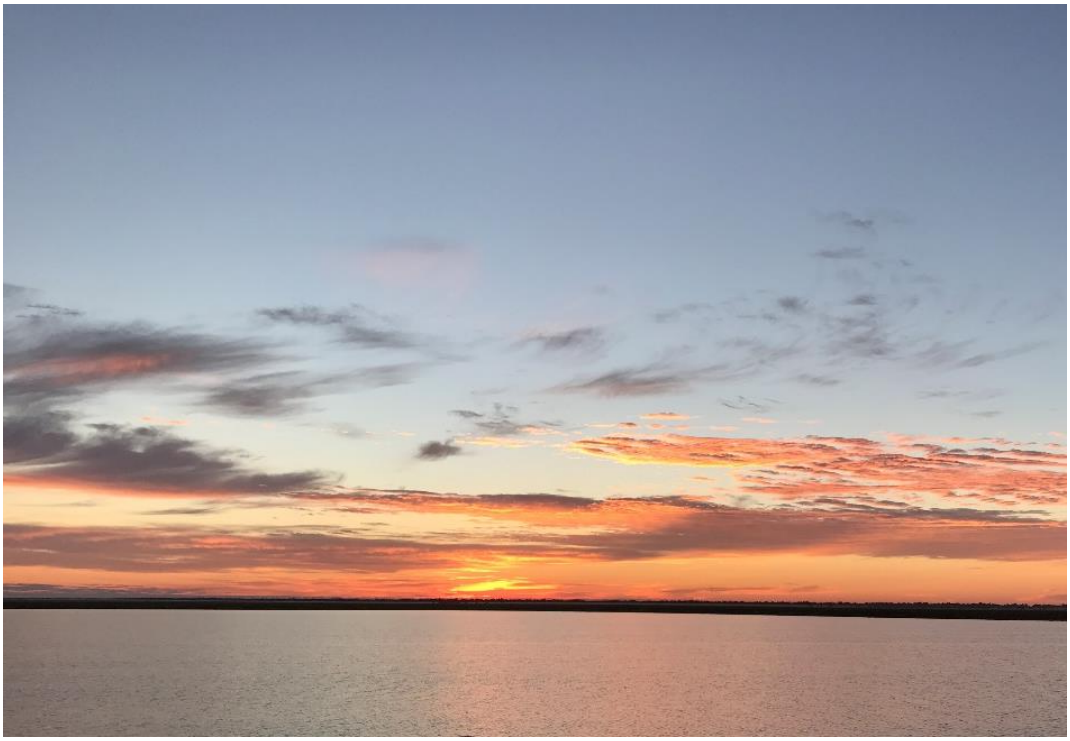
Brad & Sally Anderson

‘MALLAWA’ WATER STORAGE

NARROMINE NSW

STATEMENT OF ENVIRONMENTAL EFFECTS

OCTOBER 2024



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DOCUMENT VERSION HISTORY

Revision	Date	Comment
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Attachment 2 Narromine LEP Land Use Zones Map
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1.0 Introduction

The aggregations of Mallawa & Duneira, hereafter referred to as Mallawa, cover over 1,700 ha approximately 5km south southwest of Narromine **(Attachment 1)**. Nearly 400 ha of Mallawa is laid out from irrigation **(Attachment 1)**. Water for this irrigation is supplied partly by the Macquarie River via the Narromine Irrigation Scheme (NIS) and partly by more reliable groundwater. Brad & Sally Anderson (Anderson) are proposing to construct a water storage (water supply system) to store pumped irrigation water from the NIS and groundwater accessed under their Groundwater Access Licence.

This Statement of Environmental Effects (SEE) has been prepared to support the Development Application (DA) submitted to Narromine Shire Council (NSC) relating to the proposed storage upgrade. Tahlee Consulting Services (TCS), based in Gunnedah NSW, has been approached by Anderson to complete this SEE.

2.0 Project scope

Anderson proposes to construct a storage with a capacity of 660 megalitres (ML). This volume of the storage will allow Anderson to store water when it is available and manage irrigation production on the property in periods of low flows in the Macquarie River.

3.0 Location of proposed development

The proposed storage will be located on the aggregations referred to as Mallawa, within the land parcels LOT 51 DP 595537 and LOT 6 DP 569413. The location of the storage relative to Narromine is shown in **Figure 3.1**. A detailed layout of the proposed storage is shown in **Attachment 1**.

Figure 3.1 Mallawa storage Location, Image Courtesy Google Earth

4.0 Existing environment

The existing storage site is located within an area that has been historically cleared for both agricultural grazing & cropping operations. Surrounding properties exhibit very similar characteristics, being predominantly cleared & used for both irrigated & dryland cropping along with livestock grazing. There are a number of water storages on the surrounding properties. The closest dwelling is located on a neighbouring property, 1.8km to the south east. Other dwellings are located 1.85km to the south and 2.5km to the north.

5.0 Statutory Framework Requirements

The Mallawa storage will be required to conform with relevant pieces of local, state & federal legislation that relate to the environmental impacts of rural developments involving the construction of artificial water bodies such as the Mallawa water

storage. Locally, the development will fall under the regulations of the *Narromine Local Environmental Plan (LEP) 2011* & the *State Environmental Planning Policy (Primary Production and Rural Development) 2024.*

5.1 Narromine Local Environmental Plan (LEP) 2011

The *Narromine Local Environmental Plan (LEP) 2011* is applied under the New South Wales *Environmental Planning and Assessment Act 1979* (EP&A Act). This LEP plan applies to all land identified as relevant on the LEP Land Application Map, being the majority of the Narromine Shire LGA which the Mallawa storage site falls within. The land that the Mallawa storage falls within is designated as land zone RU1 – Primary Production, as identified by the LEP Land Zoning Map. This can be viewed in **Attachment 2**. The land use table found in Clause 2.3 of the LEP sets outs the following characteristics of zone RU1 land;

1 Objectives of Zone

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.*
- *To encourage diversity in primary industry enterprises and systems appropriate for the area.*
- *To minimise the fragmentation and alienation of resource lands.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*

2 Permitted without consent

Environmental protection works; Extensive agriculture; Forestry; Home occupations; Roads; Water reticulation systems

3 Permitted with consent

- *Agritourism; Air transport facilities; Airstrips; Animal boarding or training establishments; Aquaculture; Bed and breakfast accommodation; Boat launching ramps; Boat sheds; Building identification signs; Business identification signs; Camping grounds; Cellar door premises; Cemeteries; Community facilities; Correctional centres; Depots; Dual occupancies (attached); Dwelling houses; Eco-tourist facilities; Environmental facilities; Extractive industries; Farm buildings; Farm stay accommodation; Flood mitigation works; Freight transport facilities; Heavy industrial storage establishments; Heavy industries; Helipads; Home-based child care; Home businesses; Home industries; Home occupations (sex services); Industrial training facilities; Information and education facilities; Intensive livestock agriculture; Intensive plant agriculture; Jetties; Landscaping material supplies; Mooring pens; Moorings; Open cut mining; Recreation areas;*

Recreation facilities (major); Recreation facilities (outdoor); Roadside stalls; Rural industries; Rural workers' dwellings; Sewerage systems; Veterinary hospitals; Water recreation structures; Water supply systems

The Mallawa storage project fulfils the objectives of the RU1 zone. It encourages primary industry production by providing a water storage facility that can be used for better management of on-farm water resources, whilst allowing Mallawa to store greater volumes of water when they are made available to the property. It encourages diversity in primary industry enterprises by allowing for irrigated agriculture alongside dryland cropping and grazing, allowing for a wider range of crops to be grown. The storage is consistent with the surrounding capability of the land & does not introduce conflict between land uses in the zone.

The Mallawa storage project needs to satisfy flood planning regulations under clause 5.21 of the LEP. The proposed dam is not located in a watercourse or floodway.

The Mallawa storage will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses. It will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties.

6.0 Environmental Assessment

The following environmental assessment addresses the expected impact of the Mallawa storage proposal upon the surrounding natural environment, neighbouring properties & the Narromine community as a whole. It also addresses hazards related to the project with regards to construction & ongoing operation.

6.1 Biodiversity & Threatened Species

The construction of the Mallawa storage will not have any negative impacts on local biodiversity. The nature of the existing site & scope of works means that no threatened species of flora or fauna will be impacted by the project. The proposed works are not in an area mapped on the NSW Biodiversity Values Map, **Figure 6.1**.

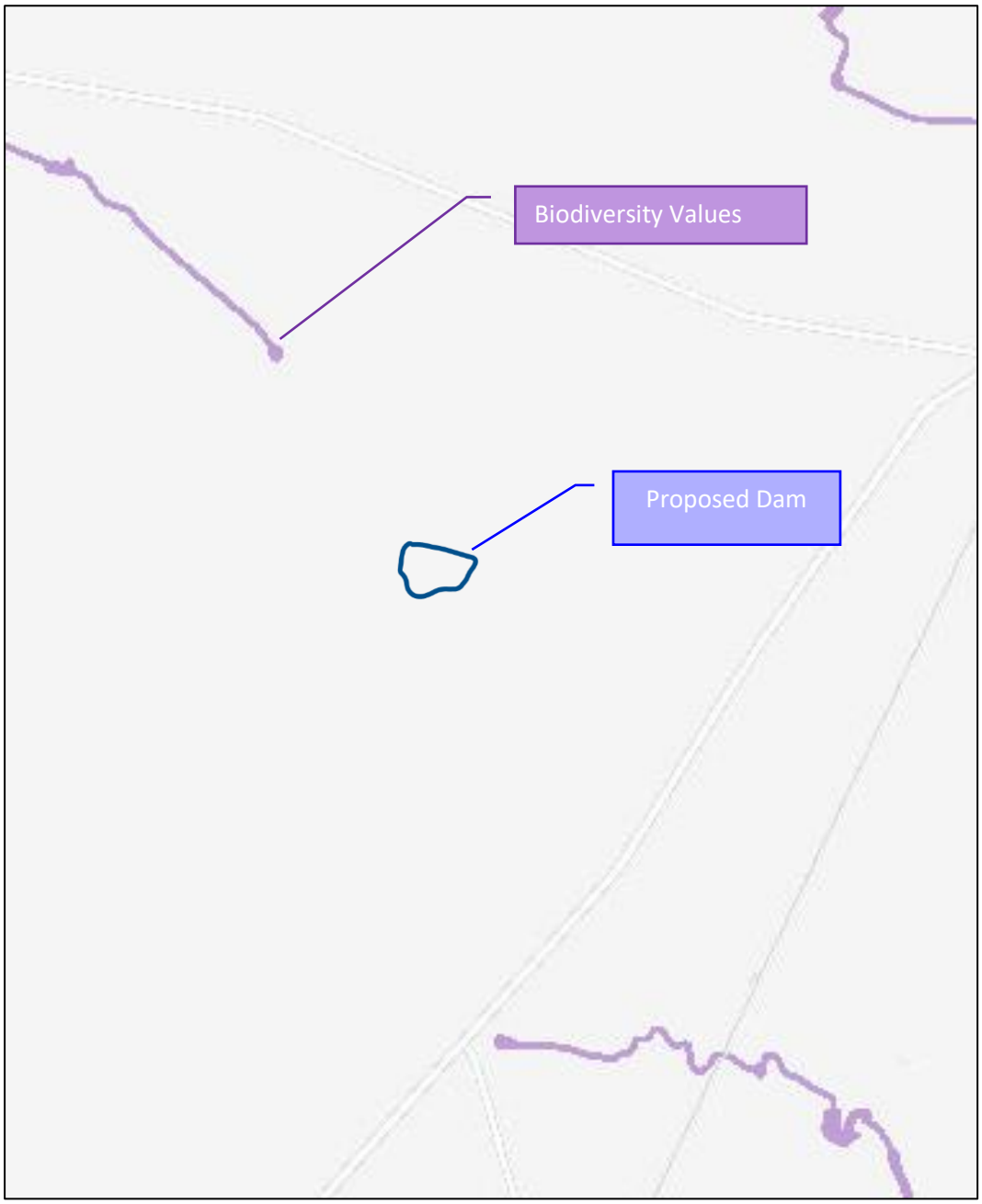


Figure 6.1 NSW Biodiversity Value Map

The storage site has been farmed land since 1996, with regular cultivation occurring, thus vegetation is minimal. There are no trees in need of clearing and the storage project also does not impact upon any endangered ecological communities or areas of outstanding biodiversity value.

6.2 Heritage

The proposed storage works will not have any impact on aboriginal or European cultural heritage in the area. The Mallawa storage site, as outlined previously, is located within an area that has been used for agricultural operations for much of recent history. An online search was conducted through the Aboriginal Heritage Information Management System (AHIMS) to check for any local heritage sites. The search area was set to an area larger than the property boundary. The storage site is located well within the boundary of this land parcel. The result from this search is attached in **Attachment 3.** It was found that 0 Aboriginal heritage sites are recorded in the search area & that 0 Aboriginal heritage places have been declared in the search area. The NSW Government Sharing & Enabling Environmental Data (SEED) website was used to search for further heritage sites in the development area. It was again found that there was no heritage sites located within the Mallawa storage project area or the surrounding field areas. Overall, the Mallawa storage project will have no impact on any category of heritage sites.

6.3 Air quality

The proposed storage upgrade will not have a major impact on air quality. During construction, some dust will be created from earthmoving equipment, an effect which is largely unavoidable. However, due to earthmoving equipment mostly hauling more compact, moist soil from beneath the ground as opposed to loose topsoil, and haul distances being generally quite short, most dust will be heavily localised to the storage site. Should inappropriate wind conditions prevail during construction, construction will be either halted or only proceed such that neighbouring properties are not impacted.

6.4 Soil quality

A soil quality test was completed by Dr. Pat Hulme of Sustainable Soils Management. Please see **Attachment 4** outlining his findings. It is concluded that the site is suitable and the proposed dam will have no impact on the soil quality in the surrounding areas.

6.5 Access, transport & traffic

Access to the storage site exists through farm access roads. The storage site is currently best accessed from Farrendale Road. Access for neighbouring properties will be maintained during & after the proposed development has occurred. There will be only a minor increase in heavy vehicle traffic on local access roads to transport earthmoving equipment to & from the site prior to & following construction. Equipment will remain on site during the construction process. The overall impact of traffic will be negligible.

6.6 Noise & vibration

The only source of noise and vibration to be introduced by the proposed project will be from earthmoving equipment, which will include scrapers and graders. Construction would be expected to be complete in two to three months, minimising the long-term noise impacts.

6.7 Services to site

The proposed dam will not impact on any services to the site.

6.8 Safety & security

The Mallawa storage upgrade development will not have any negative impact on the safety & security of the Mallawa property or neighbouring properties. The main hazard identified with the proposed development, being an embankment failure, is addressed in **Section 6.10.1**. During construction, all earthmoving contractors will adhere to the necessary Safe Work Methods for machinery operation. Ongoing operation of the pumps and maintenance of the storage facility will be completed in line with safety procedures enforced by the Mallawa operations.

6.9 Social & economic impacts

The proposed Mallawa storage development has the potential to improve the productive capability of the property, which will have greater water security as a result of the increased storage volume. The construction of the upgraded storage also opens up the possibility for local earthmoving contractors to be employed. The overall social impact of the proposed storage on the Narromine LGA will be minimal, but will not be negative in nature.

6.10 Storm Water

Stormwater management will be effectively addressed through strategic placement and design of the Mallawa Storage. Upstream of the proposed storage site the NIS channel has a 40 metre opening for the passage of overland flow towards Boggy Cowal. The storage maintains a 40-metre distance from the drainage line running towards Boggy Cowal, providing ample passage for overland flow waters that pass through the opening in the NIS channel. Additionally, the storage will aid in managing stormwater from the developed irrigation areas to the north by capturing excess rainfall, therefore preventing potential flooding on surrounding properties and increasing water efficiency. This alos minimises the risk of contaminated runoff entering natural waterways and ensures the watercourse remains unobstructed.

6.11 Potential hazards

6.11.1 Storage Cell Failure

The predominant hazard that relates to the proposed Mallawa storage is the potential failure of the embankment. The only uncontrolled inflows will be through rainfall on the surface of the storage. All other inflows and outflows are controlled through pump sites installed at the storages. There is very little risk of the storage embankment being overtopped.

The proposed storage, in the unlikely event of an embankment failure, could release up to 570 megalitres of water. This water would flow directly to the south and then west, along the existing natural drainage path to Boggy Cowal. There are no residential dwellings located between the storage site and Boggy Cowal. As such, any embankment failure would be highly unlikely to impact upon any structures or dwellings, with any surge waves also being unable to generate negative impacts on neighbouring properties.

The following steps will be implemented in order to mitigate the potential for an embankment failure occurring;

- Following appropriate geotechnical investigation processes to ensure suitable material for construction is used in the proposed dam
- Designing the storage in accordance with relevant engineering guidelines

- Implementing correct construction techniques in construction of the upgraded storage cell embankment
- Carrying out regular embankment maintenance, including managing vegetation and grading, in order to minimise embankment erosion & maintain stability
- Maintaining a minimum of 1.0m storage freeboard in accordance with engineering design

6.11.2 Service cables

A 'Dial Before You Dig' enquiry was completed to confirm the location of any services present in the vicinity of the Mallawa storage. The response indicated no powerlines, underground cables, earths or wires are within the Mallawa storage works area. The closest underground earth/wire is located 300m to the east, which will remain unaffected by the project. The basic position of this underground earth/wire relative to the storage site can be viewed in **Attachment 5.**

6.12 Site design & internal design

All engineering design work related to the Mallawa storage project is being undertaken by Tahlee Consulting Services (TCS), based in Gunnedah, NSW. TCS has extensive experience in the planning, design & construction management of compacted earth fill dams for agricultural & private purposes throughout Eastern Australia. Design drawings for the proposed storage upgrade has been included in **Attachment 1.**

6.13 Construction impacts

The construction involved in the upgrading of the existing Mallawa storage will incur minimal negative impacts to the surrounding area and neighbouring farming operations. No public road closures will be required for the development, with all work being completed within the Mallawa boundary. Heavy vehicles will transport earthmoving equipment to the site using local roads. However, once earthmoving equipment is on site it will remain there, thus associated heavy vehicles are not adding daily traffic to local roads, instead having one off trips before and after construction is completed. During construction, some noise will be generated from

earthmoving equipment including scrapers and graders. Earthmoving activities may generate small amounts of dust; however, this will be extremely localised due to the small site size and will be mitigated by only operating under acceptable wind conditions to ensure any negative impacts on neighbouring properties are avoided.

6.14 Maintenance of rural landscape

The proposed storage upgrade will not negatively degrade the aesthetic nature of the existing landscape once completed. There are existing dams on neighbouring properties and the proposed storage will not detract from the aesthetics of the area.

7.0 Conclusion

The expected environmental effects of the Mallawa storage project have been outlined, as is required by the relevant pieces of local, state & federal legislation. The major findings from this environmental assessment are as follows;

- The project involves the construction of a water storage. Anderson is seeking development approval for this storage with a volume of 660ML.
- The existing site is located within an area that has been historically cleared for agricultural cropping operations.
- There is no risk to threatened species of both flora & fauna that are found in the Narromine region. The storage site does not include any native vegetation areas or habitats relevant to threatened species, endangered ecological communities or areas of outstanding biodiversity value.
- Construction of the proposed storage will allow the Mallawa operations to store more water when it is available.
- Hazards associated with the construction of the Mallawa storage can be effectively mitigated through observance of necessary safe work methods.
- The major hazard associated with the storage is embankment failure. This hazard can be avoided by employing correct engineering design, correct construction techniques, responsible storage operation & consistent maintenance of the storage embankments.

- In the highly unlikely event of an embankment failure, the outgoing water would flow directly to the south then west due to the natural topography, with no dwellings or structures at risk.
- Minimal noise pollution will be experienced by neighbouring properties due to the location of the Mallawa storage. Any dust created will also be highly localised, however construction will not occur in high wind conditions that would create negative dust impacts on neighbouring properties.

In conclusion, it has been determined that the Mallawa storage development can be undertaken & completed in line with relevant pieces of local, state & federal legislation, with extremely minimal negative impacts being incurred by both the local environment & local community.

8.0 References

NSW Government (2024) *SEED | Sharing and Enabling Environmental Data*. Retrieved from https://www.seed.nsw.gov.au/

NSW Government (1979) *Environmental Planning and Assessment Act 1979*. NSW Government, Sydney.

NSW Government (2011) *Narromine Local Environmental Plan 2011*. NSW Government, Sydney. https://legislation.nsw.gov.au/view/html/inforce/current/epi-2011-0648

NSW Office of Environment & Heritage (2018) *Threatened biodiversity profile search*. Retrieved from: https://www.environment.nsw.gov.au/threatenedspeciesapp/

NSW Department of Planning, Industry & Environment (2022) *Areas of Outstanding Biodiversity Value register*. Retrieved; https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value/area-of-outstanding-biodiversity-value-register

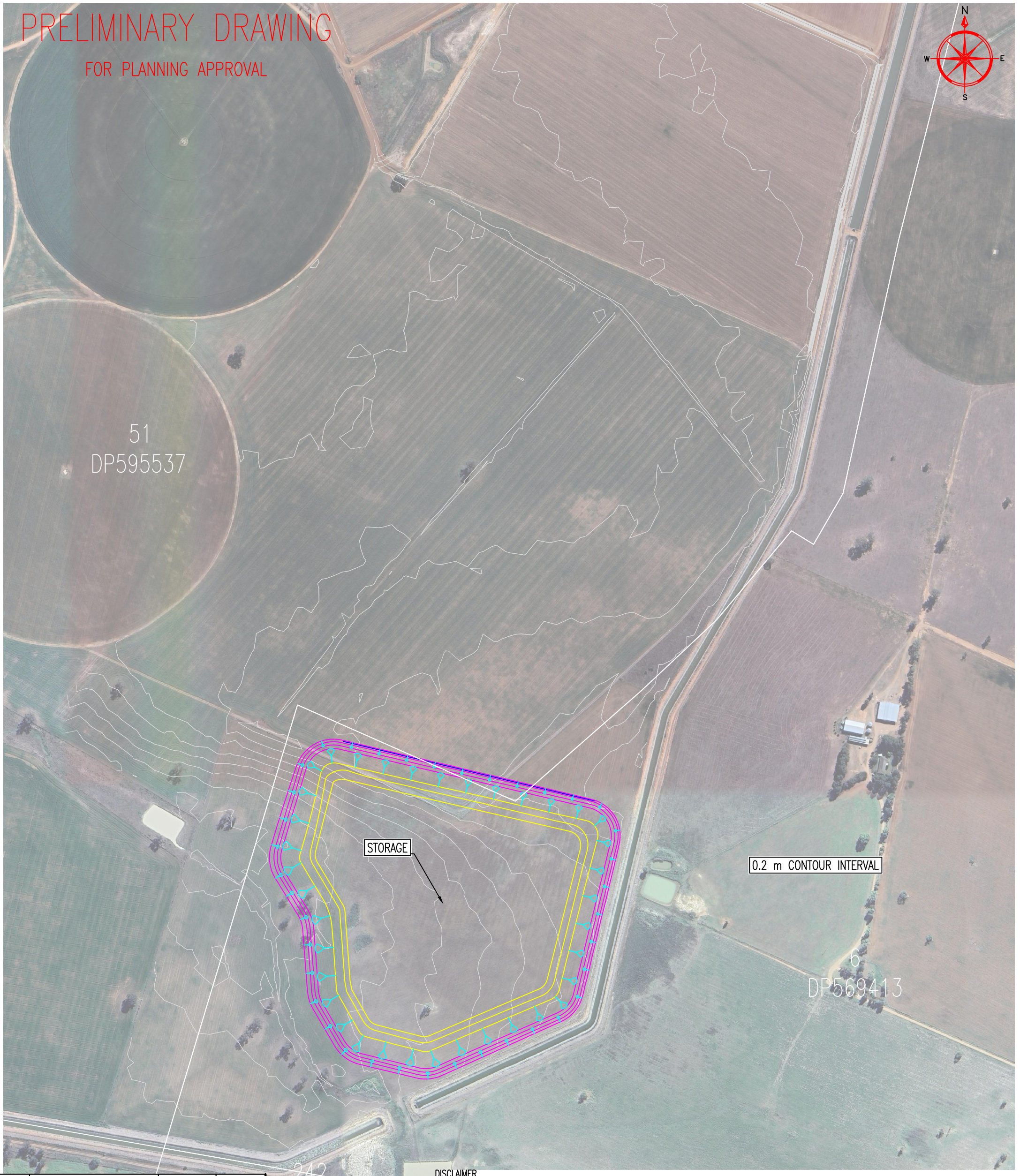
Attachment 1

Mallawa Storage Development

Location, Layout & Design Drawings

PRELIMINARY DRAWING

FOR PLANNING APPROVAL



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SURVEYED BY: TCS/LiDAR

DATUM: GDA94

DRAWN: NB | CHECKED: | APPROVED:

PROJECT: BRAD ANDERSON MALLAWA

TITLE: MALLAWA DEVELOPMENT PROPOSED STORAGE LAYOUT SHEET 1 OF 1

SCALE: 1:5000 (A3 SHEET)

DRAWING NO.: 0106_5.1

AMDT.: A

Attachment 2

Narromine LEP Land Use Zone Map

Narromine Local Environmental Plan 2011

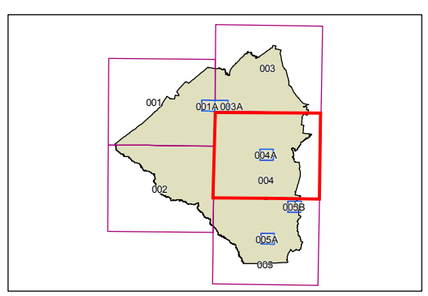
Land Zoning Map - Sheet LZN_004

Zone

- B2 Local Centre
- E1 National Parks and Nature Reserves
- E2 Environmental Conservation
- E3 Environmental Management
- IN1 General Industrial
- R1 General Residential
- R5 Large Lot Residential
- RE1 Public Recreation
- RE2 Private Recreation
- RU1 Primary Production
- RU3 Forestry
- RU5 Village
- SP2 Infrastructure
- W2 Recreational Waterways

Cadastre

Cadastre 14/12/2010 © NSW LPMA



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Projection: GDA 1994
MGA Zone 55

0 1.5 3 6 Kilometres

Scale:160,000 @ A3

Map identification number: 5850_COM_LZN_004_160_20151127

GIN GIN
TRANGIE
BURROWAY
NARROMINE
DUBBO LGA
TOMINGLEY
E2
E3
RU1
RU3
R5
SP2 Classified Road
SP2 Rail Infrastructure Facilities
SP2 Air Transport facilities
Refer to map LZN_004A
Proposed Storage

Attachment 3

Aboriginal Heritage Site Search Results

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : Mallawa

Client Service ID : 939010

Bernie Martin

122A Barber St
Gunnedah New South Wales 2380

Attention: Bernie Martin

Email: bernie@tahlee.com.au

Date: 11 October 2024

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -32.2903, 148.1731 - Lat, Long To : -32.2812, 148.1886, conducted by Bernie Martin on 11 October 2024.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.

A search of Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (https://www.legislation.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Heritage NSW upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Heritage NSW and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date. Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Level 6, 10 Valentine Ave, Parramatta 2150
Locked Bag 5020 Parramatta NSW 2124
Tel: (02) 9585 6345

ABN 34 945 244 274
Email: ahims@environment.nsw.gov.au
Web: www.heritage.nsw.gov.au

Attachment 4

Suitability of Soil Report

Sustainable Soils Management *Pty Ltd*
ACN 105 201 581

5 Lawson St,
P.O. Box 130,
Warren, NSW. 2824.
Ph (02) 68473367
Fax (02) 68473401

ASSESSMENT OF SUITABILITY OF SOIL ON PART OF MALLAWA FOR AN IRRIGATION RESERVOIR

Prepared for: **B ANDERSON**

February, 2024

Prepared by: **PAT HULME**

1.0 Investigation Background

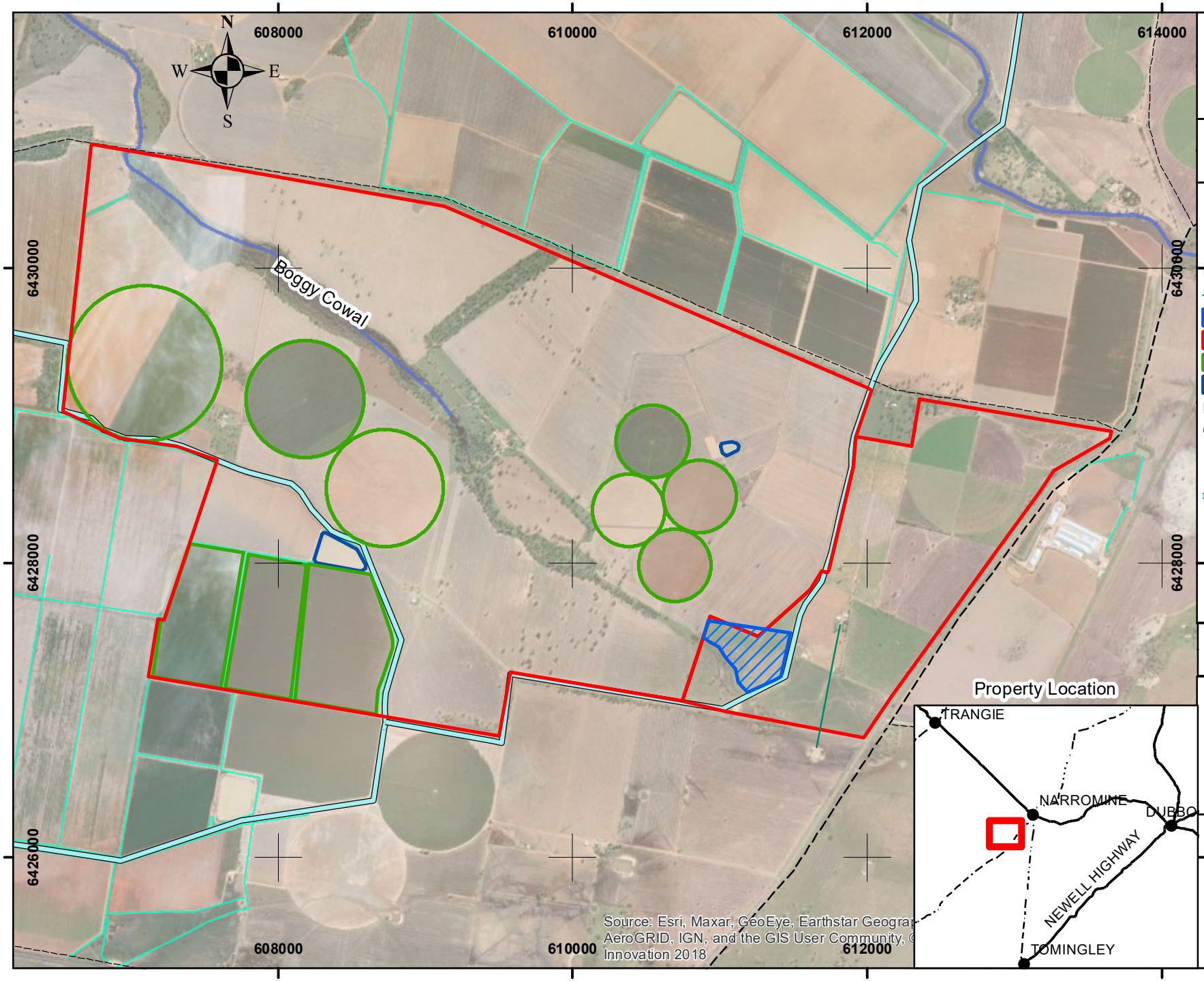
Mallawa covers over 1,700 ha approximately 5 km south southwest of Narromine (Map 1). Nearly 400 ha of Mallawa is laid out from irrigation (Map 1). Water for this irrigation is supplied partly by the Macquarie River via the Narromine Irrigation Scheme (NIS) and partly by more reliable groundwater.

The most productive bore on Mallawa is near the northeastern storage in Map 1 and its use is constrained by the small volume in the storage.

Brad Anderson would like to construct a storage that is north of the timbered drainage line to the south east of the Boggy Cowal in Map 1 and leaks slowly enough to be used for long-term storage.

This report describes an assessment in 3 phases:

1. Desktop assessment of soil and landscape information from the public domain, including airborne electromagnetic (AEM) survey data.
2. Drilling of 15, 3.6 m deep test holes.
3. Laboratory geotechnical measurements on samples from 2 of the test holes.



Mallawa

Narromine

Aerial Image and Irrigation Infrastructure

Legend

- Powerline
- Proposed Storage
- Property Boundary
- Field
- Storage

Roads

CLASS

- 3
- 4
- NISChannels

Hydroline

<all other values>

relevance

1; 2; 3; 4
5
6
7
8
9
10

0 500 1,000
Metres

Property Location

Certification

Draft/Uncontrolled Document
Unless Signed & Dated

SSM
Sustainable Soil Management

Job Code: R313
Map Printed: 2024

Contact: Sustainable Soils Management
Phone : (02) 68 473367
Datum: WGS 84
Projection: UTM

Map 1

2.0 Properties of Landscape around Proposed Reservoir

The pattern of soil landscapes over Mallawa in Map 2a indicates that the centre pivot circles are on Trangie Meander Plain, while the rectangular shaped furrow irrigation fields are mapped as Trangie Backplain. This is consistent with the cracking clay soil on the Trangie Backplain and the red loamy soil that is expected on the Trangie Meander Plain (Hulme, 2003). The existing larger storage on Mallawa is near the boundary between these 2 formations, and was inspected and assessed to be on backplain soil.

The Proposed Storage is mapped as being on an Upstream Bugwah Channel. This formation was deposited 5,000 to 15,000 years ago and is generally dominated by Brown Vertosol (cracking clay) soil with sodic subsoil (Forbes *et al.*, 2010 unpublished).

Map 2b indicates that Mallawa is in the Trangie Hydrogeological Landscape. Elevated meander plains within the Trangie Hydrogeological Landscape are free-draining (Figure 2.1). Consequently, irrigation water storages within this landscape need to be on areas that are locally clayey in order to leak less than the 2 mm/day that occurred in the average storage assessed in the cotton industry (Cotton CRC, 2011).

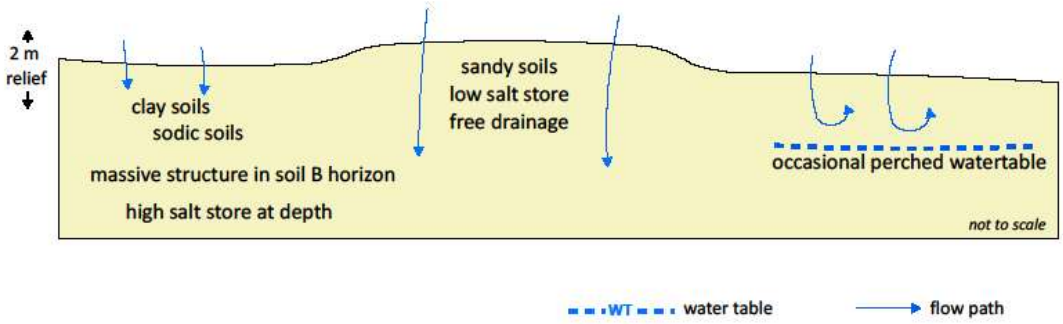
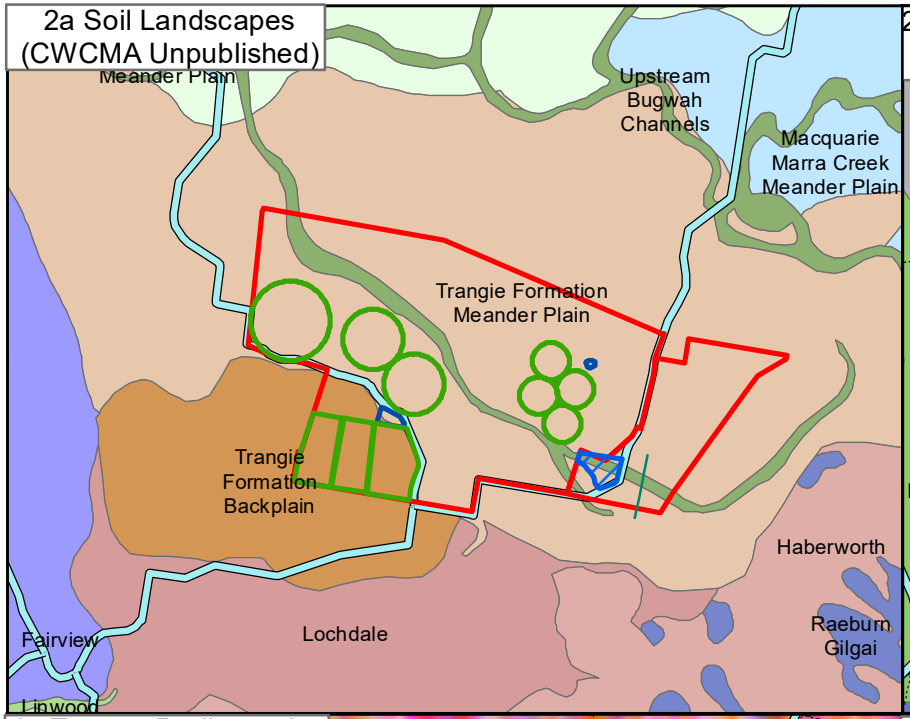
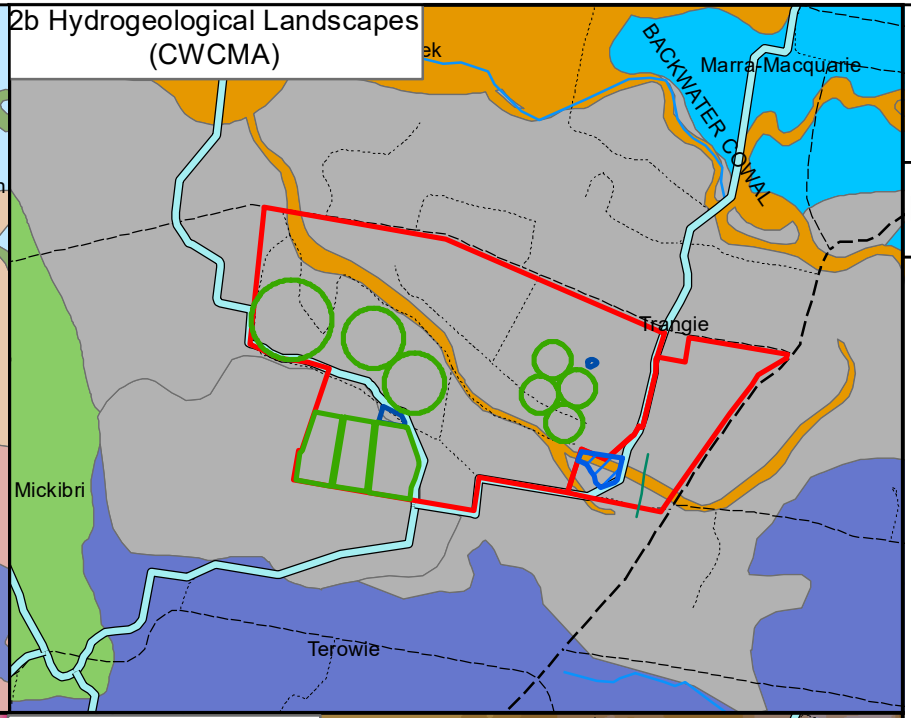


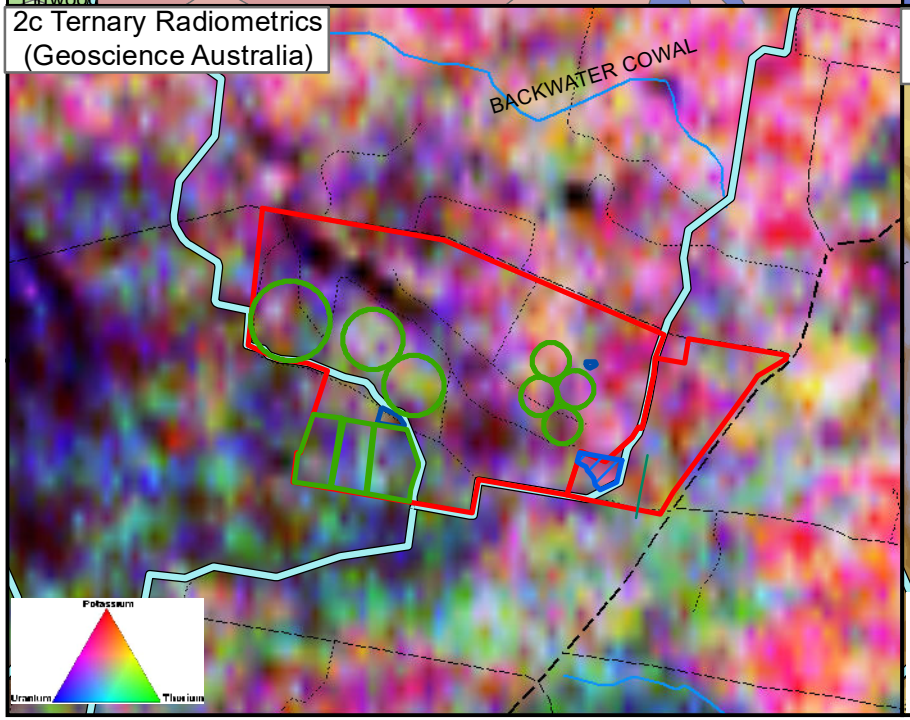
Figure 2.1. Conceptual Trangie Hydrogeological Landscape cross-section showing the distribution of regolith, landforms, salt sites and flow paths. From Wooldridge et al. (2012).

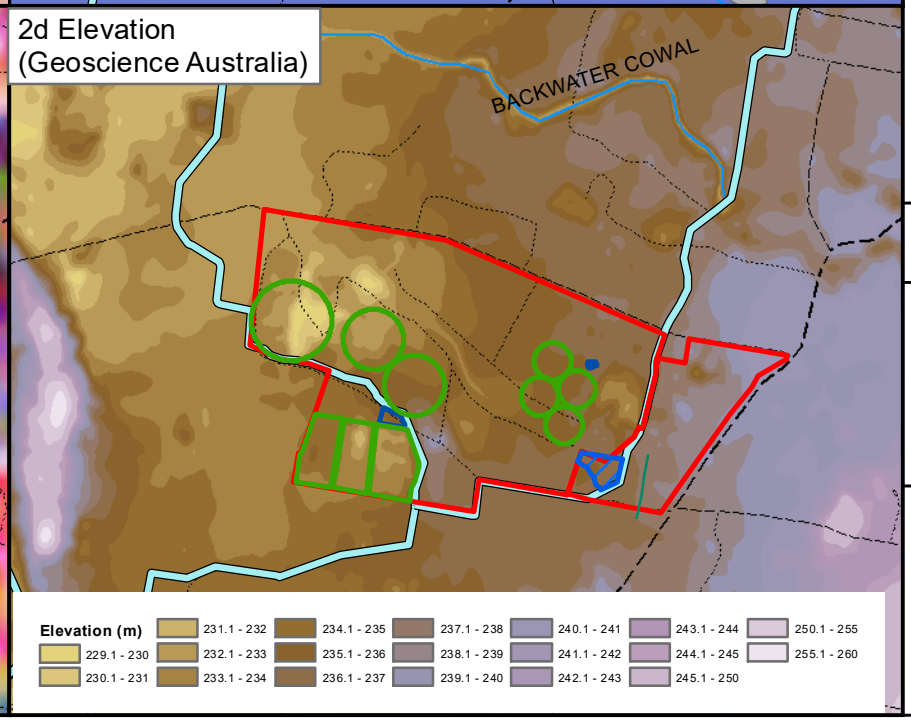
The Ternary Radiometrics in Map 2c is influenced by natural radiation emitted by potassium, thorium and uranium in the surface 20 cm of soil. This shows a trend across Mallawa of potassium generally decreasing (less red) and thorium increasing (more green) from north to south. This indicates that clay content increases from northeast to southwest across Mallawa since soil with high potassium in the Macquarie floodplain is generally sandy, while soil with high thorium is generally clay. The pattern of clay increasing from south to north also applies to the proposed storage site.

The elevation surface in Map 2d indicates that there is a general fall across Mallawa from east to west. This surface also shows that this slope flattens across Mallawa. The Proposed Storage is in the eastern part of Mallawa where the slope is relatively steep.









Mallawa
Narromine

Landscape Summary

- Powerline
- Proposed Storage
- Property Boundary
- Field
- Storage
- NISChannels

N
W E
S

0 0.5 1 2
Kilometres

Certification

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Unless Signed & Dated

SSM
Sustainable Soil Management

Job Code: R313
Map Printed: 2024
Contact: Sustainable Soils Management
Phone : (02) 68 473367
Roads: NSW Minerals

Datum: WGS 84
Projection: UTM

Map 2

The Lower Macquarie Airborne EM Project (BRS *et al.*, 2007) surveyed much of the Macquarie Bogan alluvial floodplain. North-South transects, 300 m apart were flown across Mallawa, and conductivity surfaces were created from the surface to 200 m. Airborne electromagnetic induction (AEM) sense properties of a greater soil depth than ground-based EM surveys, but makes predictions at a coarser resolution than ground based surveys.

The 0 to 5 m AEM surface across Mallawa indicates that the Proposed Storage is near a boundary between resistive (low apparent electrical conductivity or ECa) and conductive (higher ECa) soil.

ECa increases more rapidly with depth beneath the Proposed Storage than in parts of Mallawa north of the Proposed Storage (Map 3b and Map 3c). ECa beneath the Proposed Storage fell between the 10 to 15 m (Map 3c) and 15 to 20 m (Map 3d) layers, but was still greater than 0.12 S/m.

The pattern of ECa increasing rapidly with depth indicates that salinity increases with depth, which in turn indicates slow water movement through the profile. This pattern contrasts with very low ECa in the 0 to 5 m layer in most of Mallawa mapped as Trangie Meander Plain north of the Proposed Storage.

The cross sections in Figure 2.2 show a more precise view of the data in Map 3 (J. Kellett, pers. comm.). These cross sections show a pattern beneath the Proposed Storage of a resistive surface layer over a more conductive layer. The deep (below 200 m above sea level) resistive layer is likely to be rock, and yellowish lines that extend to the bottom of the transect are likely to be artefacts. However, the 10 m thick resistive (blue) zone north of the Proposed Storage indicates a zone of leaky soil.

The background data indicates that the majority of Mallawa including the Proposed Storage is on the leaky Trangie Meander Plain. The Proposed Storage is on an area mapped as Upstream Bugwah Channels, which are underlain by clayey, sodic soil, which would be expected to leak slowly.

The airborne EM survey indicates that the Proposed Storage is in an area with moderately low ECa in the 0 to 5 m layer over more conductive (and salty) soil. This pattern indicates that the site of the Proposed Storage should leak slowly. However, the depth of low salinity soil increased rapidly to the north of the Proposed Storage. Test Drilling should be conducted to verify this pattern and locate the boundary between soil that should leak slowly and soil that leaks quicker.

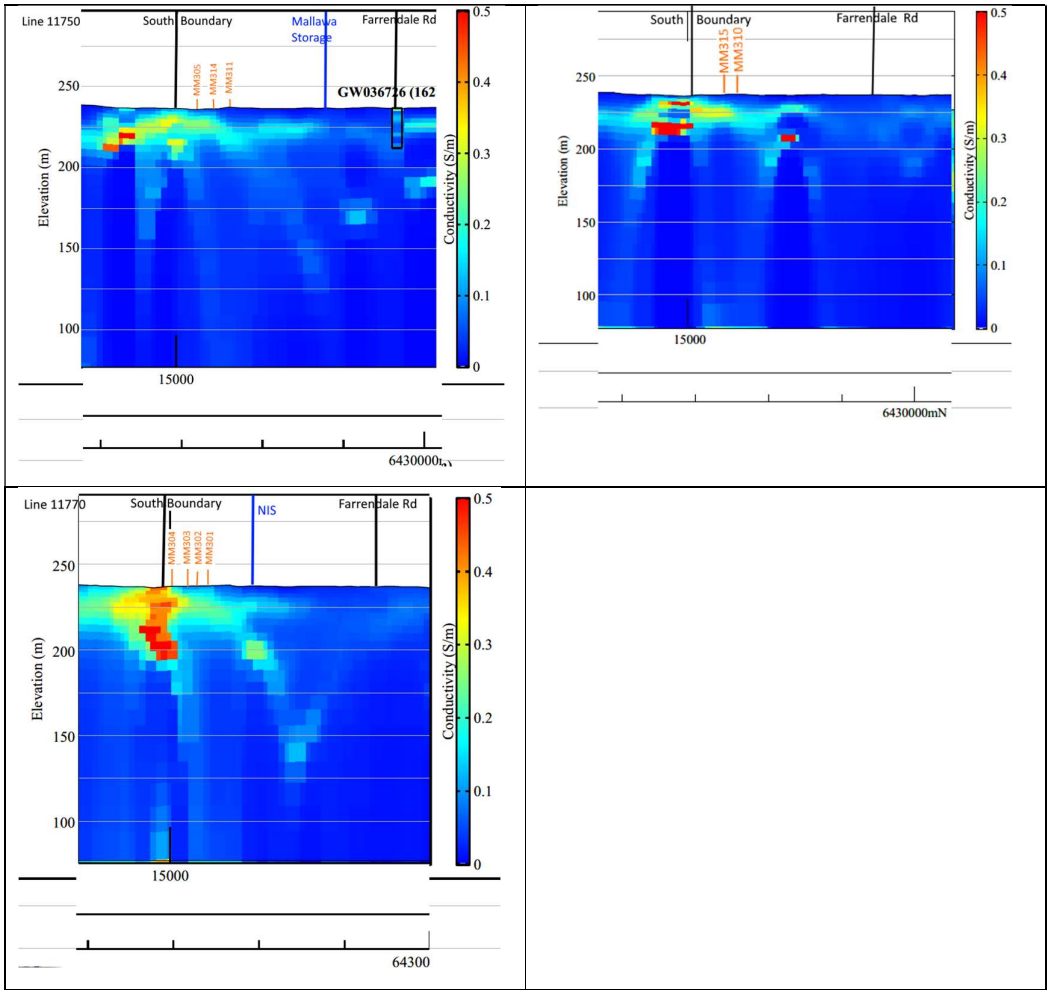
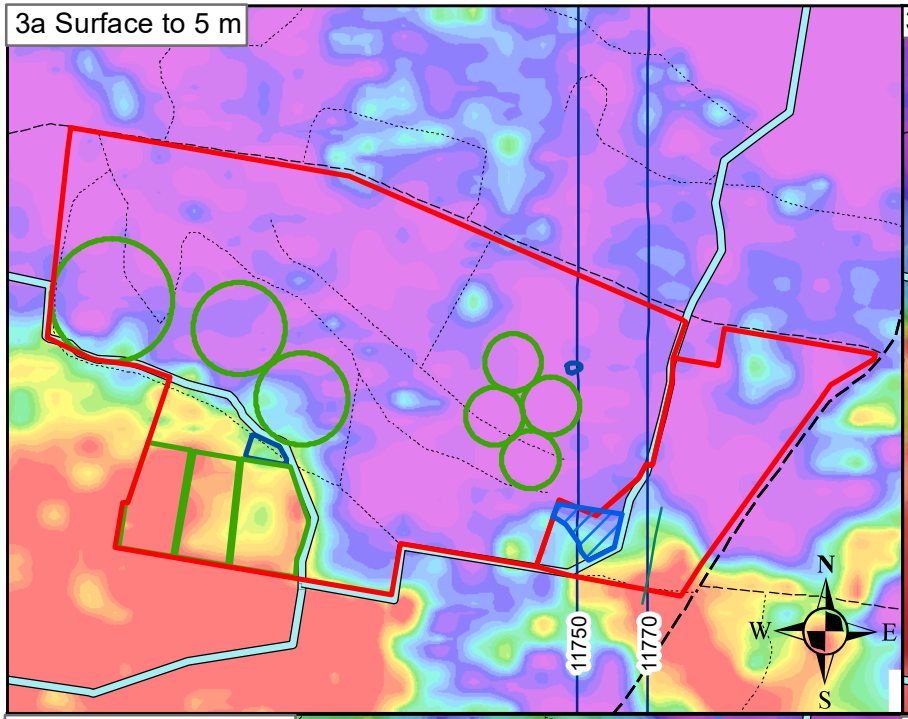
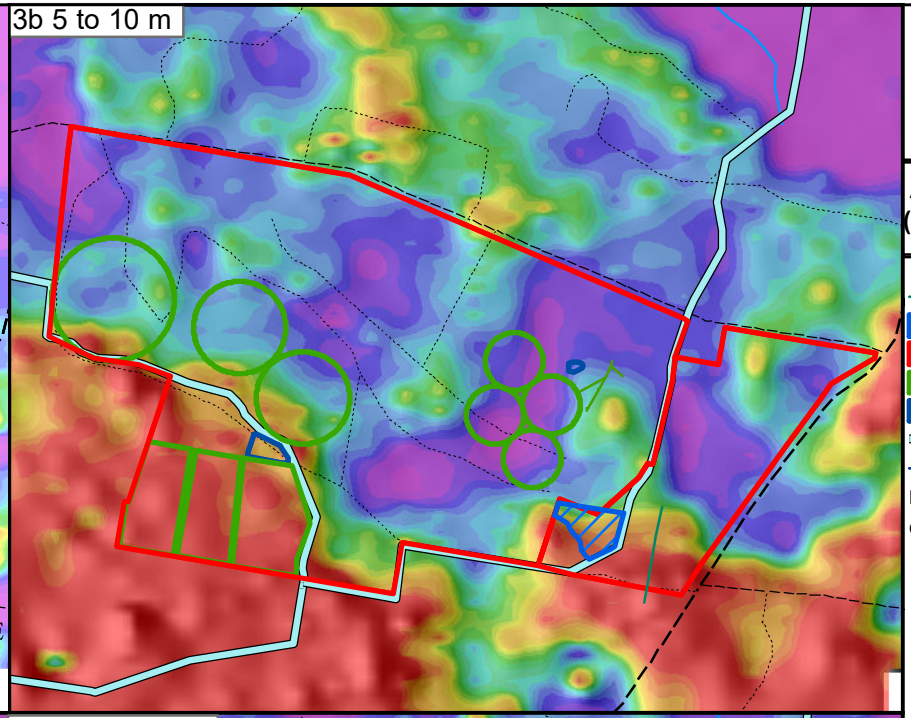
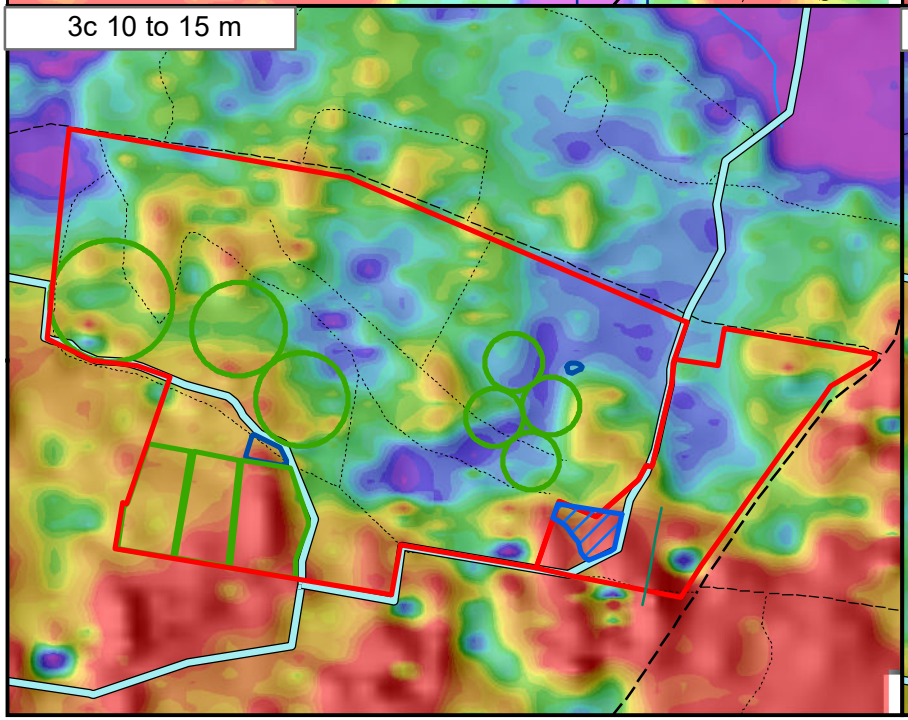
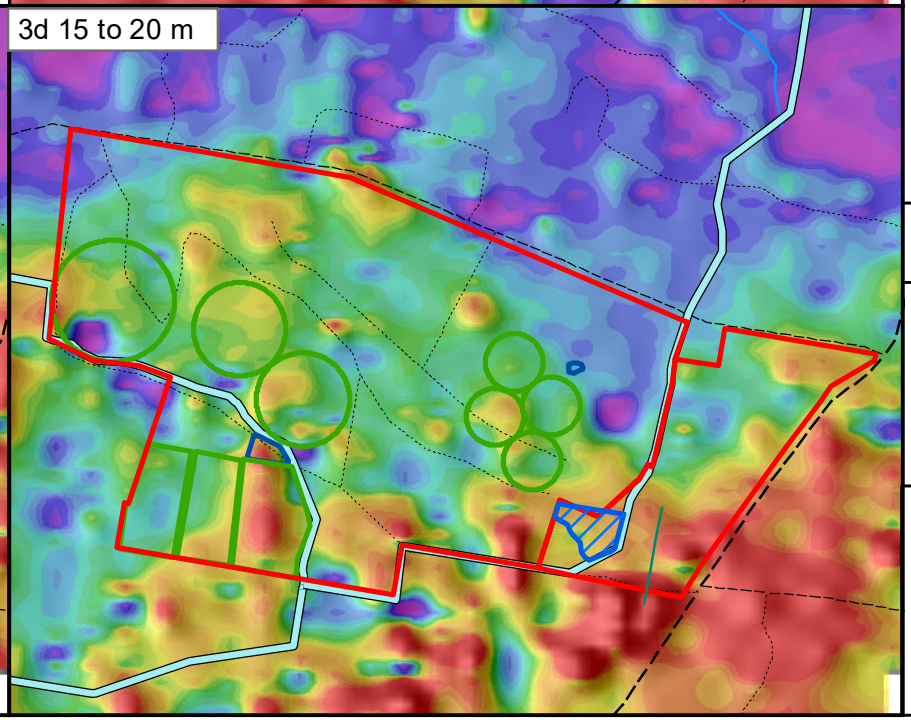


Figure 2.2. Cross sections of apparent electrical conductivity from transects across Mallawa shown in Map 3a. Orange lines represent test holes.









Mallawa

Narromine

Airborne EM Conductivity (Bureau of Rural Sciences)

Powerline
Proposed Storage
Property Boundary
Field
Storage
NISChannels
survey_lines_south

NSWGeologyR...

CLASS

3
4
5

Conductivity (S/m)

0 - 0.02
0.021 - 0.03
0.031 - 0.04
0.041 - 0.05
0.051 - 0.06
0.061 - 0.07
0.071 - 0.08
0.081 - 0.09
0.091 - 0.1
0.101 - 0.11
0.111 - 0.12
0.121 - 0.13
0.131 - 0.14
0.141 - 0.15
0.151 - 0.16
0.161 - 0.18
0.181 - 0.2
0.201 - 0.22
0.221 - 0.24
0.241 - 4.675

0 0.5 1
Kilometres

Certification

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Job Code: R313
Map Printed: 2024
Contact: Sustainable Soils Management
Phone : (02) 68 473367
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Datum: WGS 84
Projection: UTM

Map 3

3.0 Soil Assessment Procedures

Two sites were selected for investigation (Map 4) in consultation with Bernie Martin of TCS Consulting. The guidelines were:

- Option 1 – East of NIS channel and west of north- south powerline through paddock. Offsets; 50 m from southern boundary, 50 m north of drainage line, 10 m east of powerline and 10 m from NIS fence.
- Option 2 – West of NIS channel. Offsets; 50 m north of drainage line, 10 m west of NIS fence. Free to cross portion boundaries on Mallawa.

Soil distribution and properties at the site have been assessed using two techniques. First, test drilling of holes provides evidence that patterns recorded in the AEM survey describe changes in soil texture rather than changes in salinity. Second, laboratory analysis provides a detailed description of soil samples tested under standard conditions.

3.1 Test Drilling

3.1.1 Test Drilling Methods

Test holes were augered to 3 to 4 m by AJ Britton Drilling. Locations of the test holes are shown in Map 4. Their position on the ground was determined using a handheld GPS. Dr Pat Hulme assessed texture and colour of the soil at 0.5 m depth intervals. Soil profiles were assessed according to textural classification for rice, which is based on the Northcote method of soil texture description. The NSW Agriculture Guidelines for siting, design, construction and management of on-farm water storages, has adopted as a standard for reservoir location, that 3 m of the top 3.6 m should belong to the medium-heavy clay texture group of Northcote.

3.1.2 Test Drilling Results

The test holes reflected the prediction of the AEM survey in that all sites were clayey for all depths below 0.5 m. Texture of the surface 0.5 m ranged from sandy loam (USCS SC) in test holes MM301, 302 through silty clay loam (USCS SM) in MM303, sandy clay loam (USCS SC) in MM307, 308, 309, 310, 311, 312 and 313 and low plasticity clay (CL) in MM315 to clay (CH and CI) in the southernmost MM304, 305, 306 and 314.

The suitability of sites for use as the floor of an irrigation storage was assessed to vary with the plasticity of the clay in accord with NSW Agriculture (1999). Sites MM308 and 310 with light clay (USCS CL) in the bottom metre or more (Appendix I) were classed as unsuitable for use as the floor of an irrigation storage.

Option 1 (East) contained test holes with 1 m of lighter material over light and medium clay (Map 4, Appendix I). The survey Airborne EM indicates that the zone of soil with low permeability extends eastward to the property boundary. The presence of 1 m of light clay indicates that a 1.2 m deep core trench would be appropriate in the area tested.

Option 2 (West) was bounded to the north by a line to the south of marginally suitable and unsuitable sites. Material sampled in test holes MM308 and 310 was consistent with soil becoming more leaky with distance to the north. The soil profile indicated that it would be prudent to construct a 0.7 m deep core trench beneath the embankment.

3.2 Laboratory Testing

3.2.1 Laboratory Testing Methods

Soil from the 0.5 to 1.5 m layer of test holes MM312 and MM314 were tested by Barnson Pty Ltd for suitability for use as construction material. This laboratory analysis was conducted according to standard techniques. It consisted of sieving dried soil to estimate the proportions of sand and gravel, determination of Atterberg Limits to quantify consistency, carrying out Emerson dispersion test to estimate stability and measurement of linear shrinkage. Atterberg Limits and sieving analysis are combined to give a material description according to the Unified Soil Classification system.

Material description describes different soil properties to those properties described by soil texture in the test drilling report. This difference in terminology arises because the Northcote soil texture description is a system used by hydrologists to assess the behaviour of undisturbed soil. In contrast material description is used by engineers to assess the behaviour of soil after it has been modified by practices such as compaction.

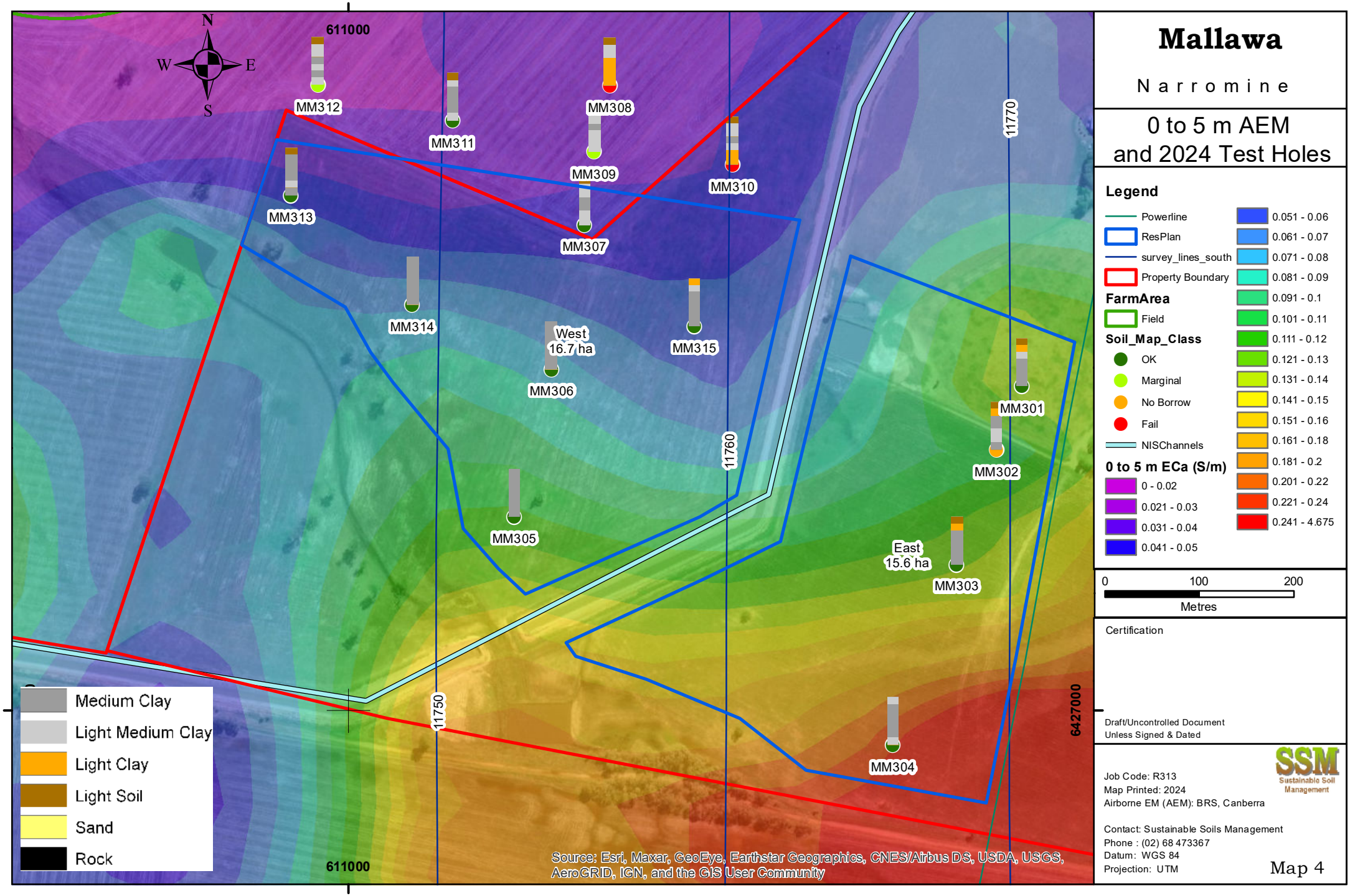
3.2.2 Laboratory Testing Results

The material from MM312 was logged as dark red light medium clay (Appendix I), had 77% of sample smaller than 75 μm, a liquid limit of 39%, and plasticity index of 23%. Consequently, the sample was classified as USCS CI. The combination of these properties with liner shrinkage of 10.5% and Emerson class 6 resulted in a material description of aggregated material (Crouch *et al.*, 2007).

The material from MM314 was logged as dark red medium clay (Appendix I), had 85% of sample smaller than 75 μm, a liquid limit of 47% and plasticity index of 33%. Consequently, the sample was classified as USCS CI. The combination of these properties, linear shrinkage of 17% and Emerson class of 4 resulted in a material description of aggregated material.

Data collected from test holes MM301 to 306 indicated that samples with high Emerson class (non-dispersive) were associated with salinity measured as electrical conductivity of 1 volume of soil to 5 volumes of water ($EC_{1:5}$) of 1.6 dS/m or higher. Samples with $EC_{1:5}$ of less than 1.6 dS/m were dispersive in field tests.

In the case of either dispersive or non-dispersive soil Crouch *et al.* (2007) recommend compaction to more than 95% of maximum dry density.



Mallawa

Narromine

0 to 5 m AEM and 2024 Test Holes

Legend

- Powerline
- ResPlan
- survey_lines_south
- Property Boundary

FarmArea

- Field

Soil_Map_Class

- OK
- Marginal
- No Borrow
- Fail
- NISChannels

0 to 5 m ECa (S/m)

- 0 - 0.02
- 0.021 - 0.03
- 0.031 - 0.04
- 0.041 - 0.05
- 0.051 - 0.06
- 0.061 - 0.07
- 0.071 - 0.08
- 0.081 - 0.09
- 0.091 - 0.1
- 0.101 - 0.11
- 0.111 - 0.12
- 0.121 - 0.13
- 0.131 - 0.14
- 0.141 - 0.15
- 0.151 - 0.16
- 0.161 - 0.18
- 0.181 - 0.2
- 0.201 - 0.22
- 0.221 - 0.24
- 0.241 - 4.675

0 100 200
Metres

Certification

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Job Code: R313
Map Printed: 2024
Airborne EM (AEM): BRS, Canberra

Contact: Sustainable Soils Management
Phone : (02) 68 473367
Datum: WGS 84
Projection: UTM

Map 4

3.3 Construction Recommendations

Design parameters and construction methods for an embankment constructed from this material should follow the parameters outlined in Barrett (2007).

The ring tank embankment should be built with a minimum crest width of 4 m (Barrett, 2007). The top of the batter should be graded to the inside with a slope of 2% or steeper to ensure that water does not pond on crest, (Barrett, 2007). The embankment should have a minimum internal batter slope of 5 horizontal:1 vertical (Barrett, 2007).

Construction methods should include stripping of topsoil beneath the embankment footprint, constructing a cut off trench at least 0.6 m deep beneath the centreline of the embankment.

The core of the embankment should be constructed from selected, moisture conditional clay. The material should be placed in layers not more than 0.15 m thick and compacted with a tamping (sheepsfoot) roller. Sufficient compaction will normally be achieved with 6 to 8 passes of suitable tamping roller (Barrett, 2007).

Topsoil should be spread uniformly in a smooth uncompacted layer not less than 0.3 m loose vertical measurement over the surface of the embankment. Pipes through or beneath the embankment should be placed during construction, not after. The pipe trench should be backfilled with moist, selected clay. More detail is provided by Barrett (2007).

4.0 Conclusions and Recommendations

- Background landscape information indicates that the soil on Mallawa is generally leaky apart from an area of Trangie Backplain near the southwestern corner and a strip mapped as Upstream Bugwah Channels near the eastern end of the southern boundary.
- The Airborne EM Survey supported the location of clayey soil of the Trangie Backplain, and predicted that the zone of clayey soil near the southeastern corner of Mallawa was bigger than indicated by the background landscape information.
- 15 test holes drilled to 3.6 m confirmed the presence of clayey moderately saline soil to the north of the Boggy Cowal drainage line along the southern boundary of Mallawa.
- The test holes also confirmed that the area further than 600 m from the southern boundary is generally leaky.
- Samples tested in a geotechnical laboratory were classified as USCS CI, have 10 to 17% linear shrinkage and were stable to rapid wetting. This stability is associated with soil salinity.
- An area of 16.7 ha to the outside toe of the embankment was mapped that contained soil that is likely to perform satisfactorily as the floor of an irrigation storage.
- The soil will require compaction to form a stable embankment. This can be achieved by following a relatively straight forward set of practices which are outlined in the report.

5.0 References

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6.0 Limitations

The investigations described in this report identified actual conditions only at those locations where sampling occurred. This data has been interpreted and an opinion given regarding the overall physical and chemical conditions at the site.

Although the information in this report has been used to interpret conditions at the site, actual conditions may vary from those inferred, especially between sampling locations. Consequently, this report should be read with the understanding that it is a professional interpretation of conditions at the site based on a set of data. Although the data were considered representative of the site they cannot fully define the conditions across the site.

APPENDIX I:

Test Hole Logs

Mallawa for B Anderson

Sampled using: auger drilling + TC bit

SSM Sustainable Soil Management

MM301 Sampled on: 12/12/2023
Described by: PJH
Comments: may be clayey due to association with depression to west
Location: 611715 m East 6427345 m North 237 m Elevation (NSW ECa: mS/m

Depth (m)	GRAPHIC LOG		SS) Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Red brown sandy loam, (USCS SC).	Complete	0		Dry
0.5		Dark red light medium clay, (USCS CI). Trace carbonate, trace medium sand	Partial	1	0.2	Dry
1.0		Dark red light medium clay, (USCS CI). With carbonate, trace medium sand	Partial	1		Just Moist
1.5		Dark red medium clay, (USCS CH). With carbonate	Partial	0		Moist
2.0		Brown yellow medium clay, (USCS CH).	Partial	1		Moist
2.5		Brown yellow medium clay, (USCS CH). Trace carbonate	Partial	1	0.4	Moist
3.0		Brown yellow medium clay, (USCS CH). Grey mottle	Partial	1		Moist
3.5						
4.0						

MM302 Sampled on: 12/12/2023
Described by: PJH
Comments: lighter soil than MM301
Location: 611687 m East 6427277 m North 237 m Elevation (NSW ECa: mS/m

Depth (m)	GRAPHIC LOG		SS) Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Dark red sandy loam, (USCS SC).	Complete	0		Dry
0.5		Dark red light medium clay, (USCS CI). Trace carbonate, trace medium sand	None	1	0.1	Dry
1.0		Dark red medium clay, (USCS CH). Trace carbonate, trace medium sand	None	1		Just Moist
1.5		Dark red medium clay, (USCS CH). Trace carbonate, trace medium sand	None	1		Just Moist
2.0		Yellow brown light medium clay, (USCS CI). Carbonate common, trace fine sand	None	1		Just Moist
2.5		Yellow brown light medium clay, (USCS CI). Trace medium sand	Partial	1		Just Moist
3.0		Yellow brown medium clay, (USCS CH). Trace medium sand	Partial	1	0.7	Just Moist
3.5						
4.0						

MM303 Sampled on: 12/12/2023
Described by: PJH
Comments: good past 1 m
Location: 611645 m East 6427155 m North 236 m Elevation (NSW ECa: mS/m

Depth (m)	GRAPHIC LOG		SS) Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Brown grey silty clay loam, (USCS SM).	Partial	2		Dry
0.5		Brown grey light clay, (USCS CL).	Partial	1	0.8	Dry
1.0		Brown grey medium clay, (USCS CI). With carbonate, trace medium sand	Partial	0		Dry
1.5		Brown grey medium clay, (USCS CH). Trace carbonate	Partial	0		Just Moist
2.0		Brown grey medium clay, (USCS CH).	Partial	0		Just Moist
2.5		Yellow grey medium clay, (USCS CH).	Complete	0	1.6	Just Moist
3.0		Yellow grey medium clay, (USCS CH).	Complete	0		Just Moist
3.5						
4.0						

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Mallawa for B Anderson

Sampled using: auger drilling + TC bit

MM304 Sampled on: 12/12/2023
Described by: PJH
Comments: pinrushes, soil cracks
Location: 611578 m East, 6426963 m North, 236 m Elevation (NSW SS)
ECa: mS/m

Depth (m)	Description	Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0	Brown grey light medium clay, (USCS CI). Trace medium Sand, trace carbonate	Partial	1		Dry
0.5	Grey brown medium clay, (USCS CH). Trace carbonate	Partial	1	0.4	Just Moist
1.0	Brown grey medium clay, (USCS CH). Mangans common	Partial	1		Just Moist
1.5	Yellow grey medium clay, (USCS CH).	Partial	0		Just Moist
2.0	Red brown medium clay, (USCS CH).	Partial	0		Just Moist
2.5	Red brown medium clay, (USCS CH). Trace grey mottle	Partial	0	3	Just Moist
3.0	Yellow grey light medium clay, (USCS CI). With fine sand	Partial	0		Just Moist
3.5					
4.0					

MM305 Sampled on: 12/12/2023
Described by: PJH
Comments: good past 1 m
Location: 611176 m East, 6427206 m North, 235 m Elevation (NSW SS)
ECa: mS/m

Depth (m)	Description	Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0	Grey brown medium clay, (USCS CH). Trace carbonate	None	1		Just Moist
0.5	Grey brown medium clay, (USCS CH). Trace carbonate	None	1	1.6	Just Moist
1.0	Yellow grey medium clay, (USCS CH). Mangans common	Complete	0		Moist
1.5	Yellow grey medium clay, (USCS CH).	Partial	0		Moist
2.0	Yellow grey medium clay, (USCS CH).	Partial	0		Moist
2.5	Yellow grey medium clay, (USCS CH).	Partial	0	3.7	Moist
3.0	Yellow grey medium clay, (USCS CH).	Partial	0		Moist
3.5					
4.0					

MM306 Sampled on: 12/12/2023
Described by: PJH
Comments: thin red topsoil
Location: 611216 m East, 6427363 m North, 235 m Elevation (NSW SS)
ECa: mS/m

Depth (m)	Description	Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0	Red grey medium clay, (USCS CI).	Partial	2		Just Moist
0.5	Brown grey medium clay, (USCS CH). Trace red mottle	Complete	1	1.4	Just Moist
1.0	Brown grey medium clay, (USCS CH). Trace carbonate	Complete	0		Just Moist
1.5	Brown grey medium clay, (USCS CH). Trace mangans	Complete	0		Just Moist
2.0	Brown grey medium clay, (USCS CH). Trace carbonate	Complete	0		Just Moist
2.5	Yellow grey medium clay, (USCS CH).	Complete	0	2.9	Just Moist
3.0	Grey yellow medium clay, (USCS CH).	Complete	0		Just Moist
3.5					
4.0					

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Mallawa for B Anderson

Sampled using: auger drilling + TC bit

MM307 Sampled on: 12/12/2023
Described by: PJH
Comments: probably ok due to dispersion
Location: 611250 m East 6427516 m North 236 m Elevation (NSW ECa: mS/m

Depth (m)	GRAPHIC LOG		SS) Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Red brown sandy clay loam, (USCS SC).	Complete	2		Just Moist
0.5		Dark red light medium clay, (USCS CI).	Partial	2		Just Moist
1.0		Dark red light medium clay, (USCS CI).	Partial	2		Just Moist
1.5		Orange brown medium clay, (USCS CH). Ok	Partial	2		Just Moist
2.0		Orange brown medium clay, (USCS CH).	Partial	2		Just Moist
2.5		Orange brown light medium clay, (USCS CI).	None	2		Just Moist
3.0		Orange brown light medium clay, (USCS CI).	None	2		Just Moist
3.5						
4.0						

MM308 Sampled on: 12/12/2023
Described by: PJH
Comments: FAIL
Location: 611277 m East 6427663 m North 236 m Elevation (NSW ECa: mS/m

Depth (m)	GRAPHIC LOG		SS) Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Red brown sandy clay loam, (USCS SC).	Complete	2		Just Moist
0.5		Dark red light medium clay, (USCS CI).	Partial	2		Just Moist
1.0		Dark red light medium clay, (USCS CI).	Partial	2		Just Moist
1.5		Orange brown light clay, (USCS CL).	Partial	2		Moist
2.0		Orange brown light clay, (USCS CL).	None	2		Moist
2.5		Orange brown light clay, (USCS CL).	None	2		Moist
3.0		Orange brown light clay, (USCS CL).	None	2		Moist
3.5						
4.0						

MM309 Sampled on: 12/12/2023
Described by: PJH
Comments: just good enough - no borrow
Location: 611261 m East 6427593 m North 236 m Elevation (NSW ECa: mS/m

Depth (m)	GRAPHIC LOG		SS) Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Red brown sandy clay loam, (USCS SC).	Complete	3		Just Moist
0.5		Dark red light medium clay, (USCS CI).	None	3		Just Moist
1.0		Dark red light medium clay, (USCS CI).	None	3		Just Moist
1.5		Red brown medium clay, (USCS CH).	None	3		Moist
2.0		Orange brown light medium clay, (USCS CI). With fine sand	None	3		Moist
2.5		Orange brown light medium clay, (USCS CI). With fine sand	None	3		Moist
3.0		Orange brown light medium clay, (USCS CI).	None	3		Moist
3.5						
4.0						

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Mallawa for B Anderson

Sampled using: auger drilling + TC bit

SSM Sustainable Soil Management

MM310 Sampled on: 12/12/2023
Described by: PJH
Comments: ok from 0.5 to 2.5 and dispersive, no borrow
Location: 611408 m East, 6427580 m North, 236 m Elevation (NSW SS)
ECa: mS/m

Depth (m)	GRAPHIC LOG		Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Grey brown sandy clay loam, (USCS SC).	Complete	3		Dry
0.5		Dark red light medium clay, (USCS CI). With carbonate	None	3		Just Moist
1.0		Dark red light medium clay, (USCS CI). With carbonate	None	3		Just Moist
1.5		Grey brown medium clay, (USCS CH). With carbonate	None	3		Just Moist
2.0		Grey brown light medium clay, (USCS CI). With carbonate	None	3		Just Moist
2.5		Grey brown light clay, (USCS CL).	None	3		Moist
3.0		Grey brown light clay, (USCS CI).	None	3		Moist
3.5						
4.0						

MM311 Sampled on: 12/12/2023
Described by: PJH
Comments: good enough
Location: 611111 m East, 6427626 m North, 236 m Elevation (NSW SS)
ECa: mS/m

Depth (m)	GRAPHIC LOG		Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Orange brown sandy clay loam, (USCS SC).	Complete	0		Dry
0.5		Dark red light medium clay, (USCS CI).	Complete	0		Dry
1.0		Dark red medium clay, (USCS CH). Trace grey mottle	Partial	1		Dry
1.5		Brown grey medium clay, (USCS CH). Trace carbonate	None	3		Just Moist
2.0		Brown grey medium clay, (USCS CH).	None	3		Just Moist
2.5		Brown grey medium clay, (USCS CH).	None	3		Moist
3.0		Brown grey light medium clay, (USCS CI).	None	3		Moist
3.5						
4.0						

MM312 Sampled on: 12/12/2023
Described by: PJH
Comments: texture marginal, but dispersive, so likely to leak slowly enough
Location: 610967 m East, 6427664 m North, 236 m Elevation (NSW SS)
ECa: mS/m

Depth (m)	GRAPHIC LOG		Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Grey brown sandy clay loam, (USCS SC).	Complete	1		Dry
0.5		Dark red light medium clay, (USCS CI).	Complete	3		Just Moist
1.0		Dark red light medium clay, (USCS CI).	Partial	3		Just Moist
1.5		Brown grey medium clay, (USCS CH). With carbonate	None	3		Just Moist
2.0		Brown grey light medium clay, (USCS CL).	None	3		Moist
2.5		Grey brown medium clay, (USCS CH).	None	3		Moist
3.0		Grey brown light medium clay, (USCS CI).	None	3		Moist
3.5						
4.0						

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Mallawa for B Anderson

Sampled using: auger drilling + TC bit

MM313 Sampled on: 12/12/2023
Described by: PJH
Comments: ok but not good
Location: 610939 m East 6427547 m North 235 m Elevation (NSW SS)
ECa: mS/m

Depth (m)	GRAPHIC LOG		Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Grey brown sandy clay loam, (USCS SC).	Complete	0		Dry
0.5		Grey brown medium clay, (USCS CH). With red mottle	Partial	1		Dry
1.0		Yellow grey medium clay, (USCS CH). With red mottle	Partial	1		Just Moist
1.5		Yellow grey medium clay, (USCS CH).	Partial	0		Just Moist
2.0		Yellow grey medium clay, (USCS CH).	None	2		Just Moist
2.5		Grey yellow light medium clay, (USCS CI).	None	2		Just Moist
3.0		Grey yellow medium clay, (USCS CH).	None	2		Just Moist
3.5						
4.0						

MM314 Sampled on: 12/12/2023
Described by: PJH
Comments: good - can support 1.5 m borrow
Location: 611068 m East 6427431 m North 234 m Elevation (NSW SS)
ECa: mS/m

Depth (m)	GRAPHIC LOG		Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Dark grey medium clay, (USCS CH).	Partial	1		Just Moist
0.5		Brown grey medium clay, (USCS CH). With carbonate	Partial	0		Just Moist
1.0		Yellow grey medium clay, (USCS CH). With carbonate	Partial	0		Moist
1.5		Yellow grey medium clay, (USCS CH).	Partial	0		Moist
2.0		Yellow grey medium clay, (USCS CH).	Partial	0		Moist
2.5		Yellow grey medium clay, (USCS CH). Trace yellow mottle	Partial	0		Moist
3.0		Yellow grey medium clay, (USCS CH). Trace carbonate	Partial	0		Moist
3.5						
4.0						

MM315 Sampled on: 12/12/2023
Described by: PJH
Comments: good past 1 m
Location: 611367 m East 6427409 m North 236 m Elevation (NSW SS)
ECa: mS/m

Depth (m)	GRAPHIC LOG		Slaking	Dispersion (0 to 4)	EC 1:5 (dS/m)	Layer Moisture
0.0		Brown grey light clay, (USCS CL).	Partial	3		Dry
0.5		Grey brown light medium clay, (USCS CI).	Complete	2		Dry
1.0		Grey brown medium clay, (USCS CH). Trace medium sand	Complete	2		Just Moist
1.5		Grey brown medium clay, (USCS CH). Trace carbonate	Partial	0		Just Moist
2.0		Grey brown medium clay, (USCS CH).	Partial	0		Just Moist
2.5		Grey brown medium clay, (USCS CH).	Partial	0		Just Moist
3.0		Grey brown medium clay, (USCS CH).	Partial	0		Just Moist
3.5						
4.0						

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Key to test hole description:

COLOUR

DG	Dark Grey
GB	Grey Brown
G	Grey
YB	Yellow Brown
B	Brown
DB	Dark Brown

TEXTURE

SCL	Sandy clay loam
CL	Clay loam
SiC	Silty clay
LC	Light clay
LMC	Light medium clay
MC	Medium clay

tr	trace
CC	Calcium and/or magnesium carbonate
FS	Fine sand
gyp	gypsum

APPENDIX II:

LABORATORY ANALYSIS

Performed by:

Barnson Pty Ltd

Material Test Report

Barnson Pty Ltd
Dubbo Laboratory
16 L Yarrandale Road Dubbo NSW 2830
Phone: 1300 BARNSON
Email: nreardon@barnson.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nick Reardon
Laboratory Manager
NATA Accredited Laboratory Number: 9605

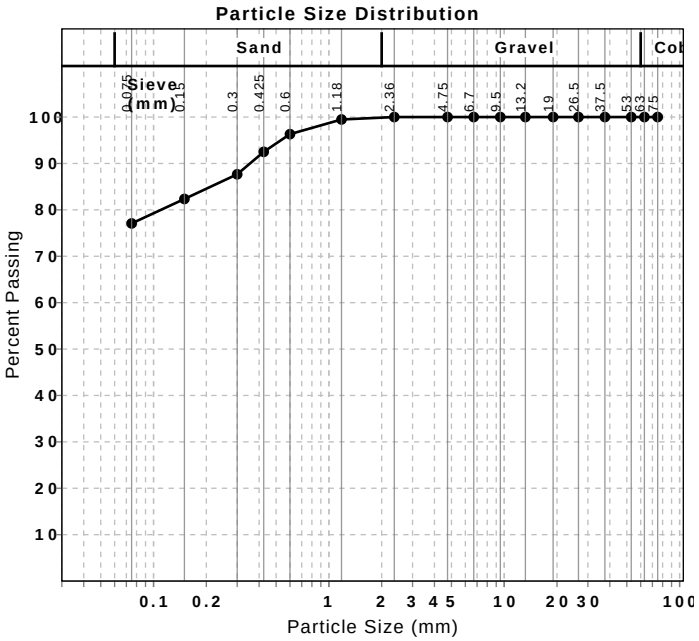
Report Number: **43321-1**
Issue Number: 1
Date Issued: 01/02/2024
Client: Sustainable Soils Management
P.O Box 130, Warren NSW 2824
Contact: Pat Hulme
Project Number: 43321
Project Name: Material Evaluation
Project Location: MM314 & MM312, Narromine NSW
Work Request: 9682
Sample Number: D24-9682A
Date Sampled: 10/01/2024
Dates Tested: 11/01/2024 - 25/01/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **MM312, Depth: 0.5-1.5m**
Material: Red Sandy Silty CLAY

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
75 mm	**100**			0		
63 mm	**100**			0		
53 mm	**100**			0		
37.5 mm	**100**			0		
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**100**			0		
1.18 mm	**99**			1		
0.6 mm	**96**			3		
0.425 mm	**93**			4		
0.3 mm	**88**			5		
0.15 mm	**82**			5		
0.075 mm	**77**			5		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	39		
Plastic Limit (%)	16		
Plasticity Index (%)	**23**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**10.5**		
Cracking Crumbling Curling	Cracking		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	Red Sandy Silty CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	24		



Material Test Report

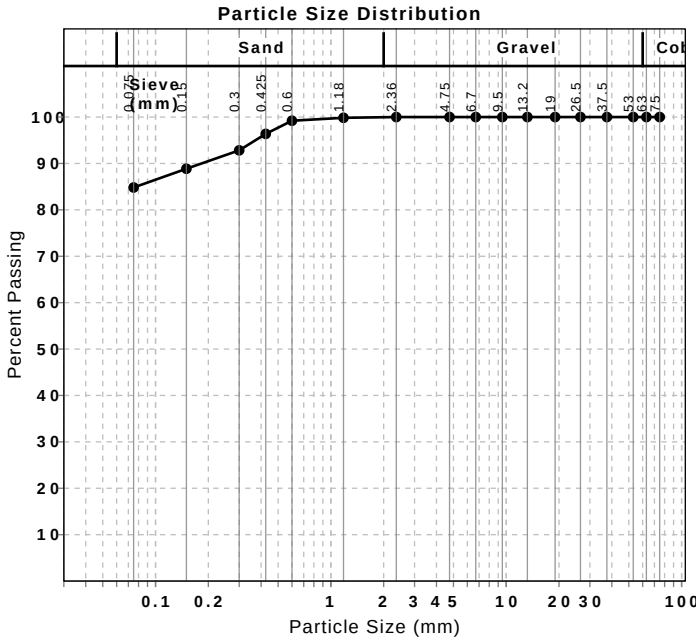
Barnson Pty Ltd
Dubbo Laboratory
16 L Yarrandale Road Dubbo NSW 2830
Phone: 1300 BARNSON
Email: nreardon@barnson.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nick Reardon
Laboratory Manager
NATA Accredited Laboratory Number: 9605

Report Number: **43321-1**
Issue Number: 1
Date Issued: 01/02/2024
Client: Sustainable Soils Management
P.O Box 130, Warren NSW 2824
Contact: Pat Hulme
Project Number: 43321
Project Name: Material Evaluation
Project Location: MM314 & MM312, Narromine NSW
Work Request: 9682
Sample Number: D24-9682B
Date Sampled: 10/01/2024
Dates Tested: 11/01/2024 - 25/01/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **MM314, Depth: 0.5-1.5m**
Material: Red Sandy Silty CLAY

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
75 mm	**100**			0		
63 mm	**100**			0		
53 mm	**100**			0		
37.5 mm	**100**			0		
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**100**			0		
1.18 mm	**100**			0		
0.6 mm	**99**			1		
0.425 mm	**96**			3		
0.3 mm	**93**			4		
0.15 mm	**89**			4		
0.075 mm	**85**			4		



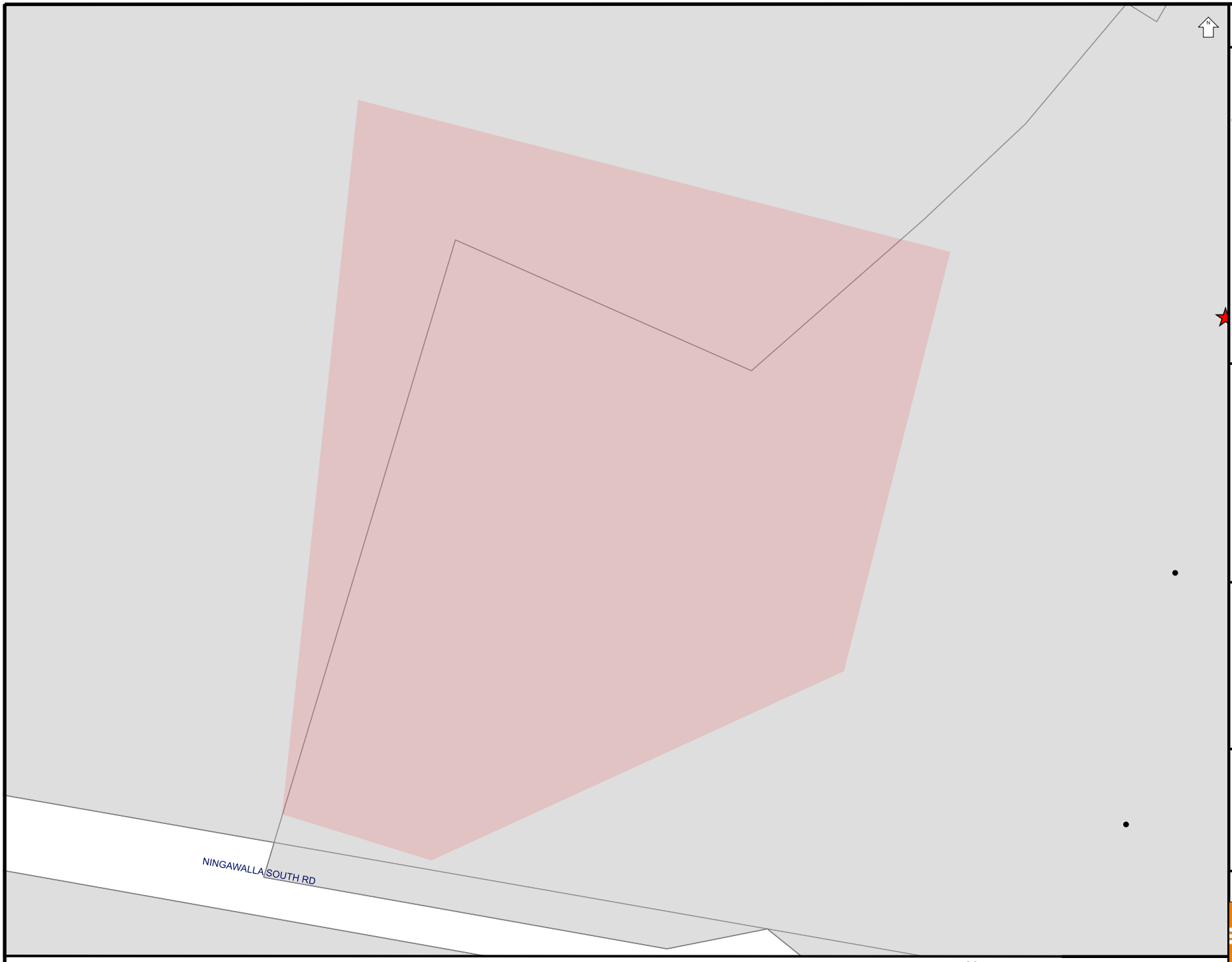
Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	48		
Plastic Limit (%)	15		
Plasticity Index (%)	**33**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**17.0**		
Cracking Crumbling Curling	Curling		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4**		
Soil Description	Red Sandy Silty CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	24		

Attachment 5

Map of Service Locations



Overhead wires not shown
LOOK UP & LIVE!

LEGEND

- LV Underground Cable
- HV Underground Cable
- Underground Pipe
- Underground Earth or Wires
- Ground Substation
- Pole
- Cubicle
- Pit
- Area of Interest

Critical Assets

Contact Essential Energy on 13 23 91

- Zone Substation
- Underground Cable
- Underground Fibre

Proposed Works

- Area of proposed works

Proposed assets are shown as orange symbols

THE INFORMATION ON THIS MAP MAY NOT BE ACCURATE. If details are incorrect, please notify Essential Energy on 13 23 91 (or fax 1800 354 636)

ISSUE DATE: 14/10/2024

You must resubmit your request if you have not started work within 4 weeks of the 'Issue Date' above

A4 | SCALE: 1:5212

Job Number: 37810796 Sequence number: 245977006 Job location: 810 The McGrane Way, Narromine

Map Centre: 148° 10' 50.7", -32° 17' 4.6"

essential energy