ELECTROMAGNETIC SURVEY
FORMER ERIC WEISSEL OVAL SITE

WAGGA WAGGA CITY COUNCIL

APRIL 2014

Survey conducted by:
Terrabyte Services Pty Ltd
PO Box 1411,
Wagga Wagga NSW 2650
Email: enquiries@terrabyte.net.au
Website: www.terrabyte.net.au
Phone: 02-69719144

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1 Introduction

The variability in soil physical and chemical properties can have significant implications for the determination of appropriate soil, landuse and decontamination management strategies or infrastructure development. Understanding the nature and extent of this variability can lead to improved management and better matching of landuse to land capability.

Electromagnetic (EM) surveying is a technology routinely used to identify the variability in soil characteristics by measuring the soils' apparent conductivity. Influenced by soil porosity, soil moisture, the concentration of dissolved salts and the amount and type of clay within the soil profile, apparent conductivity has been proven to be a useful indicator of soil trends and for the determination of appropriate locations for targeted soil investigations.

Together with targeted soil profile investigations, geotechnical advice can then be used to maximise understanding of the survey area characteristics and develop appropriate management or development plans.

A non-contact technique, EM surveying uses the generation of a magnetic field by the EM instrument to cause a current to flow in the soil and inducing a secondary magnetic field that is detected by the EM. The magnitude of the second magnetic field varies with the conductivity of the soil and is referred to as the soils 'apparent conductivity'.

Figure 1. *EM31/EM38 and GPS mounted on a 4-wheeled motorbike*

Additional to the conductivity measurement, the EM31 sensor simultaneously measures an Inphase reading that identifies areas of magnetic susceptibility. Typically the inphase readings rise or fall near metallic objects and it is the relative change in values rather than specific readings or ranges of values that indicate the potential presence of metallic objects.

Collecting data at 1 second intervals, transect spacing is adjusted to suit each application and typically range from 5m to 50m transects yielding between 40 and 2000 measurements per hectare.

Following surveying, a targeted soil profile investigation plan can be developed to initially determine the magnitude of difference between soils within the highest, lowest and average conductivity locations, and to correlate soil conditions and soil conductivity. From this information the potential need for further sampling is determined and planned as required. Initial investigation may involve only physical soil description with samples retained for chemical assessment at a later date if required.

Under normal conditions, the highest conductivity readings will represent soils with the highest overall clay content and lowest drainage, with greatly elevated readings indicating potentially saline or contaminated conditions. The lowest conductivity readings indicate relatively coarse textured soils with lower electrolyte levels and typically having increased relative drainage characteristics.

Measuring the average conductivity of the soil profile, Terrabyte Services has both EM31 and EM38 units providing sensor depth options ranging from 0.75m to 6.0m depending on the sensor configuration as shown in Table 1.

Instrument	Mode	Depth of recording (m)
EM 31	Vertical	6.0
EM38	Vertical	1.5

***Table 1**: EM depth of measurement*

2 Collection of Position Data

The location of individual measurements is recorded using a Global Positioning System (GPS). The position is differentially corrected in real time resulting in an accuracy of 80-120 cm. While the vertical error with differential GPS is greater than the horizontal error, the topographical information obtained will reflect relative differences. Unless otherwise specified, ground references are based on UTM coordinates using the WGS 84 datum. To assist in the interpretation of the conductivity maps the location of some features (eg. fence lines, dams etc.) may also be recorded.

3 Map Production

The EM instruments collect point data from directly beneath the sensor and geo-statistical processes are then used to interpolate the collected point data onto a regular grid. A solid surface, from the gridded points, is then generated. The interpolation process uses a kriging algorithm which is a geostatistical process developed for mineral resource mapping.

Kriging is based on the assumption that data points which are near each other have a certain degree of spatial correlation, but points that are widely separated are statistically independent. The kriging process determines the distance from a data point to an interpolated grid point and weights its contribution accordingly. Spikes or noise in the data can be removed as the contribution of a single anomalous reading is minimal when considered with large numbers of surrounding data points.

While interpolation using kriging is a statistically robust method of map production, it is still making assumptions in areas which have not actually been measured and so any ground truthing should be carried out as close to an actual data point reading as possible. If ground truthing is not on a data point, then it should be undertaken for the purpose of testing the interpolated result.

4 Limitations

The conductivity survey reading are affected by buildings, roads, concrete slabs and other cultural objects. These objects interfere with the readings produced by the EM instruments and are best identified by reference to the inphase measurements.
Refer to Appendix 2 for maps of the actual data points.

The apparent conductivity maps produced are a guide for landscape assessment, the data identifies trends throughout the whole survey area at a resolution of the transect spacing, which was 5 metres. Further on ground investigations should be carried out if smaller features are required to be identified.

5 Ground Truthing

The EM sensors record the apparent conductivity of a point location, directly beneath the sensor, taken at regular intervals along survey transects. If a soil feature is located entirely between two transects it will not be directly measured by the EM instrument and therefore will not appear on the maps.

While the generation of conductivity maps uses statistical process to interpolate the data between actual reading locations to create a filled map surface, it is advisable to undertake soil investigations as close as practical to the actual data reading locations to most accurately determine the relationship between conductivity readings and soil characteristics.

Initial soil investigations will typically involve assessment of several locations within the highest, lowest and average conductivity areas to assess the magnitude of variability across the survey area and uniformity within conductivity zones. Assessment should involve physical examination of the soil profile to a depth of at least 1 metre with samples retained for possible further chemical analysis. Landuse and geological history as well as any other historical data will be useful in assessing the differing soil characteristics.

6 Survey Location

<u>TBJ1644 – EM survey, March 2014</u>

Client: Wagga Wagga City Council
Locality: Wagga Wagga NSW

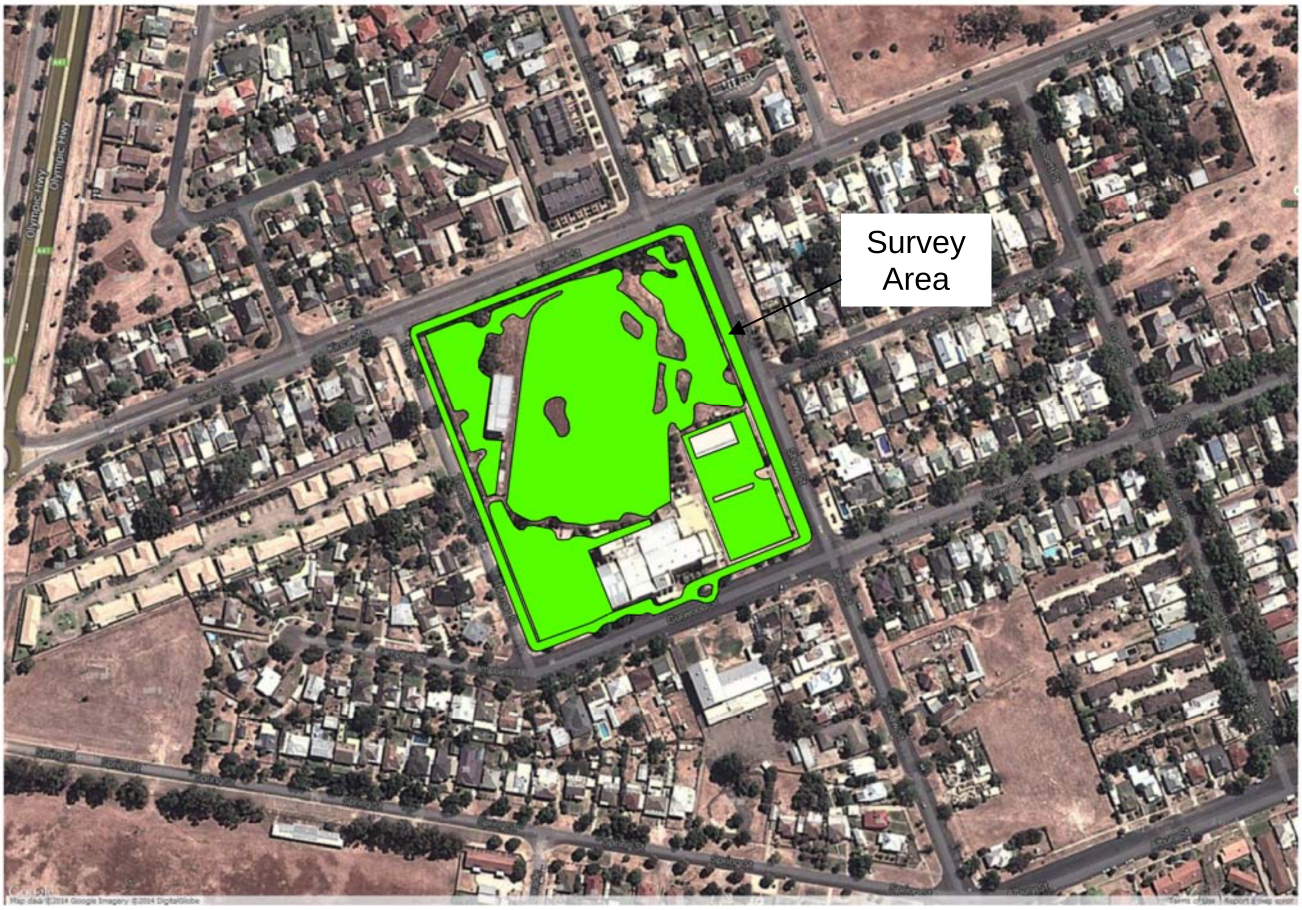


Figure 2. *Location of the Electromagnetic survey conducted at Wagga Wagga, NSW.*

7 Survey Specifications

Instruments:	EM-31vertical dipole
Positioning system:	Trimble R6 – 20mm accuracy
Survey purpose:	Soil contamination assessment
Transect spacing:	2 metres

8 Survey Results and Discussion

The EM31 survey of the Eric Weissel site was conducted on April 7th 2014 and included all accessible areas bordered by Kincaid, Thomas, Gurwood and Shaw streets, including the footpath and nature strip areas as indicated by the data point location map (Fig.1). Within the former oval property, several areas of stockpiled rubble north of the grand stand, east of the oval and in the north-eastern corner were not accessible. There were also small piles of soil and an area of stored scaffolding on the oval the prevented survey access.

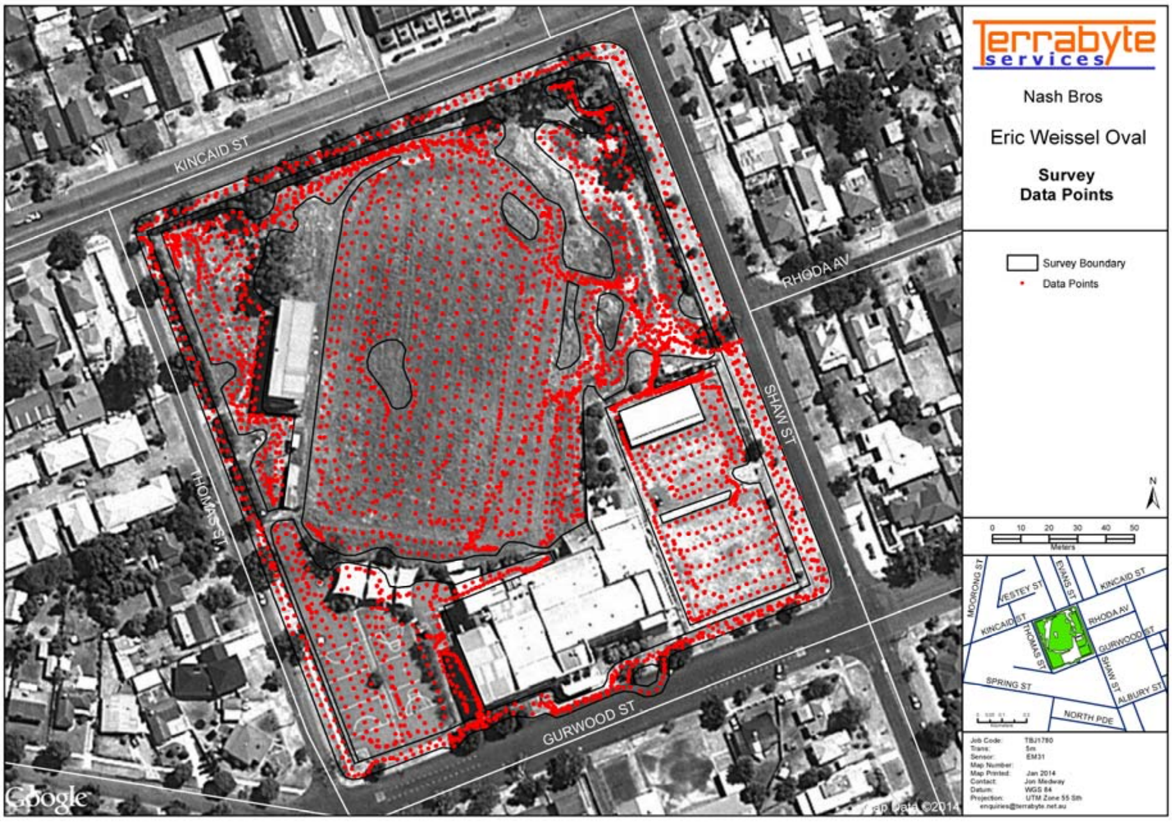


Figure 3. Survey coverage - EM31 data point locations.

Processing of the EM31data (Fig.3 and Fig.4) shows the undeveloped areas of the site to have generally consistent conductivity of between 5 and 70 mS/m which is typical the conductivity measured in surveys of similar landscapes.

Areas of higher conductivity where measured in those areas where concrete surfaces, paths and kerb and guttering were present, apart from the existing concrete cricket pitches in the north western corner of the site where lower conductivity was observed. The elevated or negative readings are typical of the interference caused by concrete and differences in the amount of reinforcing steel used and proximity to metal structures such as fencing. The general consistency of readings in those concreted areas does however suggest a general consistency of the soil profile beneath the surface.

The areas of highest conductivity immediately adjacent to the Leagues Club building and the perimeter of the now disused bowling green areas correspond to the areas of lowest inphase measurements and are likely to be the areas of greatest interference caused by the proximity to survey instrument to buildings, fences and concrete.

Figure 4. EM31 - Interpolated apparent conductivity data.

Figure 5.EM31 - Interpolated inphase data

When considering the planning of further site investigations, the football field area appears to be quite uniform indicating no preferred sampling locations and the anomalies associated with the rubble in the north eastern corner, the existing cricket pitches, fencing at the southern end of the football field and within the bowling green and basketball court areas may be of most interest.

9 Conclusion

Apparent conductivity mapping typically identifies the natural changes soil profiles across a landscape and are an indication of the soil depth, type and salinity status, the disturbed nature of this survey site however increases the importance and need for further ground truthing to determine the relationship between the survey data and soil profile characteristics.

The apparent conductivity and magnetic susceptibility maps presented in this report show several general trends.

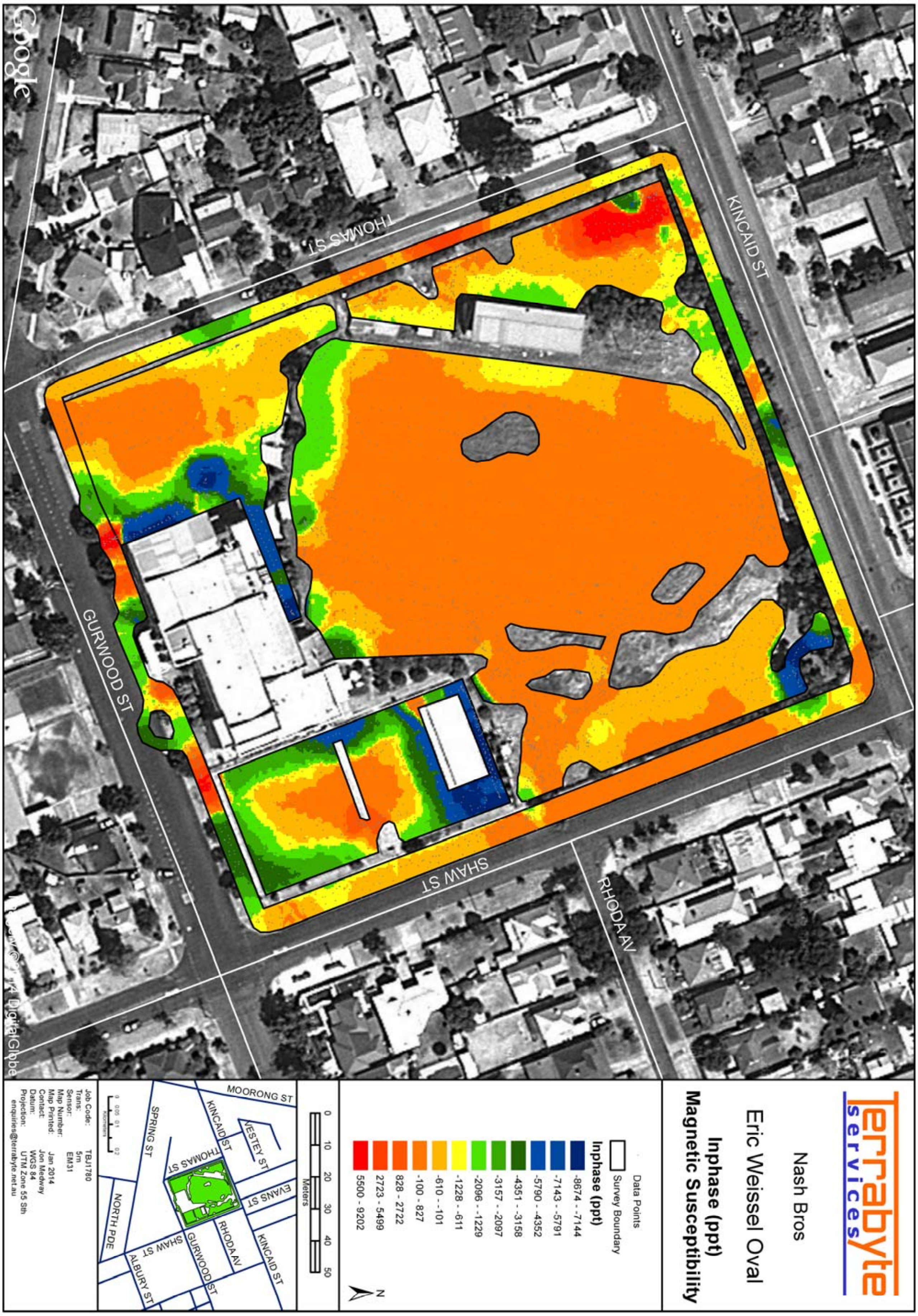
- The undeveloped areas have a generally consistent low conductivity, and
- Lower and higher conductivity areas appear to correspond to interference caused by proximity of the survey unit to concrete and steel structures.

Further investigation of the site with soil coring or drilling will assist with final determination of the relationship between the conductivity data and observed soil characteristics, particularly in those areas with the negative or highest conductivity readings.

Appendix 1: Survey Maps

EM31-EricWeissel-rot.tif


Terrabyte services
Nash Bros
Eric Weissel Oval
EM31 (mS/m)
Apparent Conductivity
Data Points
Survey Boundary
EM31 (mS/m)
-207 - -133
-132 - -60
-59 - -9
-8 - 20
21 - 41
42 - 54
55 - 67
68 - 80
81 - 95
96 - 116
117 - 151
152 - 204
0 10 20 30 40 50
Meters
N
THOMAS ST
KINCAID ST
GURWOOD ST
SHAW ST
RHODA AV
MOORONG ST
SPRING ST
VESTEY ST
EVANS ST
NORTH PDE
ALBURY ST
Job Code: TBJ1780
Trans: 5m
Sensor: EM31
Map Number:
Map Printed: Jan 2014
Contact: Jon Medway
Datum: WGS 84
Projection: UTM Zone 55 Sth
enquiries@terrabyte.net.au
Google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Inphase (ppt)
Magnetic Susceptibility
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Survey Boundary
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-8674 - -7144
-7143 - -5791
-5790 - -4352
-4351 - -3158
-3157 - -2097
-2096 - -1229
-1228 - -611
-610 - -101
-100 - 827
828 - 2722
2723 - 5499
5500 - 9202
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Appendix 2: Data Sample Points


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SHAW ST
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