SOIL AND LAND RESOURCE IMPACT ASSESSMENT STUDY

VHM Limited

Goschen Rare Earths and Mineral Sands Project

What the impact assessment study found

In line with the EES scoping requirements, the soil and land resource assessment considered the effects on land stability, erosion and soil productivity associated with the project. Specifically, the impact assessment took into account:

- any special characteristics of the land
- the surrounding environment
- the need to stabilise the land
- the desirability or otherwise of returning agricultural land to a state that is as close as reasonably possible to its state before the mining licence, prospecting licence or extractive industry work authority was granted
- any potential long-term degradation of the environment.

Land use

The slightly undulating to flat landscape with winter dominant rainfall environment comprises a Calcic Red-Brown Calcarosol soil which is predominantly used by the landholders for winter cereal and pulses including wheat, barley, canola and lentils. Hay production for the export market is becoming more common as part of the farming system. Soil depth exceeds one metre, with root growth from winter cereal crops having been observed at the base of sampling.

Crops are sown using minimum or zero tillage techniques with an emphasis on minimal ground disturbance and stubble retention to protect the topsoil. Soils have good structure and could be classed as being in good condition for the current agricultural activities. Sheep and cattle grazing is undertaken opportunistically, however cropping is the predominant land use.

Geology

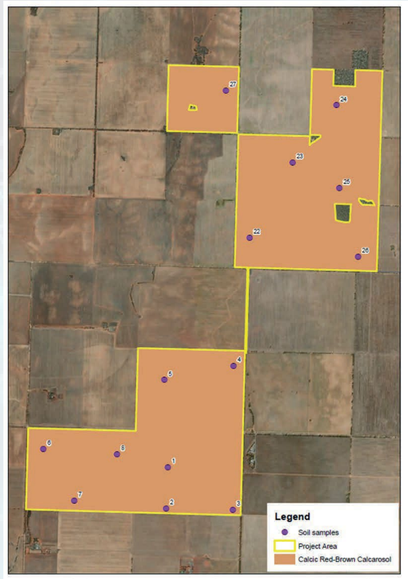
The outcropping geology in the study area is comprised of a thin quaternary cover of sandy clay, and ranges in thickness from approximately five to ten metres below ground surface. The quaternary material overlays the Loxton Parilla Sands, which hosts the target mineralisation zone. The Loxton Parilla Sands overlays the Geera Clay, which separates the Loxton Parilla Sands from the Renmark Group (GeoScience Australia, 2022).

Soil

Soil profiles were assessed at 14 sites in accordance with the Australian Soil and Land Survey Field Handbook (NCST, 2009). Each soil-profile exposure was sampled with a hydraulic soil corer, either a depth of 1.2 metres, to equipment refusal, or to bedrock. Laboratory analysis to determine Particle Size, pH and EC, Exchangeable Cations, Emerson Aggregate Test at 11 of the sites to determine the salinity and dispersion risks of the soils.

The dominant soil type is Calcic Red-Brown Calcarosol found at 11 sites with sub-dominant soil types of Eutrophic Red Chromosol and Subnatric Brown Sodosol at the remaining three sites. The characteristics of the three identified soil types are:

- Calcarosols are soils which are calcareous throughout the solum, or calcareous at least directly below the A1 horizon, or within a depth of 0.2 metres. Carbonate accumulations must be judged to be pedogenic. Calcarosols do not have a clear or abrupt texture contrast between the A and B horizons
- Sodosols are soils with a strong texture contrast between the A horizon and a sodic B horizon which is not strongly acidic.



Above: Detailed soil sample sites across Area 1 and 3.

Soil Map Unit 1 – Calcic Red-Brown Calcarosol

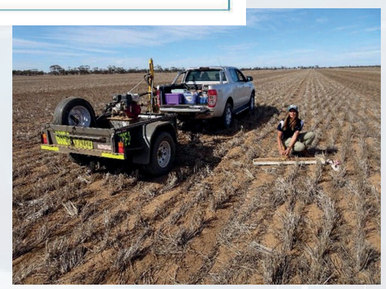
Dominant soil type – Calcic Red Calcarosol

TProfile: Calcic Red Calcarosol (Site 2)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark reddish-brown (5YR 3/3) clay loam, weakly crumb structured 5-10 mm peds with moderate consistence and a rough fabric. Nil mottling, nil stone content, nil segregations, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	B21 0.15 – 0.30	Reddish-brown (5YR 4/4) medium clay, moderately structured 10-20 mm blocky peds with moderate consistence and a rough fabric. Nil mottling, nil stone content, 20% soft calcium nodules, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B22 0.30 – 0.60	Yellowish-red (5YR 4/6) light clay, moderately structured 15-30 mm blocky peds with moderate consistence and a rough fabric. Nil mottling, nil stone content, 20% soft calcium nodules, coarse roots common. Well drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B23 +0.60	Yellowish-red (5YR 4/6) medium clay, massively structured. Nil mottling, nil stone content, nil segregations, coarse roots common. Well drained, layer continues beyond sample depth. Sampled 0.65 – 0.75 and 0.90 – 1.0

Potential impacts

- Main risk is dispersive subsoils
- High to very high Exchangeable Sodium Percentage (ESP)
- Only at risk when exposed to rainfall or water flow
- Treat with gypsum to minimise dispersion risk
- Ameliorate and seed stockpiles to minimise dispersion
- Minor risk is degradation of soil structure



Above: Trailer mounted soil sampling drill rig.

Mitigation and contingency measures

- Weed control prior to topsoil stripping being undertaken
- Consultation with landowners regarding soile
- management.
  Treat with gypsum prior to stripping topsoil
- Strip all disturbance areas to 20 centimetres for topsoil
- Strip all mining pit areas a further 80 centimetres
- for subsoil
- Ameliorate and seed topsoil and subsoil stockpile surfaces
- Seasonal weed control on stockpiles
- Use freshly stripped soil for progressive rehabilitation
- Detailed stockpile inventory
- Regular inspections
- Lab testing prior to respreading

Conclusion

The current good condition of the soil provides VHM with an ample resource for rehabilitation activities during and post mining. By implementing the mitigation measures recommended throughout this assessment, potential adverse impacts on the soil and land resources will be minimised.