eight locations where possible interments were identified in the magnetic data. Soil compaction, as the name suggests, is a measure of soil density at a particular location. The upper, organic layers of soils are usually of a different density than underlying soils (which are typically denser), but when the underlying soils have been disturbed, the compaction measures are also altered. Thus, a sudden change in soil compaction may indicate a subsurface disturbance, such as the presence of an interment. A Dicky-John Soil Compaction Tester with a ¾” tip was used to take compaction measurements at 3”, 6”, 9” and 12” below the ground surface, and at 1 meter intervals along a 5 meter transect crossing the geomagnetic anomalies identified possible interments. Measurements were recorded to the nearest 25 psi. Both resistivity and soil compaction data were written into a log-book then transferred to an Excel file. Plots based on these data are presented in Figure 8.

The locations of the possible interments and the datum point for the survey were located using a Trimble GeoXT handheld GPS. The GeoXT has sub-meter resolution and, in the case of measurements taken at the Wixom Cemetery, the average resolution was 0.61 meters. Table 1 provides the coordinates of the survey datum point (which is the SW corner of the 40 meter by 40 meter grid) and the numbered possible interments.

Results

Seven possible interments were identified through the geomagnetic survey. While these cannot be proven to be interments without excavation, they are consistent with late 19th century casket interments from other cemeteries I have surveyed in Wisconsin. Since the area is identified as a cemetery and is remembered to have had headstones, the anomalies interpreted as interments are clustered, and there appear no obvious reasons why these magnetic anomalies should be present in this location, it seems reasonable to conclude that these anomalies do in fact represent interments.

Several of the soil resistivity and soil compaction transects across these anomalies are also consistent with the presence of interments. Specifically, Anomaly 1 and, to a lesser extent, Anomalies 3 and 8 show soil resistivity responses characteristic of casket interments. In these cases the burial vault, filled with a mixture of topsoil (with relatively low electrical resistance) and clay or loess subsoil (with greater electrical resistance), create a profile with lower resistance than the area surrounding the vault. The casket, on the other hand, is more resistant than the surrounding soil, and shows a spike. Similarly, Anomalies 6 and 8, and to a lesser extent, Anomalies 1, 2, and 3 show soil compaction profiles characteristic of interments, with the area over the burial vault, where soil has been removed and replaced, being less compacted than surrounding soils.

The only anomaly that does not fit either the expected soil resistivity or soil compaction profiles is Anomaly 7, and its magnetic characteristics vary somewhat from what would be expected from a single interment. First, it appears to be a linear feature, and may connect with the much less magnetic linear feature at the north end of the original 40 meter by 40 meter survey (although the two have different magnetic strengths and do not fully align—see Figure 5). As a linear feature it does not have to characteristic "doughnut" shape of point features on the variance map (Figure 6). However, it does align with Anomaly 6, which does appear consistent with an interment. Thus, I suggest Anomaly 7 may represent two, or perhaps three, interments placed immediately next to one another, so closely that their strong magnetic signatures masks their separation.

The evidence strongly suggests that there are at least 4 casket interments in the Wixom Cemetery (Anomalies 1, 3, 6 and 8), and the preponderance of the evidence suggests there are at least 7 casket interments. Additional interments may be present, but were not unambiguously identifiable given the instruments and survey techniques employed. Based on the evidence my students and I collected, I am confident that interments are present in the Wixom Cemetery.

Recommendations

1. The Wixom Cemetery should be protected as a catalogued burial site under Wisconsin Statutes 157.70.
2. Fulton Township should take charge of the Wixom Cemetery under Wisconsin Statues 157.115.
3. All use of the Wixom Cemetery for agricultural purposes should cease immediately.

Figure 1. Location of Wisconsin site RO-0434 / BRO-0033.

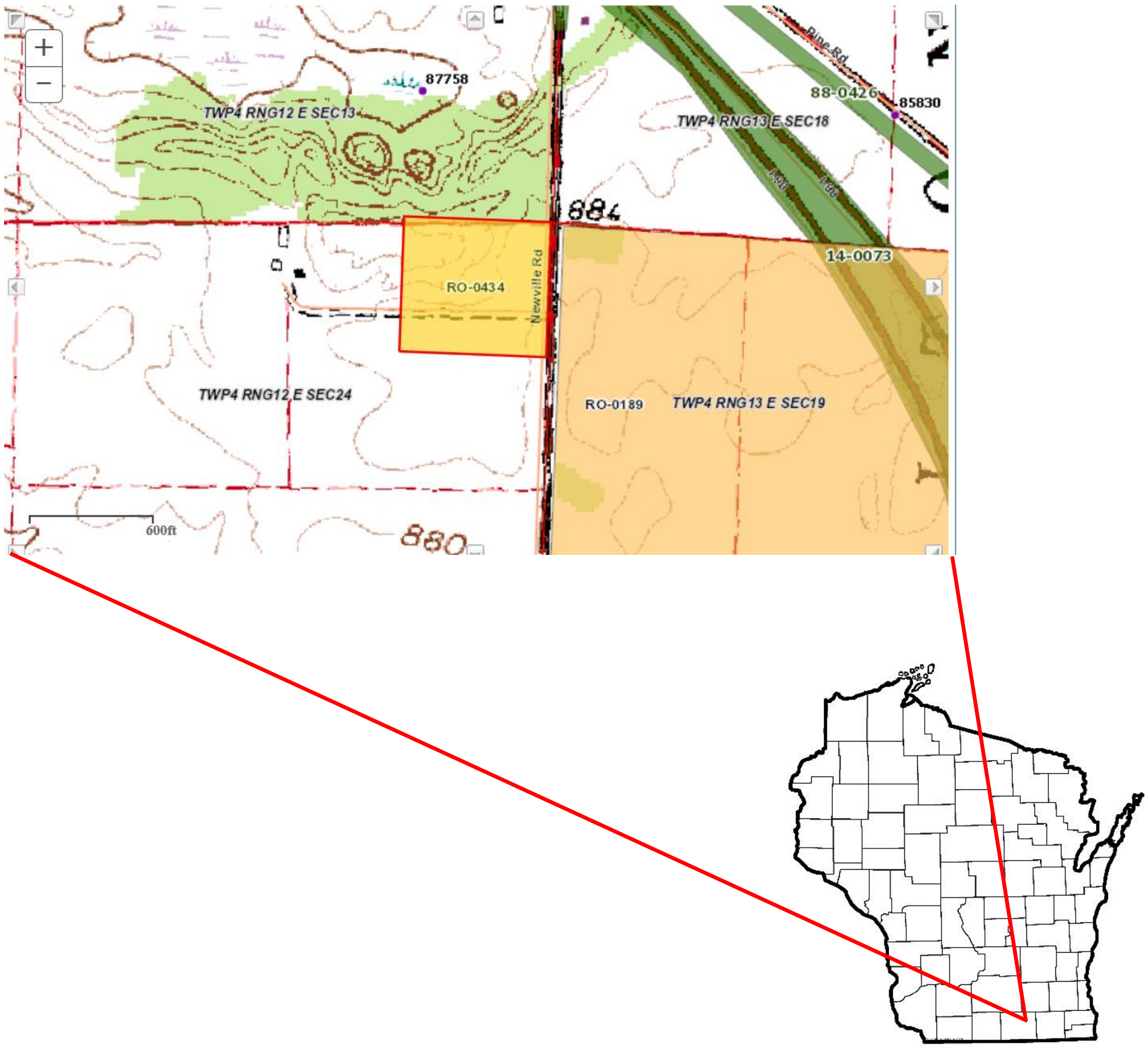


Figure 2. 1873 Plat map of Fulton Township, Rock County, Wisconsin showing the cemetery marked with a cross on the east line of T4 R12E in Sec. 24.

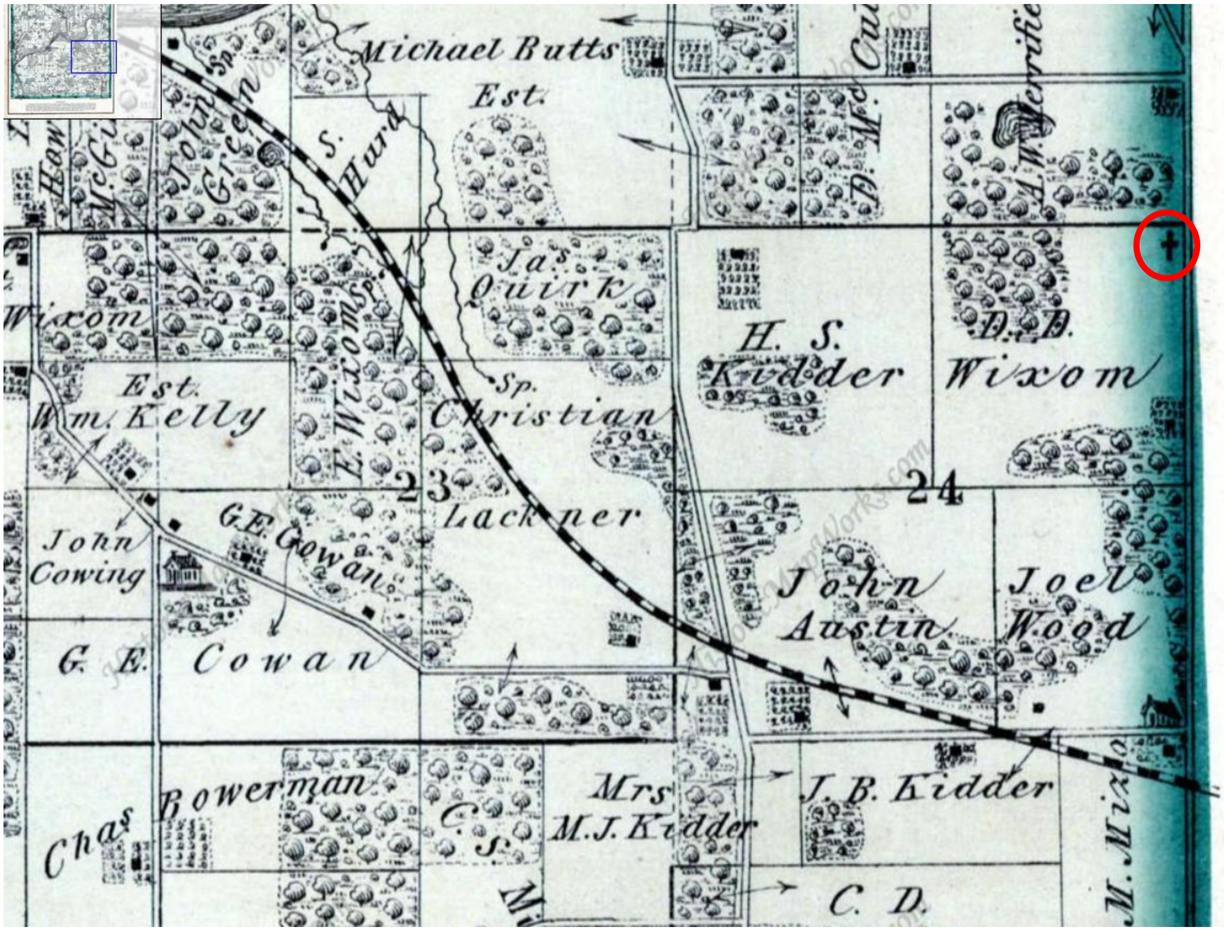


Figure 3. Aerial photograph of BRO-0033 showing the approximate boundaries of the surveyed area.

Figure 4. Magnified 1937 aerial photograph of BRO-0033, showing the approximate boundaries of the surveyed area. Note the tree in middle right of the image.

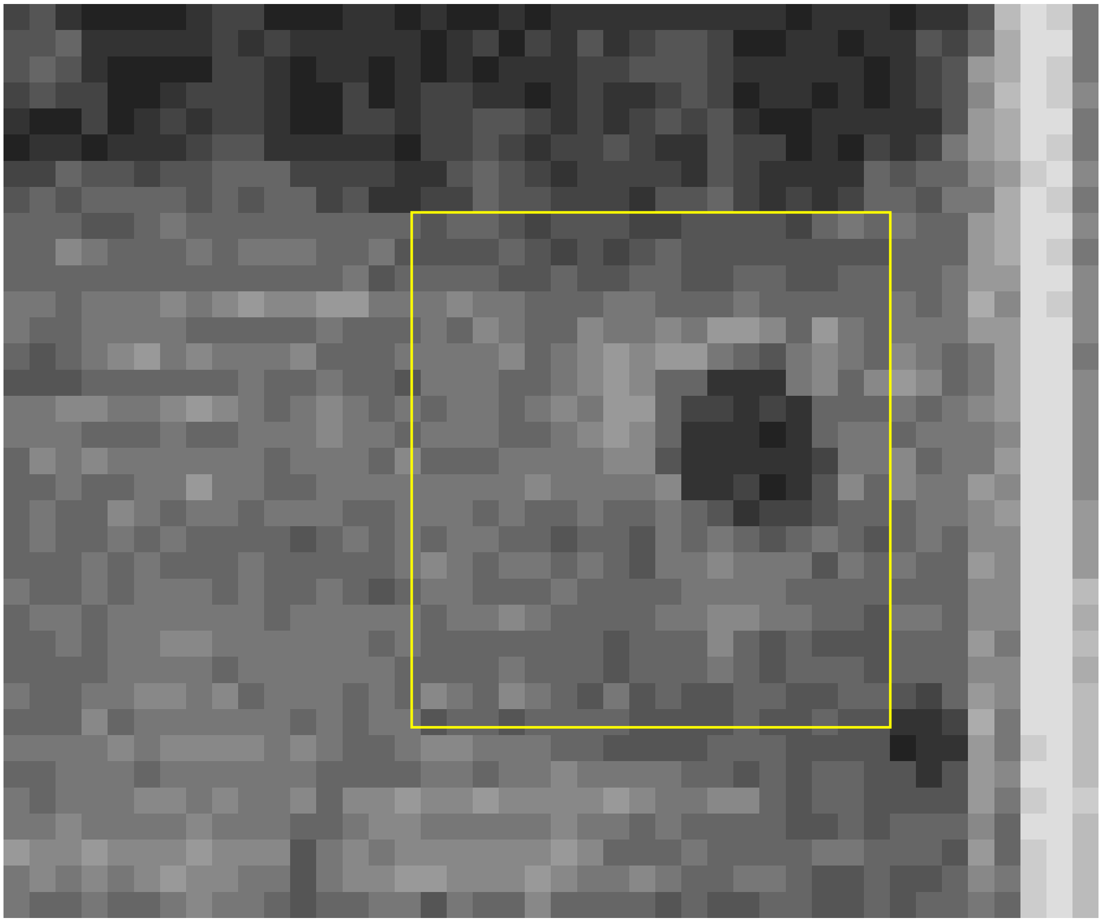


Figure 5. Magnetic map of the Wixom Cemetery, BRO-0033. North is to the top. Dimensions are 45 meters E-W and 50 meters N-S.

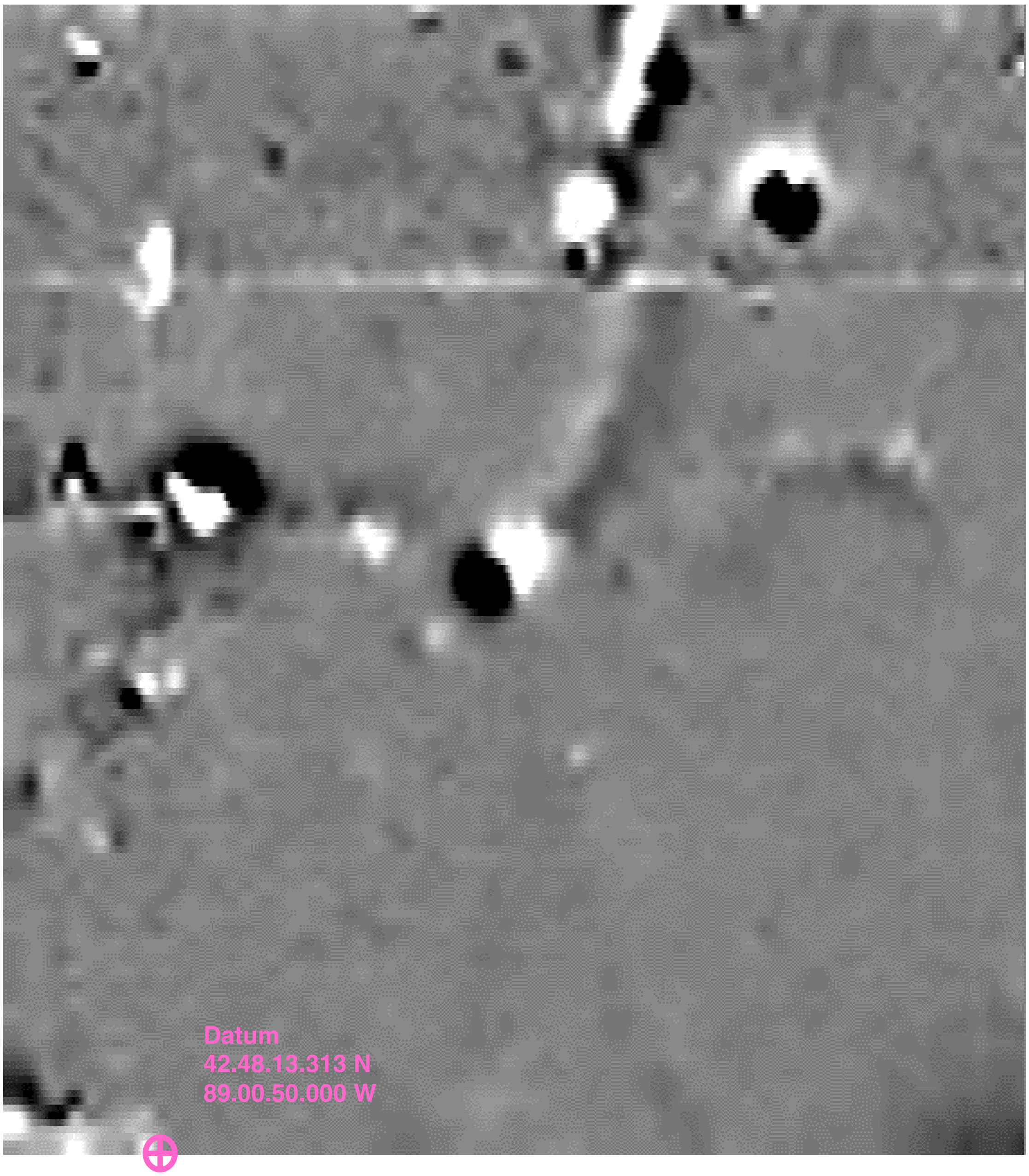


Figure 6. Magnetic variance map of the Wixom Cemetery, BRO-0033. North is to the top. Dimensions are 45 meters E-W and 50 meters N-S.

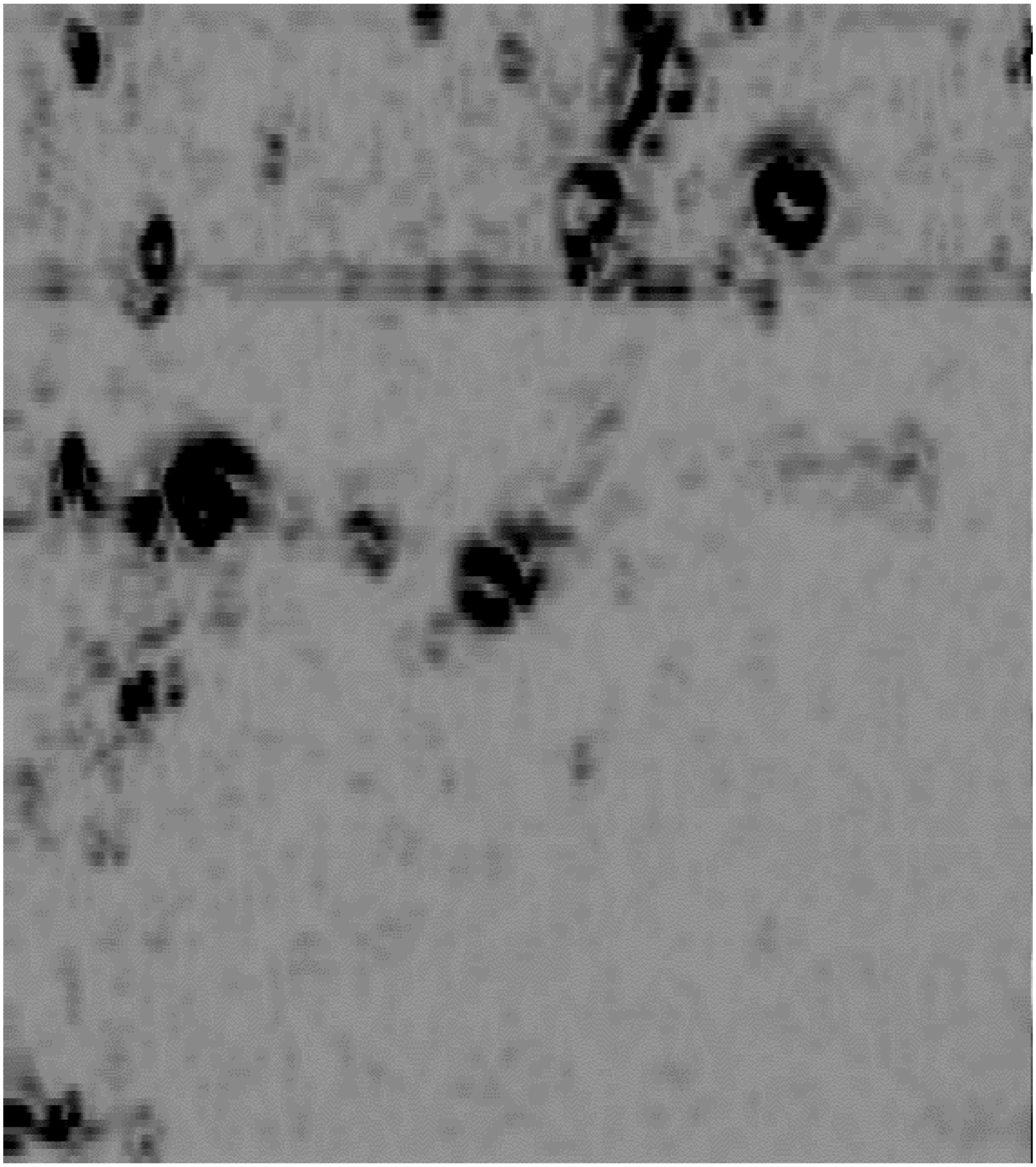


Figure 7. Interpretation of the magnetic data. Anomalies labeled A and B are the result of modern metal (A from a survey flag that was mistakenly left in place; B from a permanent metal survey stake). The anomaly labeled C is from a tree that is visible in a 1937 aerial photo of the site. Yellow ovals indicate anomalies that are interpreted as likely interments. Anomalies numbered 1 thru 8 were further investigated using measurements of soil resistivity and compaction.

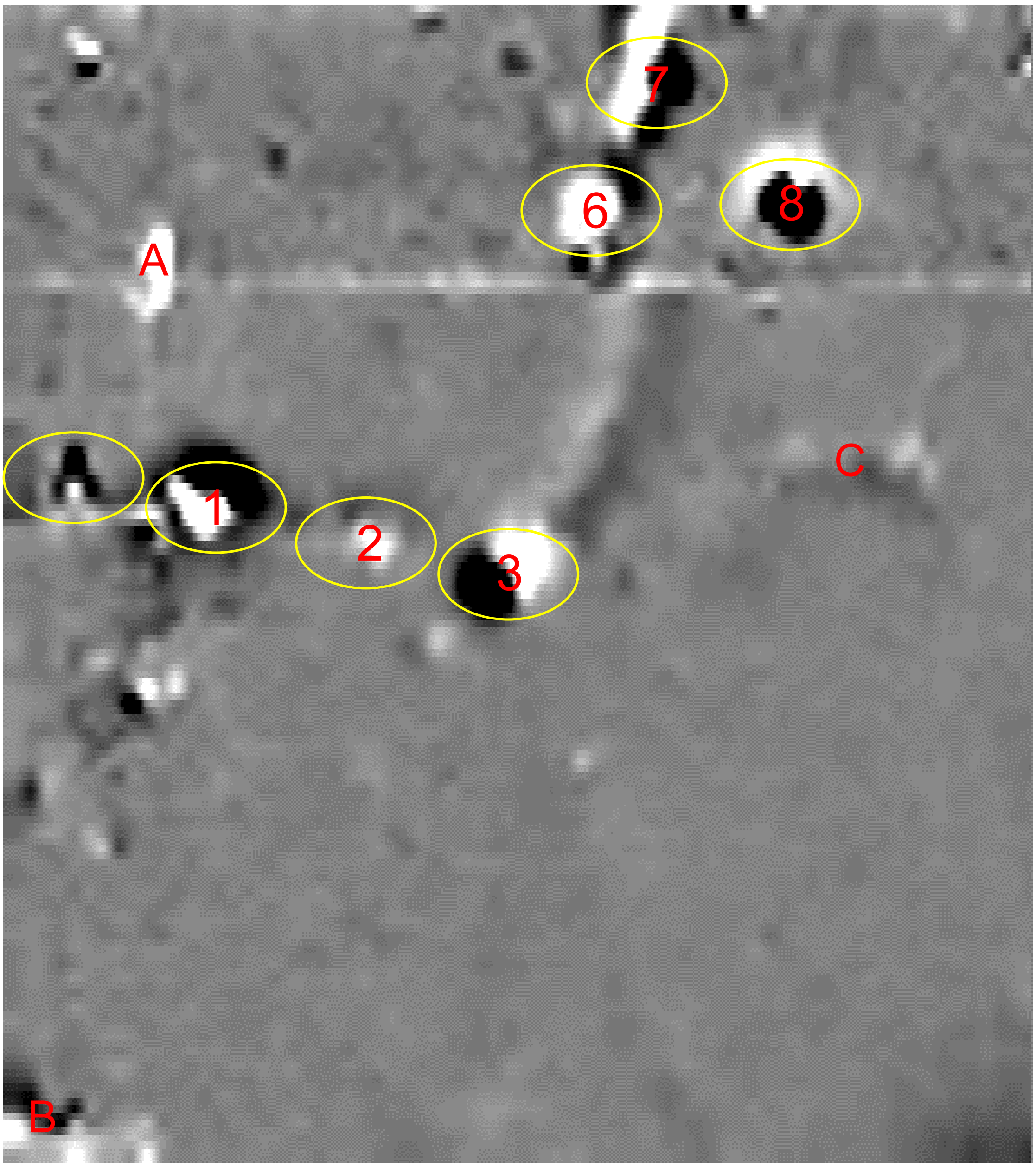
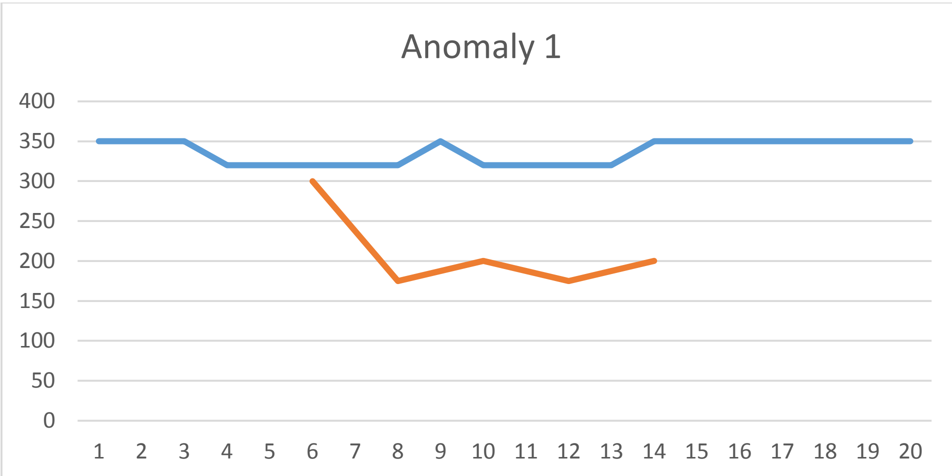
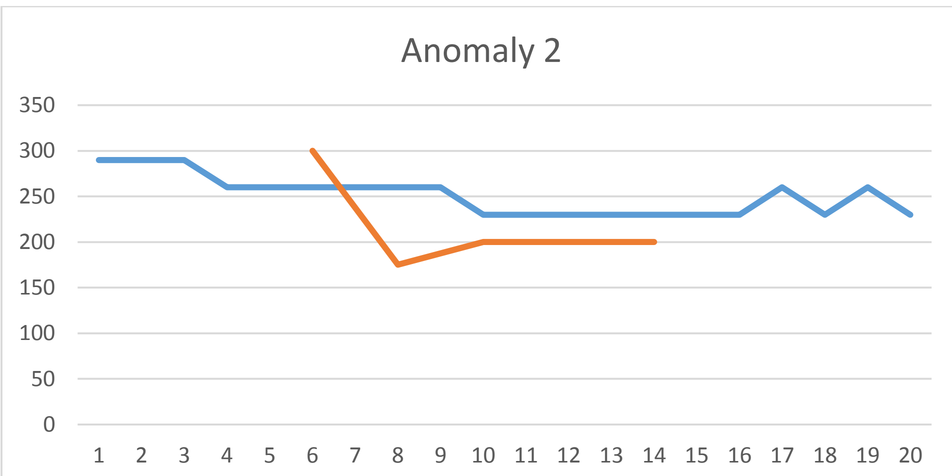
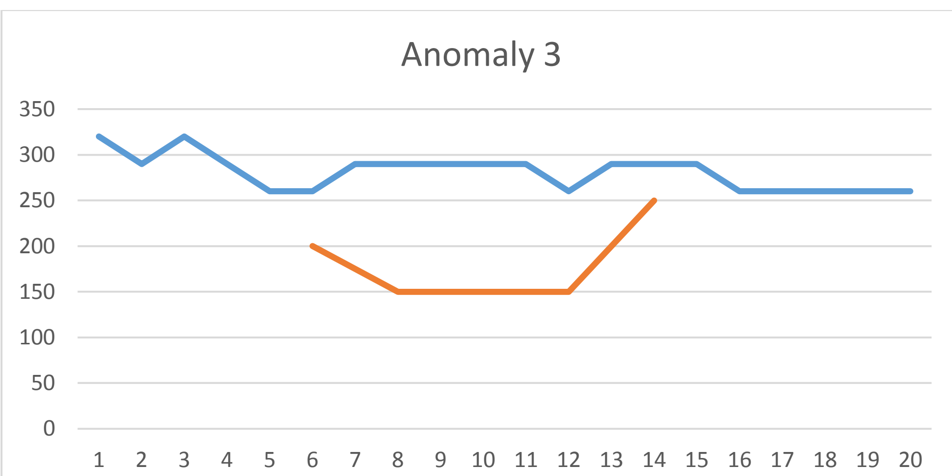
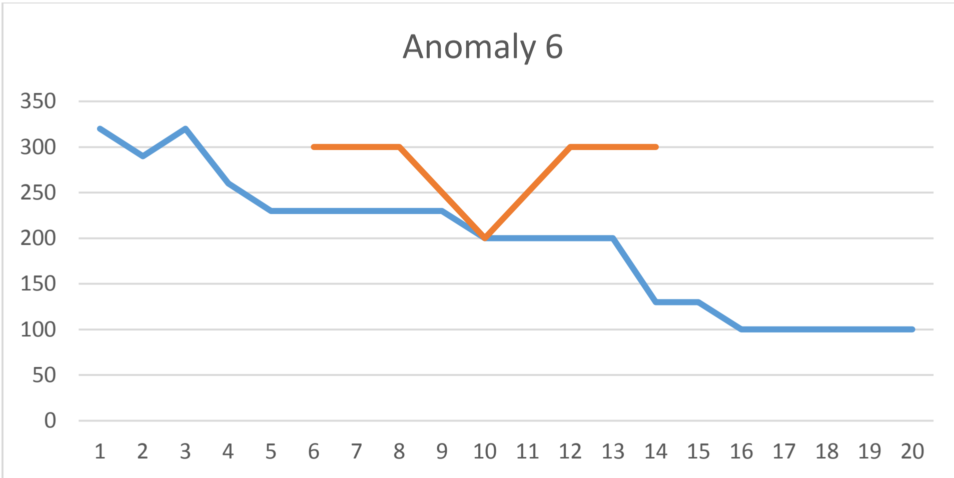


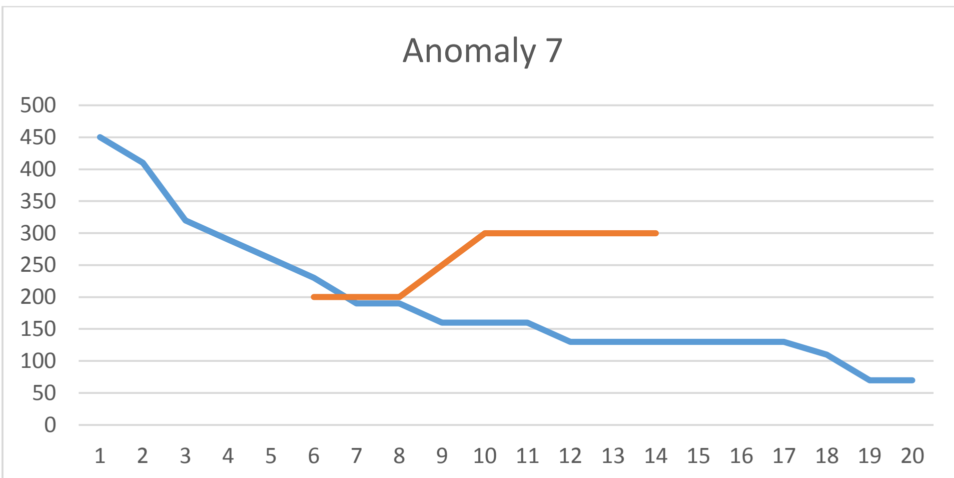
Figure 8. Soil resistivity and compaction transects across geomagnetic anomalies identified as possible interments, as shown in Figure 7. Soil resistivity measures are in blue; soil compaction measures are in orange. Resistivity measurements (in ohms) have been multiplied by a constant to put them on the same scale as soil compaction measures (in PSI).








Anomaly 6
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20


Anomaly 7
500
450
400
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

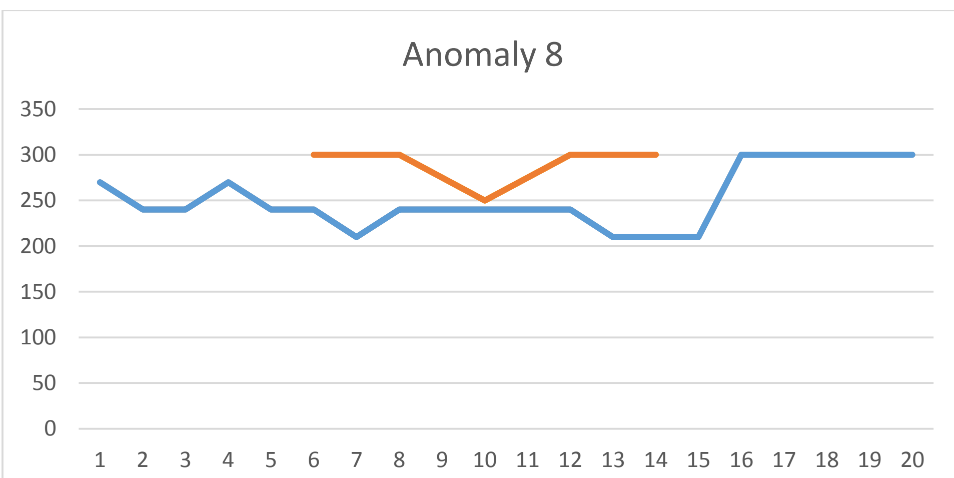

Anomaly 8
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Table 1. Geographic coordinates from the Wixom Cemetery geophysical survey.

Datum	42.48.13.313 N	89.00.50.000 W
Anomaly 1	42.48.14.070 N	89.00.49.710 W
Anomaly 2	42.48.14.010 N	89.00.49.485 W
Anomaly 3	42.48.13.990 N	89.00.49.475 W
Anomaly 6	42.48.14.431 N	89.00.49.355 W
Anomaly 7	42.48.14.545 N	89.00.49.275 W
Anomaly 8	42.48.14.425 N	89.00.49.050 W