

February 18, 2014

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Wisconsin Department of Natural Resources  
2984 Shawano Ave.  
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Re: Geophysical Survey of City of Manitowoc Gravel Pit and Adjacent Property

This memorandum describes efforts by scientists from the Wisconsin Geological and Natural History Survey to use magnetics as part of a site investigation at the City of Manitowoc Gravel Pit and an adjacent property in the town of Newton. The survey had two goals. The first goal was to use magnetics to look for buried drums that might act as potential sources of contaminant. The second goal was to identify the location of a private well buried during site development.

Magnetic surveys measure the strength of the earth's magnetic field. The units of the field strength are nanoTeslas (nT). The field is affected if a magnetic material is present. Iron and steel are highly magnetic and will have a much larger effect on the magnetic field than natural materials. If the variation in the magnetic field is large, then it is likely that iron or steel are present. If the variation is small, then it is likely that there is no buried iron or steel. The drawback to this method is that it is nearly impossible to differentiate between a buried drum and a similar amount of iron or steel, for example, a buried roll of fencing or rebar. The end result is that the method can only determine that in areas without large variation in the magnetic field, that it is unlikely that drums are present in the subsurface.

We used a Geometrics G-858 cesium vapor magnetometer with a connected GPS unit to simultaneously record the magnetic field strength and location. The GPS accuracy was checked by comparison to known locations of well nests, WT-01 and WT-03. The accuracy of the magnetometer is given by the manufacturer as less than 0.1 nT.

We conducted surveys at eight sites of interest in the gravel pit and the adjacent property. These sites are shown on Figure 1, the site map. Sites 1 to 7 were surveyed to identify high magnetic signals that might correspond to buried drums. Site 8 was surveyed to locate a buried well. An annotated contour plot of the magnetic field was prepared for each site with further explanation below the plot. The plots are shown in Figures 2 to 6. We saw large variations (greater than 1000 nT) in the magnetic field at Sites 1, 2, and 7 that indicate iron or steel at these sites. However, metal in the form of wire and rebar was observed at the surface at these three sites so the method cannot be used to answer the question of whether or not buried drums are present. In Sites 3 to 6, the variation in the magnetic field was small (less than 100 nT) and corresponds to naturally produced variation. Based on those results, we conclude that there is no buried metal beneath Sites 3 to 6. The survey beneath Site 8 showed a point of large variation on the northwest edge of the survey. That point is the likely location of the well. We refined the location by sweeping the magnetometer back and forth over that point and then marked the point using GPS.

## Conclusions

1. Based on the surveys, we cannot make any conclusions about the presence or absence of buried drums at Sites 1, 2, or 7.
2. It is unlikely that buried drums are present beneath Sites 3, 4, 5, and 6.
3. It is likely that an unabandoned well is present at the location marked on Site 8.

Please contact me ([djhart@wisc.edu](mailto:djhart@wisc.edu)) if you have any questions regarding this memorandum.

Sincerely,

David Hart  
Hydrogeologist/Geophysicist

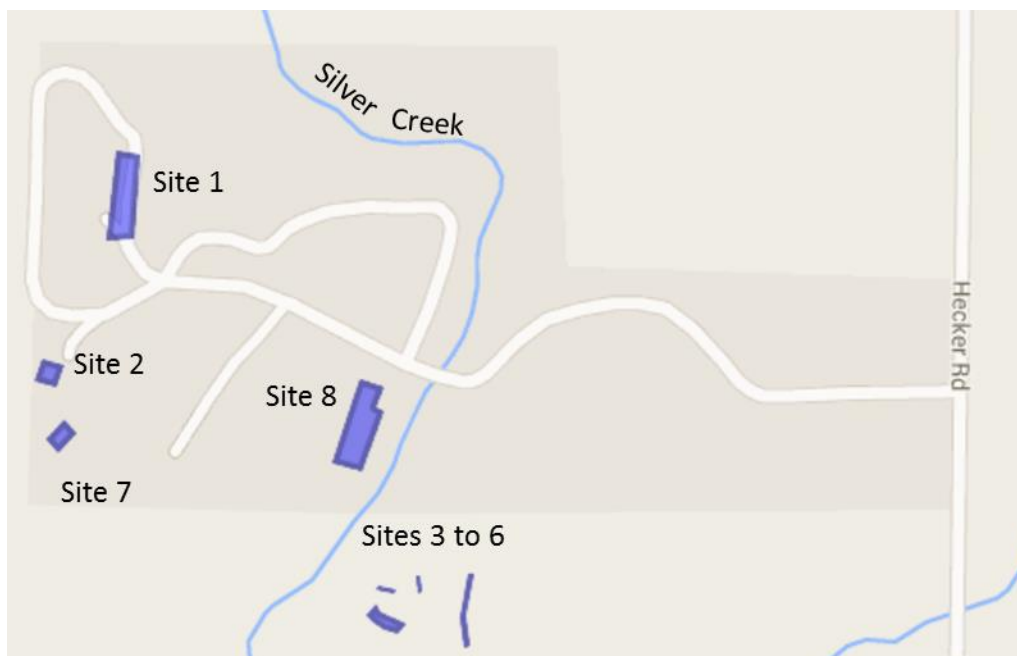


Figure 1. Map of the sites. The darker shaded area is the extent of the gravel pit.

## Site 1

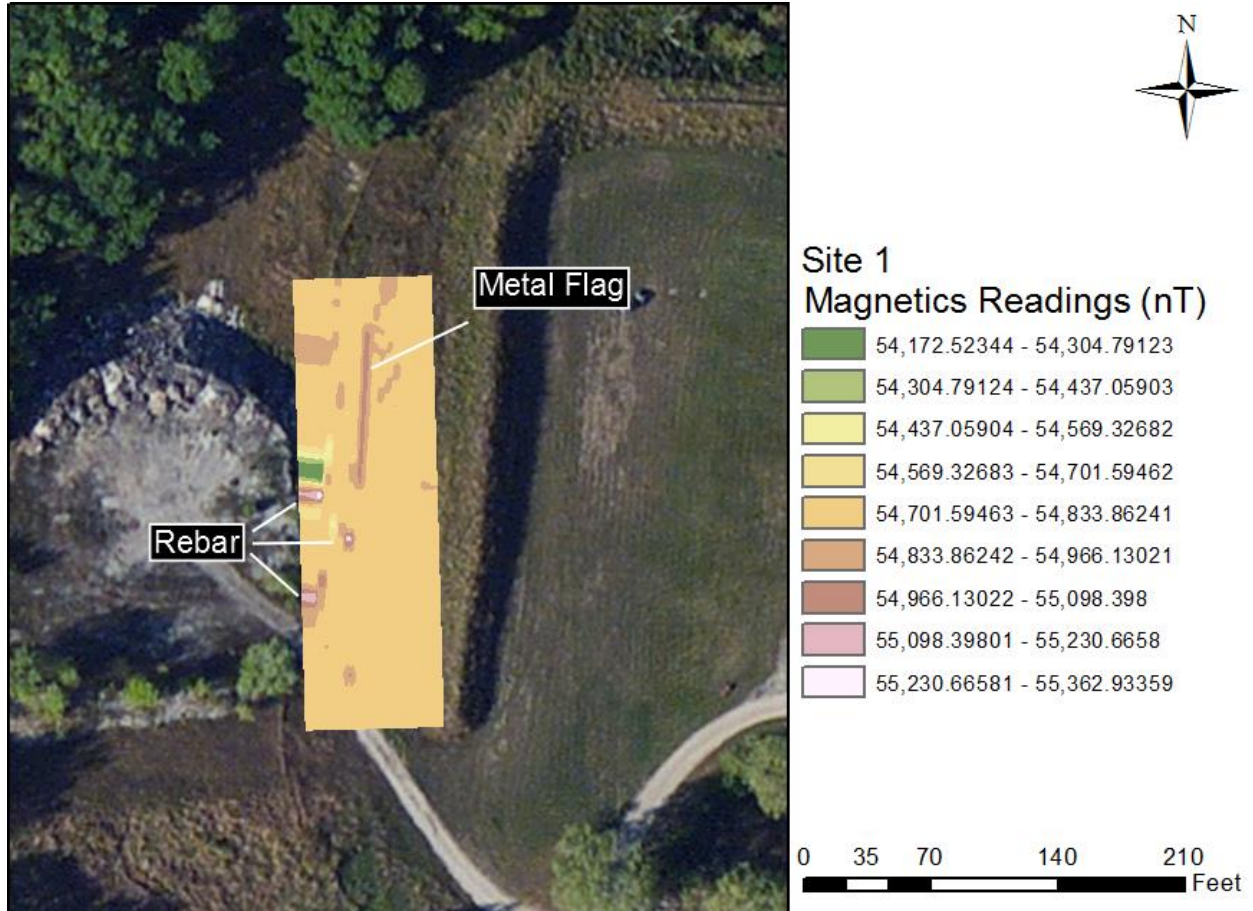


Figure 2. Site 1 consists of 14 lines running north-south with an area of ~70 x 225 feet. The GPS locations for the 4 corners of the grid are:

Southeast corner (start): N 44.06132 W 87.72034

Northeast corner: N 44.06194 W 87.72028

Northwest corner: N 44.06197 W 87.72049

Southwest corner (end): N 44.06129 W 87.72057

Anomalous values are annotated in the figure for Site 1. A metal flag was seen during acquisition of Line 9. This is the red line in the center in the northern half of the survey. Rebar was seen in the western portion of the survey grid, so this could account for the spots with higher readings in the western section. Otherwise, no anomalous values indicate significant buried objects.

## Site 2

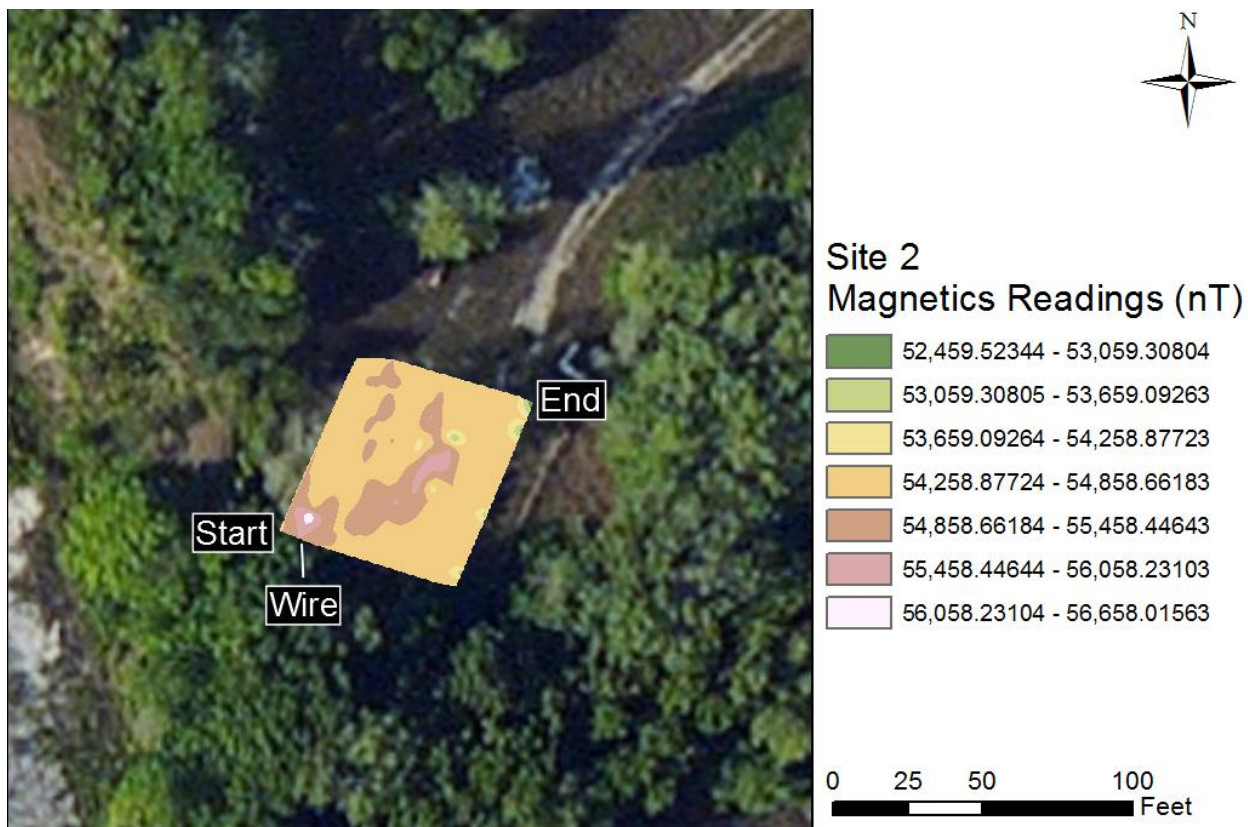


Figure 3. Site 2 consists of 13 lines running north-south with an area ~60 x 73 feet. The GPS locations for the 4 corners of the grid are:

Southeast corner: N 44.06014 W 87.72119

Northeast corner (end): N 44.06031 W 87.72108

Northwest corner: N 44.06037 W 87.72131

Southwest corner (start): N 44.06019 W 87.72142

The first line (west side of grid) had wire visible on the ground, and wire was located south of the survey grid. This could cause the anomalous values in the southwestern portion of the grid. Well casing was also located within 5 feet of the southeastern portion of the grid.

## Sites 3-6



Figure 4. Survey Sites 3, 4, 5, and 6.

### Survey Site 3

Site 3 consists of 9 lines running northwest-southeast with an area of ~40 x 86 feet.

Southeast corner: N 44.05835 W 87.71741

Northeast corner (start): N 44.05849 W 87.71766

Northwest corner: N 44.05840 W 87.71780

Southwest corner (end): N 44.05830 W 87.71748

### Survey Site 4

Site 4 consists of 2 lines running east-west with a steep east sloping hill in the western portion.

Southeast corner: N 44.05864 W 87.71740

Northeast corner: N 44.05865 W 87.71740

Northwest corner (end): N 44.05862 W 87.71773

Southwest corner (start): N 44.05859 W 87.71773

### Survey Site 5

Site 5 consists of 2 lines running north/northwest-south/southeast.

Southeast corner (start): N 44.05858 W 87.71725

Northeast corner: N 44.05884 W 87.71736

Northwest corner: N 44.05882 W 87.71742

Southwest corner (end): N 44.05859 W 87.71729

### Survey Site 6

Survey Site 6 consists of 2 lines running north-south. These lines are parallel to the property line. The site curves, because a depression in the ground was walked around.

Southeast corner: N 44.05814 W 87.71674

Northeast corner (start): N 44.05867 W 87.71667

Northwest corner (end): N 44.05870 W 87.71672

Southwest corner: N 44.05814 W 87.71680

The magnetic readings varied little at these sites. There is no indication of anomalous values due to buried metals.

## Site 7



Figure 5. Survey Site 7 consists of 11 lines running northeast-southwest with an area of ~50 x 70 feet. The GPS locations for the 4 corners of the grid are:

Southeast corner: N 44.05967 W 87.72112  
Northeast corner (start): N 44.05981 W 87.72097  
Northwest corner: N 44.05994 W 87.72115  
Southwest corners: N 44.05972 W 87.72123  
N 44.05975 W 87.72124 (end)

As at Sites 1 and 2, metal was observed on the ground in the survey area.

## Site 8



Figure 6. Survey Site 8 consisted of 18 lines starting to the northwest. Edge coordinates were not collected. The GPS coordinates recorded by the magnetometer were used for location.

The high field strength shown in light pink is the possible location of the well at location latitude N 44.06004 and longitude W 87.71795.