Zone management - subsoils

Precision agriculture tools such as yield maps, electromagnetic (EM) surveys and satellite imagery are useful for identifying variation across a paddock, and identifying areas or 'zones' with similar characteristics. These 'zones' can then be used to target 'ground truthing' (eg. soil sampling) to determine the source of paddock variation. Different management strategies can then be applied to different zones rather than a whole paddock.

This approach to zone management has been taken in a project looking at subsoil constraints funded by the National Landcare Program (Natural Resource Innovation Grant). In 2004, yield maps and EM surveys of five paddocks across the FarmLink region were used to identify high and low yielding zones within each paddock, each zone measuring 200m x 200m. These zones were GPS located and ground-truthed through subsoil sampling to a depth of up to 1.5m.

Soil test results showed varying subsoil constraints within and between sites, including acidity, salinity and sodicity. In 2005, treatments including lime, gypsum, deep rip and a manure slurry will be applied to the zones according to the subsoil constraint(s) identified. **Yeomans Plow Co**. have lent a plough for this purpose which has been modified with a fertiliser box and air hoses to try to penetrate the treatments to depth.

Subsoil cores taken to 'ground-truth 'each zone are divided into intervals to depth

The project

5 sites:
Barmedman - Rupert McLaren
Morangarell - Neil Haddrill
Marrar - Barry & Vicki Langtry
Osborne - Keith & Mark Bender
Rand - Rodney Trethowin

Tested for:

- *organic carbon*
- *pH* - measure of acidity. Risk of acidity if pH_{CaCl2} less than 5.
- *exchangeable cations* - eg. calcium, magnesium, potassium, aluminium, sodium
- *cation exchange capacity* (sum of exchangeable cations) - measure of clay content. The higher the CEC the high the clay content.
- *exchangeable sodium* - measure of sodicity. Soil can become dispersive if greater than 6%.
- *chloride and electrical conductivity (EC)*- measure of salinity. Risk of salinity if chloride greater than 300mg/kg and EC greater than 2dS/m.

Subsoil constraints identified in 2004:
Barmedman - slight acidity, sodium
Morangarell - sodium, chloride
Marrar - slight acidity
Osborne - sodium, chloride
Rand - slight acidity, sodium

Treatments for 2005:
lime
gypsum
manure
+/- deep rip

A GPS is used in the paddock to locate zones identified from yield maps and EM surveys

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# of subsoil constraints

Barmedman & Morangarell

Subsoil test results - Barmedman:

- *pH* - slight acidity (<5.0 CaCl) at 10-20cm in both zones (Fig. 2)
- *exchangeable sodium (ESP)* - increases with depth. Both zones similar to 40-60cm layer, when Northern zone becomes slightly higher, increasing to 9% at the 80-120cm layer (Fig. 3).

Fig. 1 - EM survey used to select zones at Barmedman

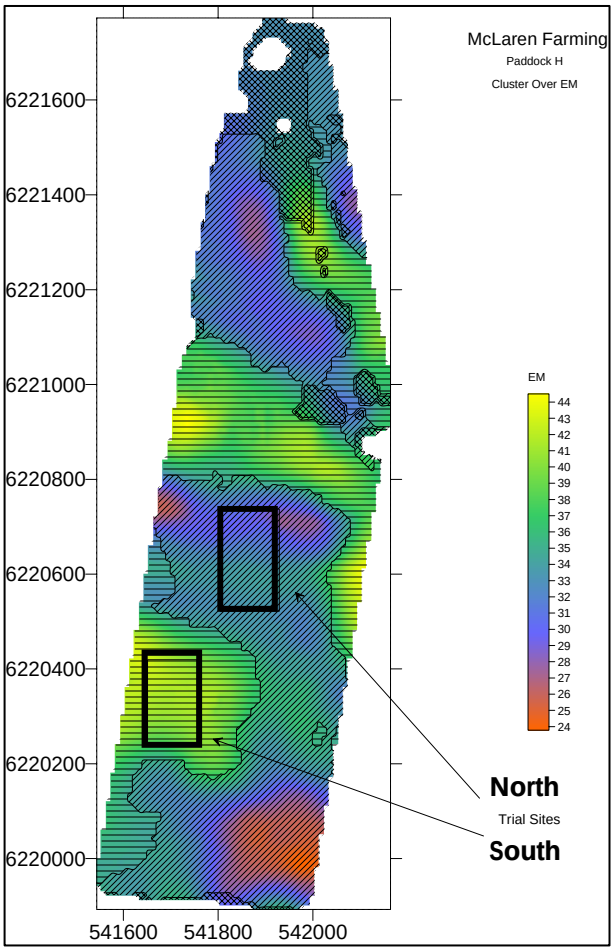


Fig. 2 - pH at depth

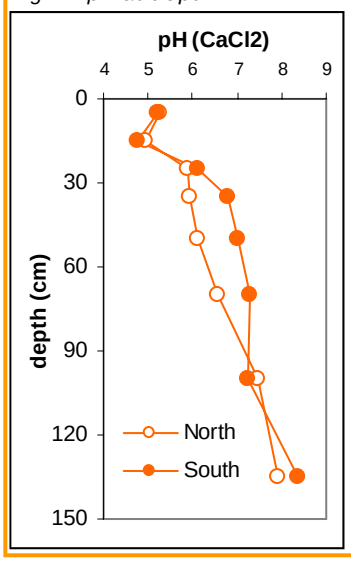
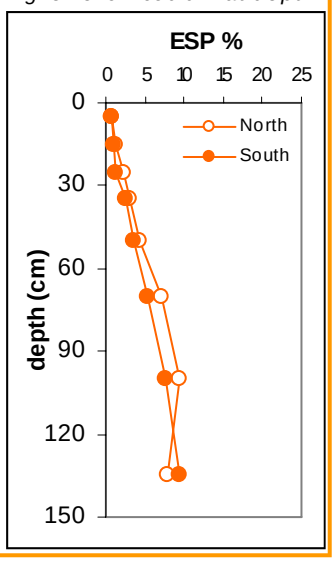


Fig. 3 - exch. sodium at depth



Subsoil test results - Morangarell:

- *exchangeable sodium (ESP)* - increases with depth. High in both zones, but particularly in Southern zone (Fig. 2).
- *chloride* - increases with depth. High in both zones, particularly Southern zone which exceeds 300mg/kg at 40-60cm layer, increasing to >1000mg/kg at depth. Northern zone exceeds 300mg/kg at 60-80cm layer. (Fig. 3).
- *electrical conductivity (EC)* - generally low. Only exceeds 2dS/m in Northern zone at 80-120cm.

Fig. 1 - yield map used to select zones at Morangarell

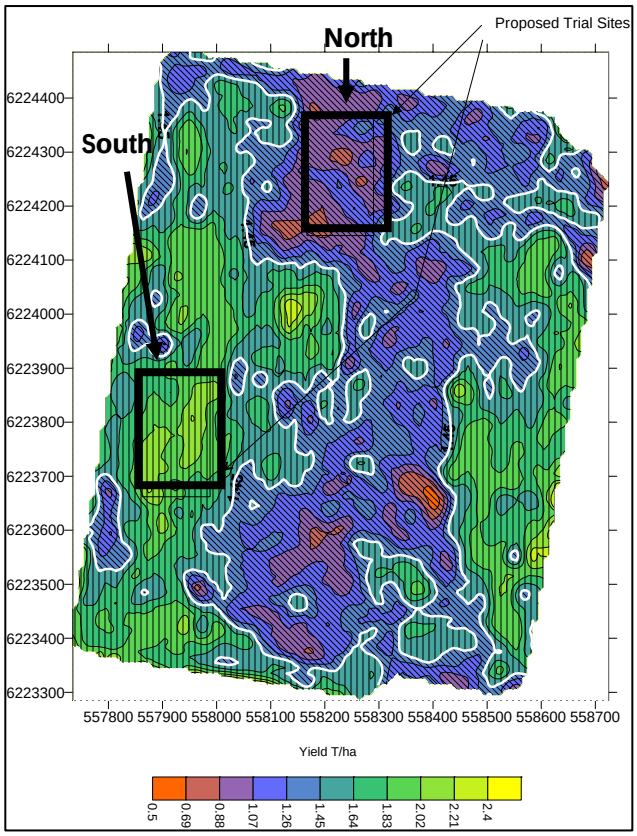


Fig. 2 - exch. sodium at depth

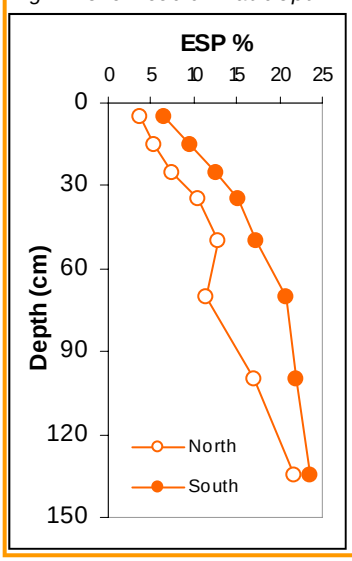
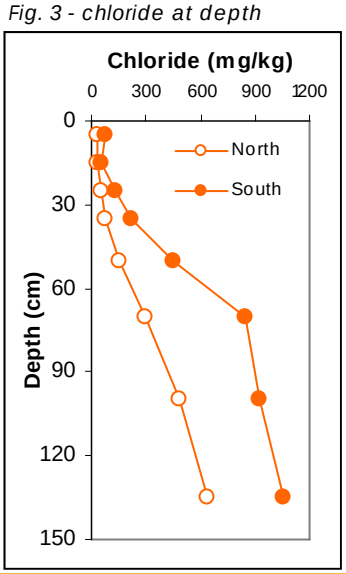


Fig. 3 - chloride at depth



# of subsoil constraints

Osborne & Rand

Subsoil test results - Osborne:

- *cation exchange capacity* - higher clay content throughout the profile in Hill zone (light to medium clay).
- *pH* - slight acidity (<5.0 CaCl) at 0-10cm in Road zone. Higher in Hill zone throughout profile. Increases with depth to 80cm.
- *exchangeable sodium (ESP)* - increases with depth. Both zones similar to 40-60cm layer, exceeding 6% at ~20-30cm. Hill zone becomes slightly higher from 40-60cm layer, increasing to 18% at the 120-150cm layer (Fig. 2).
- *chloride* - high in Hill zone, increasing with depth to 550mg/kg at 120-150cm (Fig. 3).

Fig. 1 - EM survey taken in winter 2004 showing zones (yield maps weren't available at time of zone selection)

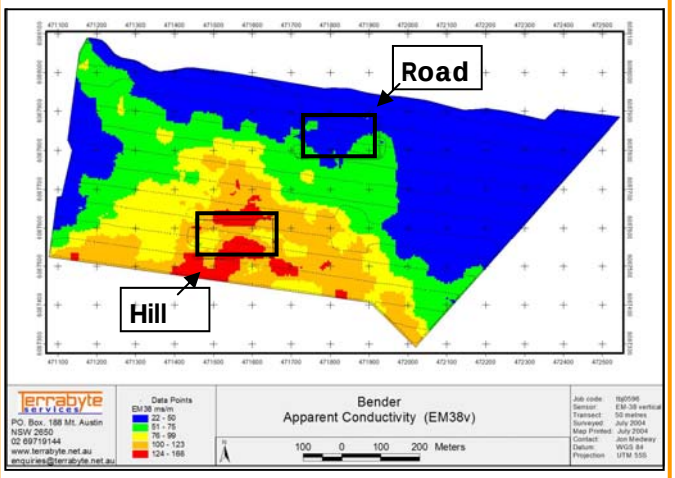


Fig. 2 - exch. sodium at depth

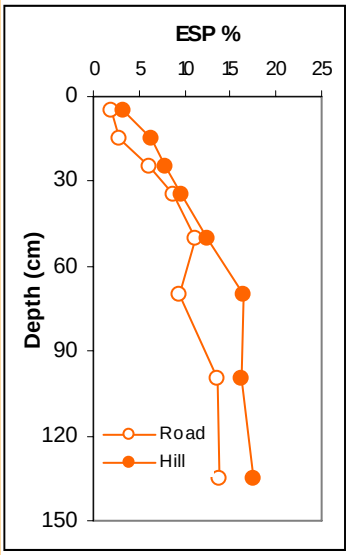
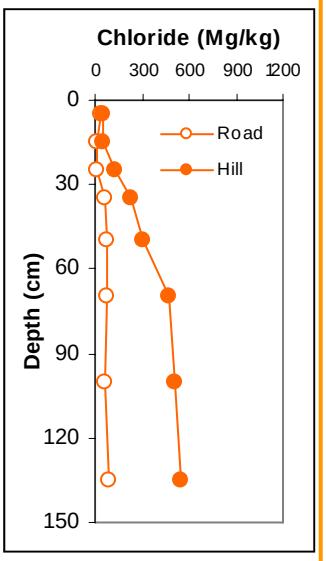


Fig. 3 - chloride at depth



Subsoil test results - Rand:

- pH - slight acidity (<5.0 CaCl) at 10-20cm in Hill zone. Both zones increase with depth from 20cm (Fig. 2).
- *exchangeable sodium (ESP)* - general increase with depth. Both zones exceed 6%, the Road zone at 20-30cm and Hill zone at 40-60cm. Higher overall in the Road zone, reaching 14% at 80-120cm (Fig. 3).

Fig. 1 - EM survey taken in winter 2004 showing zones (yield maps weren't available at time of zone selection)

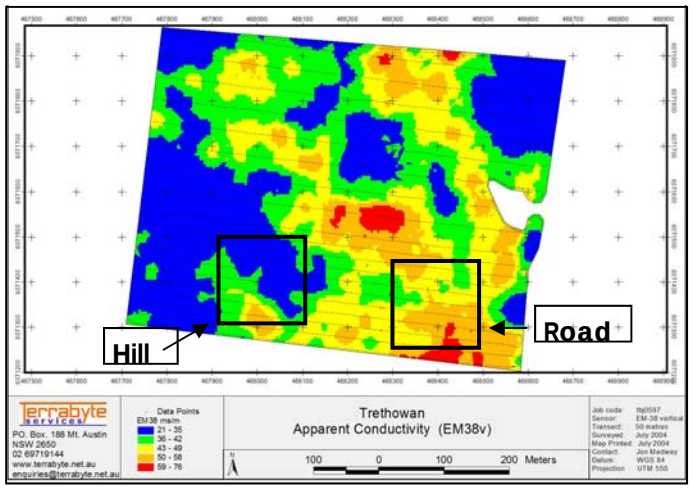


Fig. 2 - pH at depth

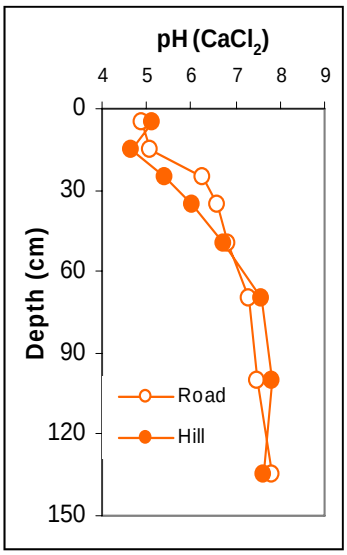
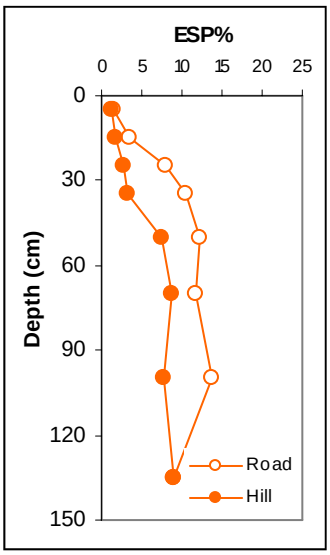


Fig. 3 - exch. sodium at depth



# of subsoil constraints

Marrar

Subsoil test results - Marrar:

- *pH* - slight acidity (<5.0 CaCl) at 10-20cm in both zones, then increasing with depth. (Fig. 2).
- *aluminium (Al%)* - 5-6% aluminium at 10-20cm in both zones in response to lower pH (Fig. 3).

Fig. 1 - cumulative yield map used to select zones at Marrar

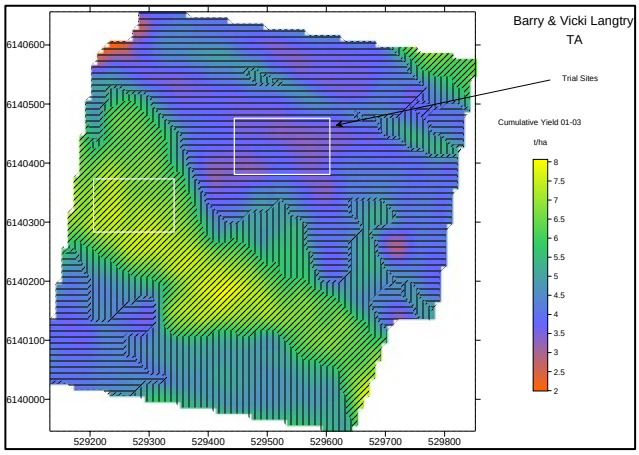


Fig. 2 - pH at depth

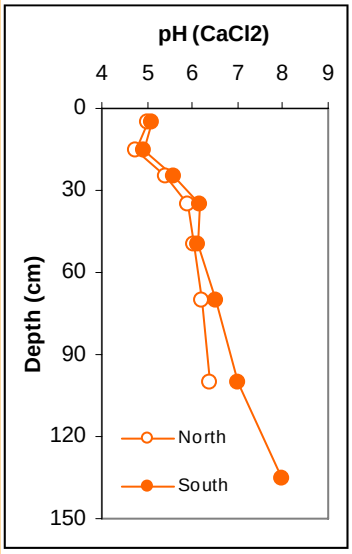
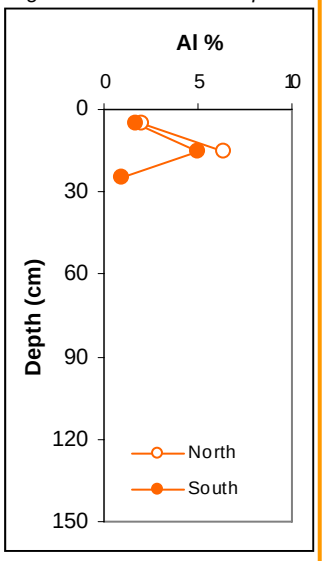


Fig. 3 - aluminium at depth



Temperature effects

As subsoils appeared not to be the reason for yield differences between the zones at Marrar, temperature loggers were placed in each zone in 2004 to see if frost was having an effect. Figure 4 shows an EM map of the paddock overlaid elevation, indicating the higher ridge running through the paddock. The Southern zone is located on the ridge and the Northern zone on the lower lying areas.

A graph of temperatures logged every 30 minutes (Fig. 5) shows the lower Northern zone experiences consistently colder temperatures than the higher Southern zone.

Fig. 4 - EM map of the Marrar site (overlaid elevation)

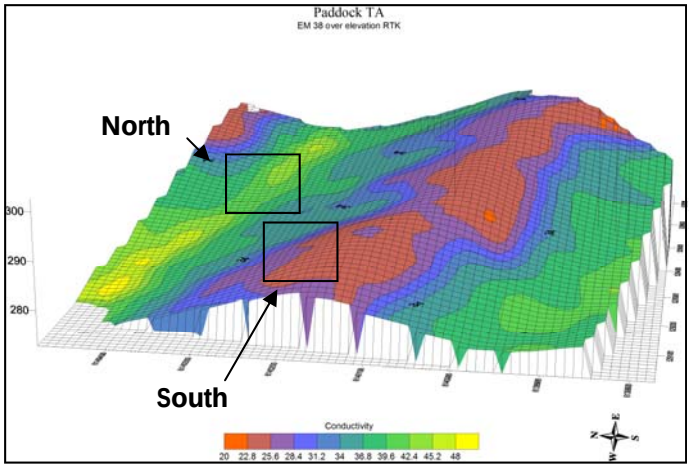


Fig. 5 - temperatures in each zone at Marrar 2004