



Douglas Partners

Geotechnics | Environment | Groundwater

Report on
Desktop Geotechnical Assessment

Planning Proposal - Rowan Village
7066 Holbrook Road, Rowan

Prepared for
DevCore Developments Pty Ltd

Project 210894.01
April 2022

Integrated Practical Solutions



Document History

Document details

Project No.	210894.01	Document No.	R.001.Rev1
Document title	Report on Desktop Geotechnical Assessment Planning Proposal - Rowan Village		
Site address	7066 Holbrook Road, Rowan		
Report prepared for	DevCore Developments Pty Ltd		
File name	210894.01.R.001.Rev1		

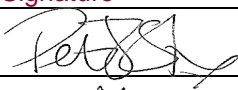
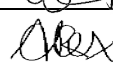
Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	Shannon Goodsell	Michael Jones	22 March 2022
Revision 1	Shannon Goodsell	Michael Jones	6 April 2022
Revision 2	Peter Storey	Michael Jones	20 April 2022

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	0	Cameron Beames, DevCore Developments Pty Ltd
Revision 1	1	0	Cameron Beames, DevCore Developments Pty Ltd
Revision 2	1	0	Cameron Beames, DevCore Developments Pty Ltd

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature		Date
Author		Peter Storey	20 April 2022
Reviewer		Michael Jones	20 April 2022



Douglas Partners Pty Ltd
 ABN 75 053 980 117
www.douglaspartners.com.au
 Unit 2, 73 Sheppard Street
 Hume ACT 2620
 PO Box 1487
 Fyshwick ACT 2609
 Phone (02) 6260 2788

Table of Contents

	Page
1. Introduction.....	1
2. Planning Proposal	1
3. Site Description	3
3.1 Site Identification.....	3
3.2 Site Description.....	3
4. Published Data	4
4.1 Soil Landscapes.....	4
4.2 Site Geology	4
4.3 Acid Sulphate Soils	5
4.4 Salinity	6
4.5 Groundwater	6
5. Field Work (Site Walkover)	7
6. Geotechnical Model	11
7. Comments	12
7.1 General	12
7.2 Anticipated Geotechnical Constraints.....	12
7.3 Site Preparation and Earthworks	13
7.4 Water Logging.....	13
7.5 Erosion Potential.....	14
7.6 Soil Salinity and Aggressivity	14
7.7 Site Classification.....	14
7.8 Foundations	14
7.9 Slope Stability	15
7.10 Excavation	16
7.11 Farm Dams	16
7.12 Groundwater	16
8. Further Investigations.....	17
9. Conclusion.....	17
10. References	18
11. Limitations	18

Appendix A:	About This Report
Appendix B:	Drawings 1 and 2
Appendix C:	Site Searches

Report on Desktop Geotechnical Assessment

Planning Proposal - Rowan Village

7066 Holbrook Road, Rowan

1. Introduction

This report presents the results of a desktop geotechnical assessment undertaken for a proposed subdivision at 7066 Holbrook Road, Rowan. The investigation was commissioned in an email dated 8 March 2022 by Cameron Beames of DevCore Developments Pty Ltd (DevCore) C/- Urbis and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal 210894.01.P.001.Rev1 dated 3 March 2022.

DP understands that Urbis are assisting DevCore in the preparation of an Indicative Layout Plan (ILP) and planning proposal for the site to rezone the site from RU1 Primary Production to R1 General Residential, R5 Large Lot Residential, B2 Local Centre and RE1 Public Recreation.

The aim of the investigation was to broadly assess the geotechnical features across the site including surface soil and water conditions, likely subsurface profile and groundwater conditions and comment on potential geotechnical constraints in order to assist with DevCore's ILP and planning proposal.

DP has also previously undertaken a preliminary contamination assessment at the site (report ref: 210894.00.R.001.Rev0, dated 24 November 2021) and are also concurrently undertaking a preliminary site investigation (PSI) for contamination which has been reported separately (report ref: 210894.02.R.001.Rev0).

This report must be read in conjunction with the notes entitled *About this Report* which are included in Appendix A.

2. Planning Proposal

The Planning Proposal seeks to rezone the site from RU1 Primary Production and R5 Large Lot Residential to the following mix of land use zones:

- R1 General Residential
- R5 Large Lot Residential
- B2 Local Centre
- RE1 Public Recreation

Based on a dwelling yield of 10 dwellings per hectare, the Planning Proposal master plan will enable the delivery of circa 2,100 dwellings across a 225 hectare site area, which importantly will encompass the delivery of a diverse mix of low density residential housing typologies described as follows:

- **Rural transition residential lots** – These residential lots will be located along the southern boundary of the site and will be the largest residential lot typology. This lot typology will

importantly provide an appropriate transition between the site and the adjacent rural context to the south of Rowan Road.

- **Neighbourhood residential lots** – A range of suitable low density residential lots will be accommodated within close proximity to open space provision and the riparian corridor network. This lot typology will provide the appropriate transition between the village residential lots and the rural transition lots. A diversity of lot sizes will be delivered through the neighbourhood residential lot typology.
- **Village residential lots** – These residential lots will leverage off the close proximity to the local centre and its associated amenities and offerings. Fundamentally, these residential lots will still uphold the low density residential housing charter that the site will deliver, whilst ensuring that an appropriate diversity of housing choice is delivered.

The Planning Proposal will enable the creation of a new amenity-led neighbourhood providing an opportunity for a variety of housing options through a range of residential lot sizes, supported by the timely delivery of resilient utilities and infrastructure that supports and promotes the future growth of Wagga Wagga in an orderly and sustainable way. The delivery of a mix of low density housing choices will be crucial to attracting a wide range of demographics to the area.

As presented in the Urban Design Study that supports the Planning Proposal, a dense, active and vibrant local village centre will be located at the heart of the neighbourhood, with a mix of land uses and services for convenience. The local centre will create a focal point for the community and encourages social gathering and interaction.

Future development on the site would be facilitated by a highly connected, and permeable network with convenient access to public transport, public spaces, facilities, and amenities. Cycleways and footpaths will connect across the site to promote a walkable community.

The Planning Proposal will also ensure that the environmental values of the site are preserved through the dedicated retention, and where required rehabilitation, of significant trees and riparian corridors.

The proposed plan for the subdivision is shown in Drawing 1, Appendix B. It should be noted that the above Planning Proposal details were provided to DP by Urbis and were required to be included in the report as a Pro-Forma section.

3. Site Description

3.1 Site Identification

Site Address	7066 Holbrook Road, Rowan
Legal Description	Lots 43, 65 and 66 in D.P. 757246 Lot 18 in D.P. 1054800 Lots 1 and 2 in D.P. 1171894 Lot 23 in D.P. 1063399 Lots 24 and 26 in D.P. 757246
Area	225.02 ha
Zoning	RU1 Primary Production and R5 Large Lot Residential
Local Council Area	City of Wagga Wagga
Current Use	Agricultural (Cropping and Grazing)
Surrounding Uses	North – Low density residential East – Vacant agricultural (future Sunnyside site – proposed to be rezoned for predominantly residential and some commercial land uses) South – Rowan Road, beyond which is rural residential and agricultural West – Holbrook Road, beyond which agricultural
Site Address	7066 Holbrook Road, Rowan

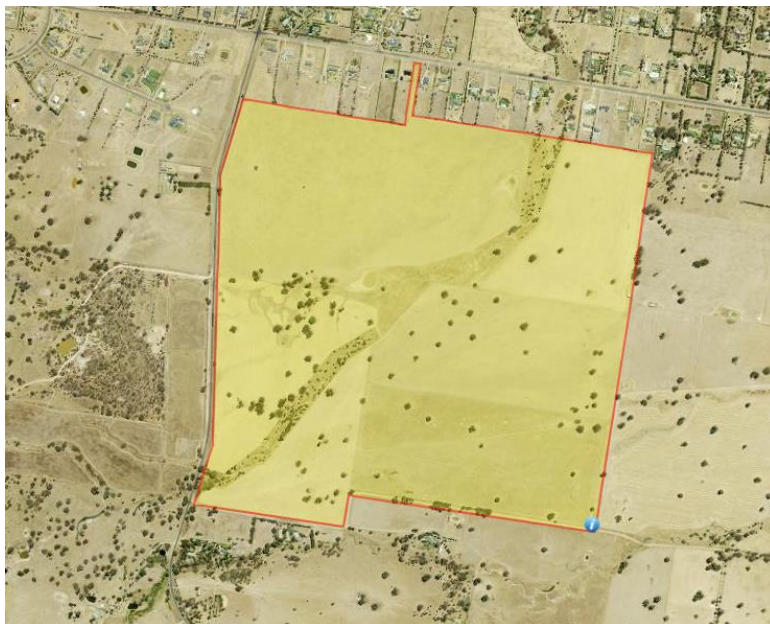


Figure 1: Site Location outlined in red and highlighted by yellow.

3.2 Site Description

The site comprises vacant cropping and grazing land. A tributary to Stringybark Creek is aligned northeast – southwest through the centre of the site. Several ephemeral drainage lines are present to the west of the tributary and flow into the Stringybark Creek tributary. Several ephemeral drainage lines are also located to the east of the tributary line, however, do not flow into the Stringybark Creek tributary. Several farm dams are present within drainage lines

The regional/broader topography (i.e. surrounding the site) comprises gently inclined footslopes and piedmonts and is adjacent to granite and sandstone hills to the west. Slope gradients are generally less than 3% and local relief is generally less than 10 m within an elevation range of 210 – 270 m.

The site topography gently slopes from 259 m in the south-west corner of the site to 224 m in the north-east corner of the site, towards Stringybark Creek with reference to levels relative to Australian Height Datum (AHD).

4. Published Data

4.1 Soil Landscapes

The site is underlain by various soil landscape groups. Published mapping indicates it is underlain by the Redbank soil group (mapped across the majority of the site – north-west portion, central and eastern and southern portions of the site), the Becks Lane soil group (mapped across a small section of the western portion of the site) and the Gregadoo variant a soil group (mapped across the south-west corner of the site) Further details of the soil landscape groups are present in Appendix C.

The Redbank soil group landscape is characterised by very gently inclined long piedmont slopes, local relief is less than 10 m and comprises of long undulating slopes and narrow drainage lines. The landscape is almost completely cleared of tall woodland. Limitations associated with the Redbank soil group include high erosion hazards, localised foundation hazards, localised water logging, strong acidity and low fertility soil.

The Becks Lane soil group landscape is characterised by gently inclined footslopes adjacent to hills of Ordovician metasedimentary rocks. Local relief ranges from 5 – 15 m and slope gradients are between 2 - 4%. Long (>300 m) waning slopes and mostly parallel, shallow drainage lines are present and the landscape is almost completely cleared of tall woodland. Limitations associated with the Becks Lane soil group include high erosion hazards, localised foundation hazards, acidity and locally hardsetting soil.

The Gregadoo variant a soil group landscape is characterised by gently inclined mid-slopes of adamellite and granite hills. Local relief ranges between 10 – 30 m and slope gradients are less than 3%. Long slopes and mostly parallel shallow drainage lines are present and rare rock outcrops are also associated with this soil landscape. Limitations associated with the Gregadoo variant a soil group include high erosion hazards, localised mass movement, localised foundation hazards, localised sodicity, strong acidity and low fertility soil with localised hardpans.

4.2 Site Geology

Published mapping indicates that the site is underlain by Quaternary alluvium that comprises of gravel, sand, silt and clay. A small portion of the western part of the site is underlain by Palaeozoic granite, gneissic granite and gneiss.

According to the published mapping, it is likely that the Quaternary alluvium is underlain by granite and possibly sandstone which is located to the west of site. Driller's Logs from on-site registered groundwater bores GW403836 and GW403837 indicate granite is present at approximately between 11.5 – 12.0 m below ground level (bgl).



Figure 2: 1966 Wagga Wagga 1:250,000 Geology Map with approximate site location (outlined in red). Alluvium is mapped as yellow and the granite is mapped as pink.

4.3 Acid Sulphate Soils

Reference to the CSIRO's Atlas of Australian Acid Sulfate Soils online mapping portal, ([A S R I S - Atlas of Australian Acid Sulfate Soils \(csiro.au\)](https://www.csiro.au/ASRIS), accessed 16 March 2022) indicates that the site has a low probability of acid sulfate soils (ASS) to be present (see Figure 3 below).



Figure 3: ASRIS – Atlas of Australian Acid Sulfate Soils map with approximate site location (outlined in red). The yellow indicates areas of low probability of ASS to be present and the green indicates areas of extremely low probability of ASS to be present.

4.4 Salinity

Reference to NSW Department of Planning Industry and Environment eSPADE website (<https://www.environment.nsw.gov.au/eSpade2Webapp>, accessed 16 March 2022) indicated that the site has a low to moderate land salinity hazard and occurrence (see Figure 4 below).

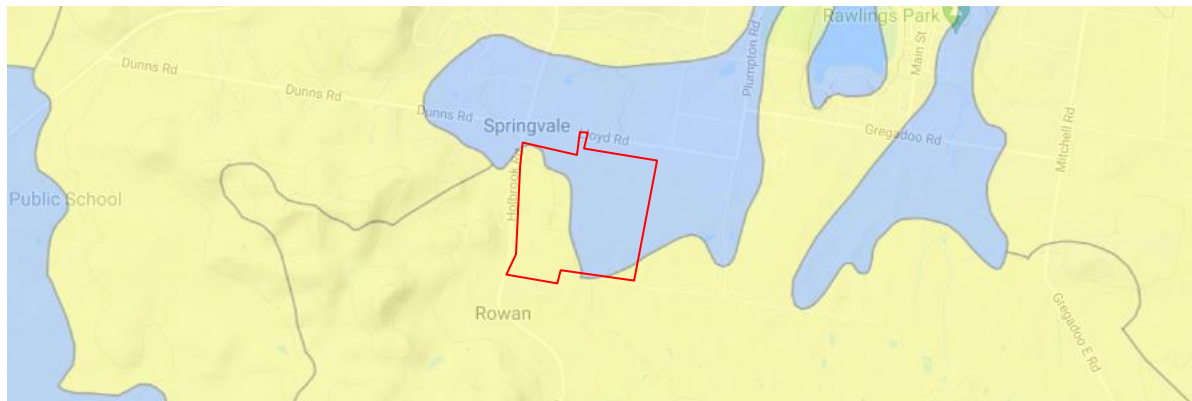


Figure 4: ASRIS – Atlas of Australian Acid Sulfate Soils map with approximate site location (outlined in red) low salinity hazard and occurrence are highlighted by the areas in blue and moderate salinity hazard and occurrence are highlighted by the areas in yellow.

4.5 Groundwater

A search of the publicly available registered groundwater bore database indicated that there are nine registered groundwater bores within 1 km of the site, two of which are located within the site. The groundwater bores from within 1 km of the site are summarised in Table 1 below, further details of each bore are presented in Appendix C.

Table 1: Summary of Available Information from Nearby Registered Groundwater Bores

Bore ID Authorised Purpose Completion Year Status	Approximate Location Relative to Site	Final Depth (m)	Standing Water Level (m bgl)
GW403836 – Monitoring Bore – 2007	Within the north-west corner of the site	15.0	8.6
GW403837 – Monitoring Bore – 2007	Within the north-west corner of the site	15.0	N/A
GW057259 – Stock/Domestic - 1983	320 m S	8.5	N/A
GW403838 – Monitoring Bore – 2007	510 m N	10.0	5.7
GW403840 – Monitoring Bore – 2007	710 m NE	8.6	6.6

Bore ID Authorised Purpose Completion Year Status	Approximate Location Relative to Site	Final Depth (m)	Standing Water Level (m bgl)
GW404190 – Stock/Domestic - 2005	830 m N	108.0	64.0
GW403835 – Monitoring Bore – 2007	860 m N	15.2	N/A
GW403839 – Monitoring Bore – 2007	910 m N	15.3	N/A
GW416362 – Stock/Domestic – 2013	1000 m N	216.0	49.0

Information from the registered groundwater bore log GW403836 indicates that the depth to groundwater within the north-west corner of the site is recorded as being 8.6 m bgl. It should be noted there was no groundwater data for bore GW403837. Information from the registered groundwater bore logs in the vicinity of the site are recorded as being between 5.7 m and 64 m bgl.

Based on the regional topography and the inferred flow direction of nearby water courses, the anticipated flow direction of groundwater beneath the site is to the north-east, towards Stringybark Creek and Lake Albert, the likely receiving surface water body for the groundwater flow path.

5. Field Work (Site Walkover)

A site walkover was undertaken by a Geo-Environmental Scientist on 10 March 2022. The general site topography was consistent with that described in Section 4. The following was observed during a site walkover across the area where future development is proposed and some of the features are included on Drawing 2 (Appendix B):

- The site was mostly undeveloped agricultural land used for grazing and cropping. The site was generally divided into grassed paddocks by a series of fences;
- Vegetation appeared to be in a healthy condition, however some dead trees were present;
- Dam walls and embankments and contour berms were constructed with soil material and appeared to be site-won material. No refuse/building debris was observed on the surface of the dam walls;
- The site was gently undulating and generally sloped down from the south-west to the north-east;
- Gully line erosion was present within the south-west of part of the site (within the Stringybark Creek tributary). Various materials had been tipped in a section of the Stringybark Creek tributary, including vegetation, timber, concrete, brick and cattle carcasses. The soil within the erosion line was up to approximately 3 m deep and no rock was observed within the walls of the gully. The soil comprised a mixture of silty sand and sandy clay with gravel;
- Several ephemeral drainage lines are present across the site (see Drawing 2 for further details);
- A machinery shelter shed was located along the central part of the eastern boundary of the site;

- During DP's environmental walkover (12 November 2021), surface areas within the northern portion of the site, surrounding the Stringybark Creek tributary were noted to be boggy, waterlogged and soft due to recent rainfall across the site. The area was observed to be relatively dry and appeared to show no signs of waterlogging at the time of the geotechnical walkover; and
- Areas of boggy, waterlogged and soft ground were noted within the southern part of the site, associated with the drainage lines (surrounding areas of the drainage line were dry). It should be noted that DP's 4 x 4 wheel drive utility vehicle was close to being bogged during the geotechnical walkover.

It should be noted that due to the dense grass and shrub coverage across the site, observations of potential fill on-site was limited during the walkover. Figures 5 – 10 show the general conditions of the site at the time of the geotechnical site walkover.



Figure 5: General view of the drainage area within the western portion of the site, looking south-west.



Figure 6: General view of the Stringybark Creek tributary erosion within the south-west portion of the site, looking south-west.



Figure 7: General view of the Stringybark Creek tributary erosion within the south-west portion of the site, looking south-east.



Figure 8: General view of a farm dam located within the central part of the site, on the western edge of the Stringybark Creek tributary, looking north.



Figure 9: General view of the north-east portion of the site.



Figure 10: General view of the south-east portion of the site.

6. Geotechnical Model

Based on the site observations, publicly available information (refer to Appendix C) and regional geology, it is suggested that the subsurface profile on the site will likely comprise the following:

- **TOPSOIL:** silty sandy/silty sand topsoil, with gravel and rootlets potentially up to depths of 0.4 m;
- **ALLUVIAL SOILS:** generally deep (greater than 3 m deep) and most likely comprising a mixture of gravel, silt, sand and clay soils as described in Sections 4.2 and 5. Alluvial soils will be more prominent in lower lying areas of the site and within the Stringybark Creek tributary;
- **RESIDUAL SOILS:** generally deep (greater than 3 m deep) and most likely overlying granite and would most likely to comprise silty and sandy clays or clayey sands with gravel and/or possible granite core stones or tors. Residual soils will be more prominent in the western portion of the site where granite has been mapped;
- **WEATHERED ROCK:** granite is likely to be observed from ~9 – 10 m and is likely to be initially very low strength, highly weathered typically grading to stronger, less weathered rock with depth. It is expected that the granite will be more shallow towards the western portions of the site becoming deeper towards the eastern portion of the site (becoming closer to alluvial soils and Stringybark Creek). Granite tors or core stones are likely within the overlying soil matrix.

It should be noted that fill is present within the site in the form of dam walls and contour berms. These earth structures appeared to have been constructed from site-won material (i.e. no strong indications of imported soil material or other media). Fill was observed to be present in parts of the Stringybark Creek tributary or drainage lines (refer Drawing 2); dense vegetation across the site limited the observation of potential fill in other areas. All fill encountered on-site must be considered uncontrolled and undocumented and would not be suitable for construction until testing is conducted.

It should be also noted that approximate soil and rock depths were interpreted from the registered groundwater bore data (Water NSW) from two bores located within the north-west corner of the site. The actual ground conditions could vary substantially from the interpreted geotechnical model and should be confirmed with intrusive geotechnical investigations at the site.

7. Comments

7.1 General

The following sections provide general comments on geotechnical development constraints related to the assessment. The assessment has been based on information provided by the client and publicly available data. It is noted that further investigations will need to be undertaken as the planning and design of the subdivision proceeds.

7.2 Anticipated Geotechnical Constraints

Based on the review of publicly available information and site walkover, the following issues would be the major geotechnical constraints that need to be considered for the proposed development:

- Excavations are expected to encounter some fill (dams and contour berms and within portions of drainage lines), natural soils and possible variable strength rock initially of very low to low strength with potentially medium or greater strength rock anticipated in deeper locations depending on design levels;
- The presence of unsuitable material and stripping depths (i.e.: topsoil and deep sandy/silty alluvial soils over most of the site) would be considered unsuitable to support footings and pavements as they readily lose strength when subject to water infiltration;
- Site preparation (i.e.: subgrade preparation for foundations, fill operations and pavement construction) is expected to be difficult in the low-lying and gully areas due to soft/wet soils from potential seepages and water logging from poor drainage;
- Site trafficability following periods of wet weather has the potential to become problematic. Areas including the gully and low-lying portions of the site will be boggy and effectively untrafficable to all but tracked construction vehicles;
- Reuse of excavated materials may be potentially limited within the site. Any wet but suitable natural soils would require drying prior to placement in fill areas which is dependent on prior weather conditions. Uncontrolled fill, if excavated is likely to be largely unsuitable for controlled fill though could be assessed at the time of removal. Topsoil and silty soils are unsuitable for reuse as fill.

- Management of soils with high erosion hazard using safe construction methods and limiting exposure to inclement weather;
- Potential foundation hazards and soil aggressivity constraints (potential acidic soils). Physical and chemical testing should be undertaken of soil samples across the site to assist with the design of infrastructure;
- Groundwater seepages must be expected within the alluvial profiles along with anticipated water logging around lower lying areas associated with watercourses/drainage lines and possibility in higher elevation areas; and
- Salinity mapping indicates the potential for moderately saline soils.

7.3 Site Preparation and Earthworks

It is anticipated that the majority of the site should be suitable for conventional site preparation and earthworks in a low or average rainfall period and would typically comprise:

- Form swale drains at upslope locations to help intercept surface and near-surface seepage water and to redirect it into existing drainage gullies or dams, or to sediment retention ponds
- Stripping of topsoils, silts, vegetation, and moisture impacted soils;
- Removal of any uncontrolled fill, building rubble, organic matter and/or tree affected soils;
- Test rolling of exposed subgrades;
- The use of geotextiles, geogrids and/or rock drainage layers to remediate stripped surfaces may be required but would be heavily influenced by preceding weather conditions; and
- Placement of controlled fill in accordance AS3798 2007 Guidelines on Earthworks for Commercial and Residential Development.

Extensive areas of waterlogging have been noted within the site and the above site preparations and earthworks requirements may need to be more extensive and detailed. Future intrusive assessments are recommended to assist with the design of drainage and bulk earthworks. It should be noted that periods of prolonged wet weather may result in challenging earthworks conditions even to the point where the development of the subdivision may need to occur during drought/below average rainfall conditions. Any wet but suitable natural soils would require drying prior to placement in fill areas and deep stripping/excavations of unsuitable material may be required in areas across the site. Considerations will also need to be made for site trafficability and the site will need to be suitably prepared for all vehicle and machinery types.

7.4 Water Logging

Water logging may be a constraint to development in lower-lying portions of the development area, particularly around watercourses/drainage lines pending prior weather conditions. Further investigation should be undertaken including borehole or test pit excavation to determine soil moisture profiles

7.5 Erosion Potential

The site is located within Redbank, Becks Lane and Gregadoo variant a soil landscapes and the erosion hazard for these landscapes are estimated as high.

It is considered that the erosion hazard within these areas of the development would be within usually accepted limits and could be managed by good engineering and land management practices.

7.6 Soil Salinity and Aggressivity

No visual signs of salinity or salinity indication vegetation were observed during the site inspection. However, based on the results of the soil mapping, there is potential for the site is to be affected by salinity and soil aggressivity to both steel and concrete, more likely in the lower lying lower lying areas near watercourses/drainage lines. Notwithstanding this, the salinity potential of the site would most likely be within usually accepted limits which could be managed by good engineering and land management practices. Further assessment of salinity and preparation of salinity management plans (if required) is recommended prior to construction.

7.7 Site Classification

Classification of lots within the site should comply with the requirements of Australian Standard AS 2870 – 2011 "*Residential Slabs and Footings*". Based on publicly available information, it would be expected the natural subsurface profiles would range anywhere for Class H1/H2 (highly reactive) and Class M (moderately reactive) sites and remotely Class S (slightly reactive) in areas of shallow bedrock or deep sands.

Allotments, which are subject to fill, are likely to receive a Class M (moderately reactive) or Class H1/H2 (highly reactive) site classification depending on the depth and type of fill material. All fill, which is to be placed within allotments, will need to be confirmed as controlled fill (Level 1) to avoid a Class P site classification. It must also be noted that, based on the current presence of trees, uncontrolled fill and adverse moisture conditions (from water logging), parts of the site would be classified as Class P.

The site classifications can only be determined once the plasticity of the various soils assessed from laboratory testing. Individual lot site classification investigations and reports will need to be completed once the final earthworks for the subdivision has been completed.

7.8 Foundations

Subject to the classification of the various lots, it is anticipated that foundation options will range from conventional high level footing systems (strip and pad footings), slab-on-ground and raft slabs with deep edge beams to piered systems depending on the eventual structures and loading requirements.

Piering could comprise uncased bored piers where clay soils are likely to be encountered to either driven mini timber piles or screw piles if water charged/alluvial sands are encountered.

The choice of the various footing systems will depend on building design and the individual lot classification, and should be made after site-specific investigations.

Design of structures on the site must allow for the provision of a uniform bearing stratum to minimise differential settlement issues. Based on the various strata likely to be encountered, the following allowable base bearing pressures are considered appropriate for preliminary design:

- Stiff/medium dense natural soils 100 kPa
- Extremely low strength bedrock (if encountered) 400 kPa (minimum)

7.9 Slope Stability

Based on the observations made during the inspection, and available contour plans, the site is considered to be within an area of gently sloping land i.e. flatter than 1V:10H (vertical:horizontal). Therefore, the risk to property within the site would be considered to be "very low risk" with reference to the Australian Geomechanics Society Sub-Committee on Landslide Risk Management: "Landslide Risk Management Concepts and Guidelines" (AGS 2007). However, if steeper grades are encountered, care will be required to ensure that earthworks and excavation are undertaken in a safe manner.

No slope stability issues are foreseen with the construction of the subdivision provided best construction practices are implemented.

During future earthworks, vertical excavations within any fill, soil and weathered rock cannot be used to be stable for even short periods of time. For slopes up to 3 m high, maximum temporary batter slopes of 1H:1V (Horizontal : Vertical) are recommended. Permanent batter slopes should not be steeper than 2.5H:1V and should generally be flatter (4H:1V) where vegetation maintenance is required. Erosion protection should be provided for all permanent batters inclusive of surface drainage. Further advice should be sought if deeper excavations are proposed.

Surcharge loads should not be placed closer to the crest of the batter than a distance equal to the vertical height of the batter, unless specific geotechnical stability analysis shows that the loads can be placed closer.

Where retaining structures are proposed, it is suggested that earth pressures on retaining walls due to the retained soils be based on a triangular pressure distribution calculated as follows:

$$h_z = \gamma k_a z$$

where,	h_z	=	horizontal pressure at depth z
	γ	=	unit weight of retained soil
		=	20 kN/m ³ for soils
		=	22 kN/m ³ for weathered rock
	k_a	=	active earth pressure coefficient
		=	0.4 for uncontrolled fill
		=	0.3 for compacted fill, medium dense/very stiff soil
		=	0.3 for very low strength rock
		=	0.25 for low and greater strength rock

Drainage behind all retaining walls should be provided or, alternatively, full hydrostatic pressure allowed for in design. In the event that hydrostatic pressures are allowed, densities of the retained soils can be appropriately reduced to the buoyant values.

Where applicable, superimposed surcharge loads due to adjacent roadways, inclined surfaces etc should also be accommodated in the design of such structures

7.10 Excavation

All uncontrolled fill, natural soils and bedrock up to very low to low strength (if encountered) should be readily removed using a conventional earthmoving equipment, such as medium sized tracked excavators. If medium to high strength or greater rock or even cemented sands are encountered, ripping, rock hammering and/or blasting may be required.

Excavations in soil and weathered rock should include provision for temporary support using batters, benching or shoring. Vertical excavations within the soil and weathered rock will not be stable particularly if groundwater seepages are present. For excavations up to 3 m in depth (without groundwater seepages), maximum temporary batter slopes of 1H:1V (horizontal : vertical) are recommended. Permanent batter slopes should not be steeper than 3H:1V and should generally be flatter where vegetation maintenance is required. Erosion protection must be provided for all permanent batters given the results of the Emerson class testing (refer above). Further advice should be sought if deeper excavations are proposed or if groundwater seepages are likely to be present.

Surcharge loads should not be placed closer to the crest of the batter than a distance equal to the vertical height of the batter, unless specific geotechnical stability analysis shows that the loads can be placed closer.

It should be noted that any off-site disposal of spoil will generally require assessment for re-use or classification in accordance with NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste*.

7.11 Farm Dams

A number of farm dams have been identified on the site. Should future development be proposed within the areas of the dams, the dams will require dewatering and removal of all uncontrolled fill associated with the embankment and soft sediments from the dam base prior to commencement of fill operations. An assessment of any groundwater seepages and subsequent drainage measures would be required prior to backfilling.

7.12 Groundwater

Groundwater is almost certain to be present within the alluvial profiles and within the underlying rock profile in the current weather conditions. Seepage or perched groundwater would be expected along strata boundaries, porous/unconsolidated soil portions, through joints/partings within the rock and within the lower lying parts of the development area around watercourses/drainage lines. Where encountered,

water will need to be managed appropriately using a series of subsoil drains or rubble type drains. The extent of drainage measures can only be determined onsite during construction.

The two groundwater bores that are registered to be present on the site, which will need careful consideration in terms of the development layout. It is likely they will be required to be decommissioned and should be undertaken in accordance with current accepted practices. Typically, they are grout filled, which will create columns similar to the rock pinnacles mentioned above. It is recommended that DP be consulted further should development plans proceed.

8. Further Investigations

Further investigation will be required as the project planning and design progresses and any relevant geotechnical comments or recommendations arising from this work will be required to be incorporated into the design. Additional work will also be required during the project's construction phase. Specific investigation would likely include (but not necessarily be limited to):

- Detailed intrusive geotechnical investigation (test pits) to determine subsurface conditions across the site to provide soil and rock depths and strength (if encountered) to inform construction methodology as well as any geotechnical constraints;
- Samples collected from the geotechnical investigation should comprise CBR, dispersion, and plasticity testing;
- Salinity and aggressivity investigation for site soils; and
- Routine inspections and earthworks monitoring during construction.

9. Conclusion

The results of the assessment indicate that the proposed development should be technically feasible from a geotechnical perspective. It should be noted that the prior weather conditions to site development will dictate the costs and efficiency of the development. Periods of dry or below average of weather/rainfall and the summer months would be preferred times to undertake development/earthworks. Intrusive investigation will be required to characterise the development areas for detailed design, preparation of management plans and to inform construction methodology. The planning, design and construction should be carried out in accordance with good engineering practice.

10. References

Adamson C.L. and Loudon A.G. (1966) *Wagga Wagga 1:250 000 Geological Sheet SI/55-15*, 1st edition, Geological Survey of New South Wales, Sydney

AS 2870:2011, *Residential Slabs and Footings*, Standards Australia.

AS 3798:2007, *Guidelines on Earthworks for Commercial and Residential Developments*, Standards Australia.

11. Limitations

Douglas Partners (DP) has prepared this report for this project at 7066 Holbrook Road, Rowan in accordance with DP's proposal dated 3 March 2022 and acceptance received from Cameron Beames of DevCore Property Group dated 8 March 2022. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope of work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of fill of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such fill may contain contaminants and hazardous building materials.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners



Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

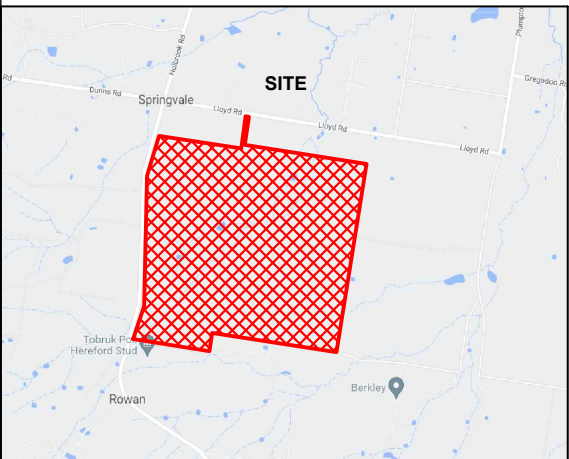
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Drawings 1 and 2



Locality Plan

LEGEND

Rowan Village (The site)
The site has a total area of 225.02 Ha.

Sunnyside Planning Proposal- Indicative

1 Primary Watercourse
The primary watercourse of the riparian corridor is categorised as Straller stream order 2 and 3.

2 Easements
The existing electricity transmission line is located on the southern side of the site.

3 Riparian Corridor
The Riparian Corridor includes a high order water course and allows for a buffer of 20-30m from the top of bank on each side. It runs through the centre of the site and is integrated wholly into the open space network.

4 Local Parks
Parks are planned to deliver quality open space within a 400m radius. In combination with passive open spaces along the riparian corridor, they create a connected network of open spaces across the site.

5 Village Centre
The local Village Centre will support approximately 2700m² of retail floorspace by 2045. This will include c.1500m² supermarket and 1200m² of retail specialities and additional non-retail convenience based facilities.
The Village Centre also supports a 2300m² childcare centre and a 500m² Medical Centre.

6 Open space integrated with the riparian corridor
This open space corridor is integrated with the riparian corridor and provides recreational amenity for the community. It also provides opportunities to accommodate active open spaces and playgrounds.

7 Drainage Basin
Five (5) drainage basins have been proposed to appropriately manage water flows. Three (3) of these are integrated with the riparian corridor, with two (2) others located at the north-east and east of the site.
These are designed with both inaccessible wet basins and dry basins with limited accessibility, including landscape buffer's and walking pathways.

Collector Road
The East-West collector road is proposed at the central location of the site. It provides connection from Holbrook Road through the site and is intended to connect through to Plumpton Rd through the Sunnyside Project to the East. The major project connection creates a network with off-road active transport and public transport options included.

Collector Road - Potential extension towards Sunnyside site

Primary Local Street
Primary roads will provide the main access routes connecting from Lloyd Road and internally to the collector road. This will further support the active transport network.

Potential primary Local Street in Sunnyside Site

Proposed road to wider street network
An opportunity to extend the primary roads in future to the north and east to connect to Lloyd Road and the surrounding context.

Park Road
Park Road is located at the interface with the riparian corridor. It is a green road with tree canopies and active transport routes and provides recreational purpose in addition to accessibility.

Rural Transition Residential Area
These residential lots will be located along the southern boundary of the site and will be the largest residential lot typology. This lot typology will importantly provide an appropriate transition between the site and the adjacent rural context to the south of Rowan Road.

Neighbourhood Residential Area
A range of suitable low density residential lots will be accommodated within close proximity to open space provision and the riparian corridor network. This lot typology will provide the appropriate transition between the village residential lots and the rural transition lots. A diversity of lot sizes will be delivered through the neighbourhood residential lot typology.

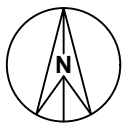
Village Residential Area
These residential lots will leverage off the close proximity to the local centre and its associated amenities and offerings. Fundamentally, these residential lots will still uphold the low density residential housing charter that the site will deliver, whilst ensuring that an appropriate diversity of housing choice is delivered.

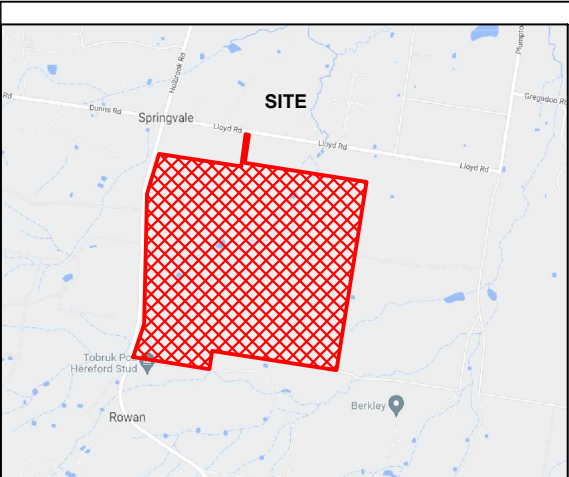
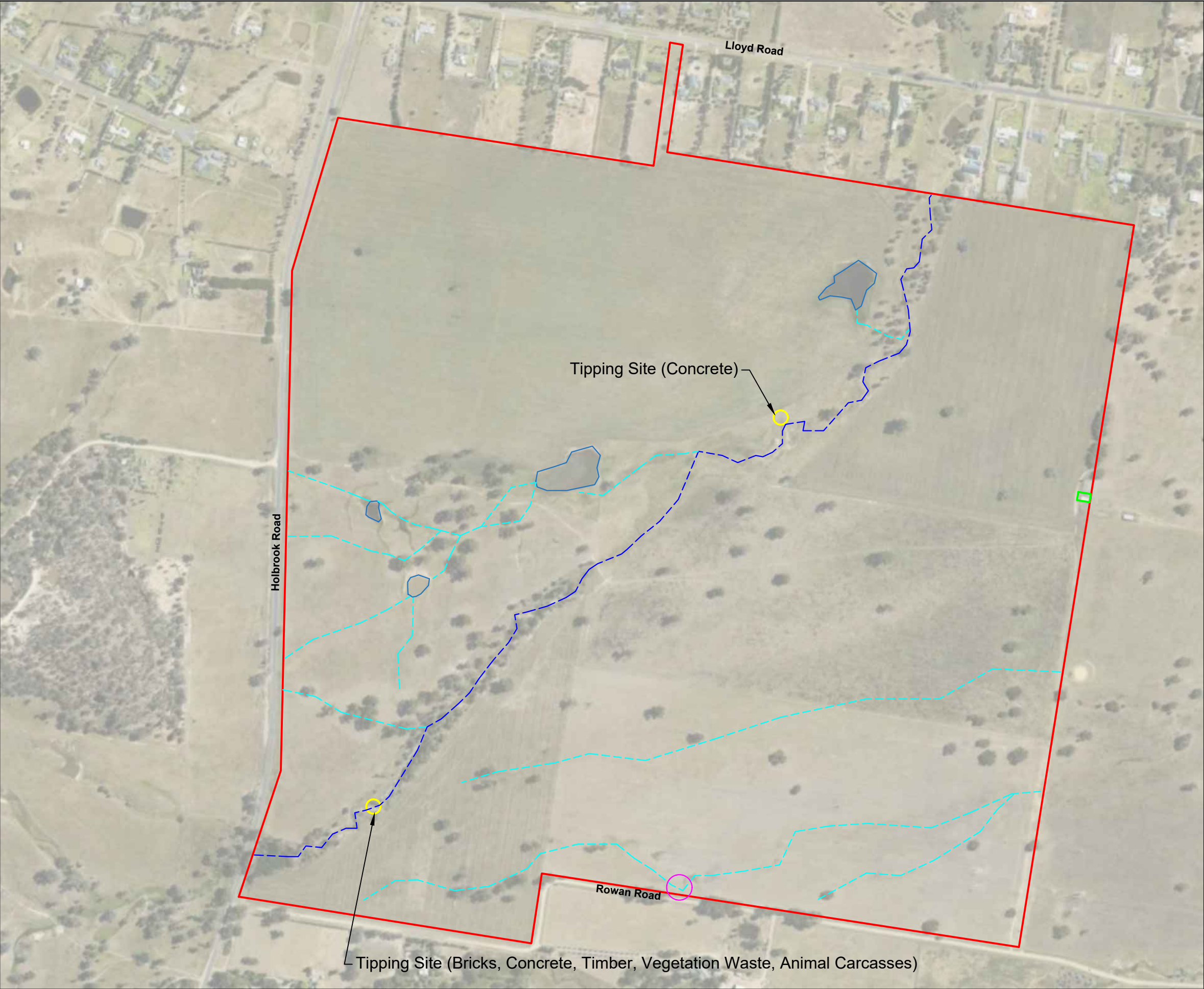
Seniors Living
The senior living component is located adjacent to the collector road, the village centre and the local open space to take advantage of the high amenity and accessibility.

LEGEND

- Approximate Site Boundary
- Approximate Sunnyside Planning Proposal Boundary

NOTE: Base drawing provided by Urbis

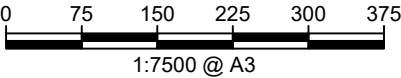




Locality Plan

LEGEND

- Site Boundary
- Approximate Tipping Site Location
- Approximate Shed Location
- Approximate Drainage Line Location
- Approximate Stringybank Creek Tributary
- Farm Dam Location
- Boggy Conditions



NOTE: Base drawing from Metromap, dated February 2022

Appendix C

Site Searches



Landscape— very gently inclined long piedmont slopes. Local relief mostly <10 m; slope gradients <3%. Long undulating slopes and narrow drainage lines. Almost completely cleared tall woodland.

Soils— moderately deep (80 – 120 cm) Eutrophic Brown Chromosols on slopes, moderately deep (80 - 120 cm) Mottled Subnatric Brown Sodosols in drainage lines.

Limitations— high erosion hazard, foundation hazard (localised), waterlogging (localised), strong acidity, low fertility soil.

LOCATION

Eroded piedmont adjacent to granite hills mostly in the Kyeamba Valley Plain. Distributed mainly in the Lake Albert catchment. Type location is about 2 km south of Lake Albert (Map reference: 5 3437*E, 61 0552*N).

LANDSCAPE

Geology and Regolith

Thick (>3 m) Cainozoic alluvial and slope-washed sediments derived mostly from Mount Flakney Adamellite and less from Ordovician metasedimentary rocks (probably with minor windblown clay addition).

Topography

Very gently inclined, long (>2 km) piedmont adjacent to granite hills. Slope gradients are mainly <3%. Local relief is mostly <10 m within an elevation range of 210 - 270 m. Narrow (<100 m) drainage depressions incised <10 m from the piedmont surface.

Vegetation

Almost completely cleared except for trees along some roads and drainage lines. Most common tree species include white box, grey box, yellow box and red stringybark. Understorey species include kangaroo grass, tussock grass, plains grass, Patersons curse, spear grass and wallaby grass.

Climate and Hydrology

Annual rainfall is about 550 mm. Soil is moderately moist to moist during winter and spring but dry in summer and early autumn. Moderate run-on occurs in the zones near drainage depressions when land cover is least during late summer to autumn. Otherwise, the run-on is generally low.

Land Use/Existing Land Degradation

Cropping for wheat with barley and cereal rye, and improved pasture of dryland lucerne. Minor natural pasture for sheep and cattle grazing on steeper parts near the hills and along drainage lines. Hobby farms, rural residential and urban development in the areas close to Lake Albert.

Moderate to severe gully erosion (up to 4 m deep, not to bedrock) along a few drainage lines. Minor to moderate sheet erosion on steeper zones near the drainage lines.

QUALITIES AND LIMITATIONS

Landscape Limitations

High to moderate water erosion hazard (localised, near drainage lines)

Foundation hazard (localised)

Erodibility

	Non-concentrated flows	Concentrated flows	Wind
rb1	moderate	moderate	low
rb2	moderate	high	low
rb3	moderate	moderate	low
rb4	moderate	moderate	low

Erosion Hazard

	Non-concentrated flows	Concentrated flows	Wind
grazing	slight	moderate	slight
cultivation	moderate	high	slight
urban	slight	moderate	slight

Foundation Hazard and Urban Capability

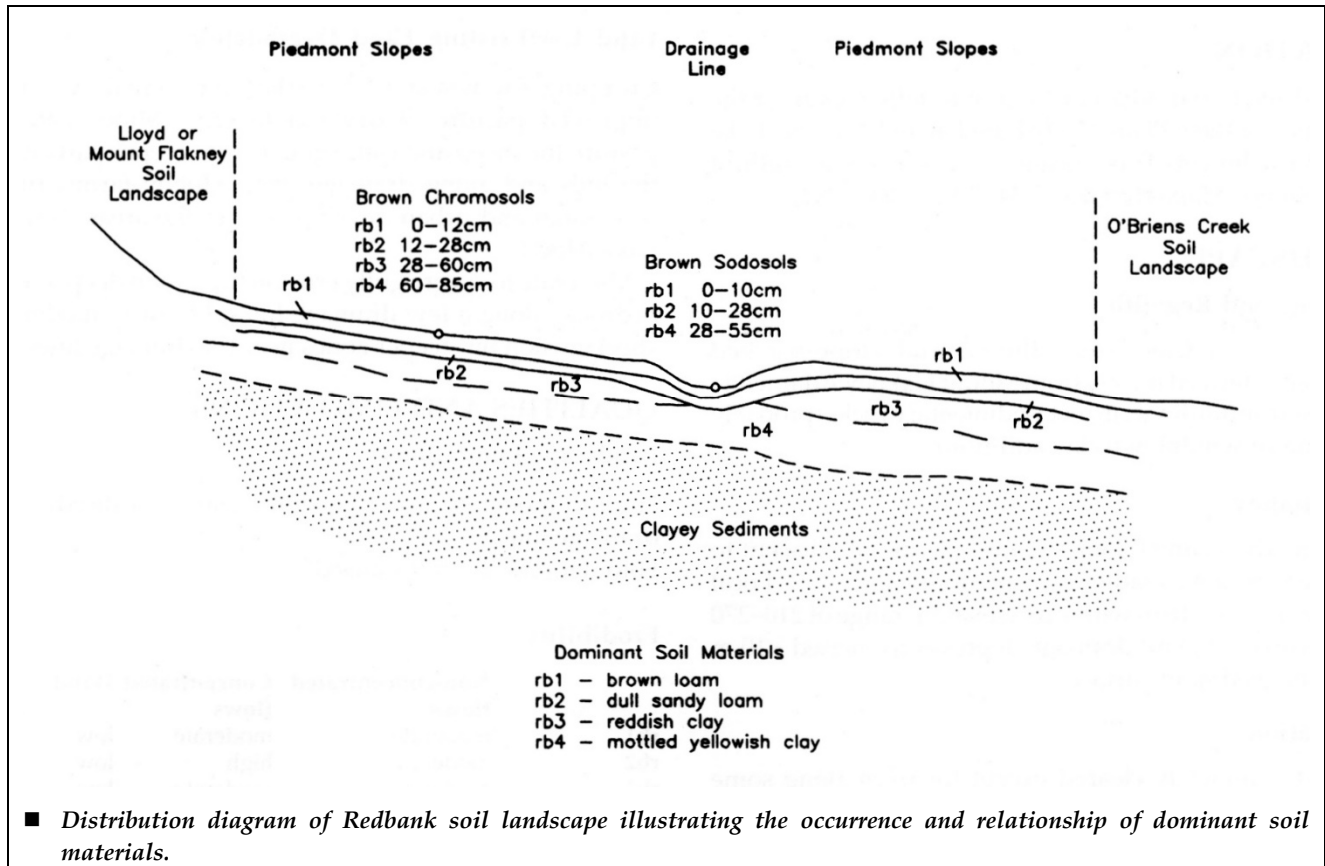
Low to moderate. Locally occurring (near drainage lines) high run-on, waterlogging and high erosion hazard result in low stability for building foundations.

Generally slight and locally (near drainage depressions) moderate limitations for urban development.

Rural Capability and Land Management Recommendations

Slight limitations for grazing and moderate limitations for cultivation.

Seasonally waterlogged areas may need to be fenced off. Eroded drainage lines should be fenced off and revegetated.



SOILS

Dominant Soil Materials and Their Qualities

rb1— Brown loam (topsoil— A₁ horizon). Brown to dark brown, loam to clay loam, massive to weakly pedal; field pH 5.0 – 5.5

Very strong acidity, low wet bearing strength, low fertility (localised), hardsetting (locally), high organic matter (localised).

rb2— Dull sandy loam (topsoil— A₂ horizon). Dull brown to dull orange, silty loam to fine sandy loam, massive; field pH 5.5 – 6.0.

Sodicity, hardsetting, low fertility, low wet bearing strength.

rb3— Reddish clay (subsoil— B₁ horizon). Bright reddish brown, light to light medium clay, moderately pedal; field pH 6.0 – 9.5.

Low fertility, low wet bearing strength, sodicity.

rb4— Mottled yellowish clay (subsoil— B, or BC horizon). Dull yellowish brown to bright brown, mottled, light medium to medium heavy clay, moderately to strongly pedal; field pH 6.5 – 8.0.

Low fertility, low wet bearing strength, shrink-swell, sodicity (localised), low permeability.

Type Profile 1: Piedmont slopes

Dominance: about 67% of soil landscape.

Moderately well-drained, Haplic Eutrophic Brown Chromosols (Yellow Podzolic Soils). No surface gravels.

Depth: 85 cm, rooting depth about 70 cm.

Location: roadside 150 m south of Red Bank, 2 km south of Lake Albert (Map reference: 5 34175°E, 61 05425°N), Soil Data System card 128. Voluntary/ native pasture.

Soil Material	Description
Layer 1, A ₁ 0 – 12 cm rb1. Brown Loam. Field pH 5.0	brown (7.5YR 4/3), loam, massive, earthy, weak (moist), coherent, moderately permeable, no coarse fragments, many roots, clear smooth boundary to—
Layer 2, A ₂ , 12 – 28 cm rb2. Dull Sandy Loam. Field pH 6.0	dull brown (7.5YR 5/4), not bleached, silty loam, massive, earthy, weak (moist), hardsetting when dry, moderately permeable, no coarse fragments, common roots, gradual boundary to—
Layer 3, B ₂ , 28 – 60 cm rb3. Reddish Clay. Field pH 9.5	bright brown (7.5YR 5/6), light medium clay, moderate pedality, <2 mm crumb peds, rough-faced peds, firm (moist), coherent, moderately permeable, no coarse fragments, few roots, gradual boundary to—
Layer 4, B ₃ , 60 – 85 cm rb4. Mottled Yellowish Clay. Field pH 7.0	bright brown (7.5YR 5/8), 2 – 10% red mottles, light medium clay, pedality, 2 – 5 mm polyhedral peds, rough-faced peds, firm (moist), coherent, slowly permeable, no coarse fragments, few roots, underlain by clayey sediments.

Type Profile 2: Drainage lines

Dominance: <20% of soil landscape.

Imperfectly drained, Eutrophic Mottled Subnatric Brown Sodosols (Soloths). No surface gravels.

Depth: 55 cm, rooting depth about 50 cm.

Location: 20 m in from fence, near road 1.5 km west of the substation 3 km south-east of Lake Albert (Map reference: 5 34400°E, 61 04450°N), Soil Data System card 325. Voluntary/ native pasture.

Soil Material	Description
Layer 1, A, 0 – 10 cm rb1. Brown Loam. Field pH 5.5	brown (7.5YR. 4/3), clay loam, weak pedality, 20 – 50 mm sub-angular blocky peds, earthy, weak (moist), coherent,

moderately permeable, no coarse fragments, common roots, clear smooth boundary to—

Layer 2, A₂, 10 – 28 cm **rb2**. Dull brown (7.5YR 4/4), fine sandy clay loam, massive, earthy, weak Sandy Loam. Field pH 5.5 (moist), hardsetting when dry, moderately permeable, no coarse fragments, few roots, clear smooth boundary to—

Layer 3, B, 28 – 55 cm **rb4**. dull yellowish brown (10YR 5/3), 10 – 20% grey mottles, Mottled Yellowish Clay. Field medium heavy clay, moderate pedality, 10 – 20 mm pH 8.0 sub-angular blocky breaking to 2 – 5 mm polyhedral peds, smooth-faced peds, firm (moist), coherent, slowly permeable, no coarse fragments, few roots, underlain by clayey sediments.



Landscape— gently inclined midslopes of adamellite and granite hills. Local relief 10 – 30 m; slope gradients 10 – 30%. Long slopes and mostly parallel shallow drainage lines. Rare rock outcrops. Almost completely cleared tall open-forest and woodland.

Landscape Variant— **gra**— similar to **gr** but with gentler slopes (<3%).

Soils— moderately deep (80 – 120 cm) Mottled Hypernatric Brown Sodosols and Mottled Subnatric Red Sodosols.

Limitations— high erosion hazard, mass movement (localised), foundation hazard (localised); strong acidity, sodicity (localised), low fertility soil with hardpans (localised).

LOCATION

Lower slopes and lower to midslopes surrounding adamellite and granite hills, mostly in the marginal zones between the Malebo-Mt Burngoogie Ranges and the Kveamba Valley Plains. Distributed widely from Lake Albert catchment to Graveyard Hill and Mt Burngoogie region towards the south-eastern corner of the mapping area. There are also small areas around the granite hills south-east of Yerong Creek township and north of The Rock township. Type location is a granite hillslope near the Gregadoo Road (Map reference: 5 3853°E, 61 0027°N).

LANDSCAPE

Geology and Regolith

Marginal zones of various Silurian granite rocks including Mount Flakney Adamellite, Burrandana Granite, Kyeamba Adamellite and Buchargindah Muscovite Granite. Moderately thick (commonly >2 m) slope-washed adamellite sands and clays on lower slopes and in drainage depressions.

Topography

Gently inclined long (>300 m) lower midslopes and lower waning slopes of adamellite and granite hills. Slope gradients are mostly 3 – 10% and may be 2 – 15%. Local relief is commonly 10 – 30 m, within an elevation range of 230 – 450 m, rising towards the south-east of the mapping area. Mostly parallel drainage lines which are narrow (<100 m) and shallow. Bedrock outcrops are rare (<2%) and the slopes are relatively smooth.

Vegetation

Mainly cleared with isolated small areas (<10%) of partially cleared tall woodland with understorey grasses in Crown reserves. Most common tree species include white box, grey box, yellow box, red stringybark, Blakelys red gum and white cypress pine. Understorey species include kangaroo grass, tussock grass, plains grass, spear grass and wallaby grass. In intensively grazed areas, pitted blue grass and paterson's curse are particularly common.

In waterlogged areas, clustered dock and curled dock are common.

Climate and Hydrology

Annual rainfall increases steadily from 550 mm in the central part to 700 mm towards the south-eastern corner of the mapping area. Soil is moderately moist to moist during winter and spring and during summer and early autumn soil is mostly dry. On some lower slopes, especially near drainage lines, waterlogging and springs occur after rains, and run-on is moderate to high. On most mid to lower slopes, run-on is generally low to moderate because of high permeability of top soils.

Land Use/Existing Land Degradation

Mainly natural pasture for sheep and cattle grazing, and improved pasture of dryland lucerne. Minor fodder cropping of oats, barley and cereal rye on flatter lower slopes.

Severe gully erosion (up to 4 m deep, down to bedrock or hardpans) occurs near some (<30%) major drainage lines, especially in convergent drainage areas. Severe to moderate sheet erosion occurs commonly, with >10 cm (but highly variable from one site to another) of topsoil lost. Waterlogging and flowing springs can occur near drainage lines after rains.

Included Soil Landscapes

Small areas of Mount Flakney landscape variant **mfa** have been included near the boundary with Mount Flakney (**mf**) soil landscape.

Small areas of O'Briens Creek (**ob**) soil landscape have been included near the boundary to the O'Briens Creek (**ob**) soil landscape on lower slopes and in valley flats.

Landscape Variants

The areas mapped as **gra** have relatively thicker (>1 m) earthy sand soils and gentler (<3%) slopes. Otherwise, this variant has similar landscape features to Gregadoo (**gr**) soil landscape.

QUALITIES AND LIMITATIONS

Landscape Limitations

High erosion hazard

High foundation hazard

Erodibility

	Non-concentrated flows	Concentrated flows	Wind
gr1	moderate	moderate	low
gr2	moderate	high	low
gr3	moderate	high	low

Erosion Hazard

	Non-concentrated flows	Concentrated flows	Wind
grazing	moderate	moderate	slight
cultivation	high	very high	slight
urban	slight	moderate	slight

Foundation Hazard and Urban Capability

Moderate to high. High subsurface flow, high erosion hazard and localised spring activity result in low stability for roads and building foundations.

Moderate limitations for urban development.

Rural Capability and Land Management Recommendations

Moderate to low limitations for grazing and high limitations for cultivation.

The subsoil (A₂ - B horizons) should not be exposed due to the high levels of sodium present. The areas of sheet erosion should be treated with diversion banks, tree planting and pasture sowing. The springs should be fenced off, as should eroded drainage lines, which should also be revegetated.

SOILS

Dominant Soil Materials and Their Qualities

gr1— Dark sandy loam (topsoil— A, horizon). Dark brown to brown, loamy sand to coarse sandy clay loam, massive; field pH 5.0 – 6.5.

Low wet bearing strength, low fertility, sodicity, strong acidity, hardsetting (locally).

gr2— Bleached loamy sand (A₂ horizon). Dull greyish yellow brown to brown, loamy coarse sand to coarse sandy loam, massive; field pH 5.5 – 6.0.

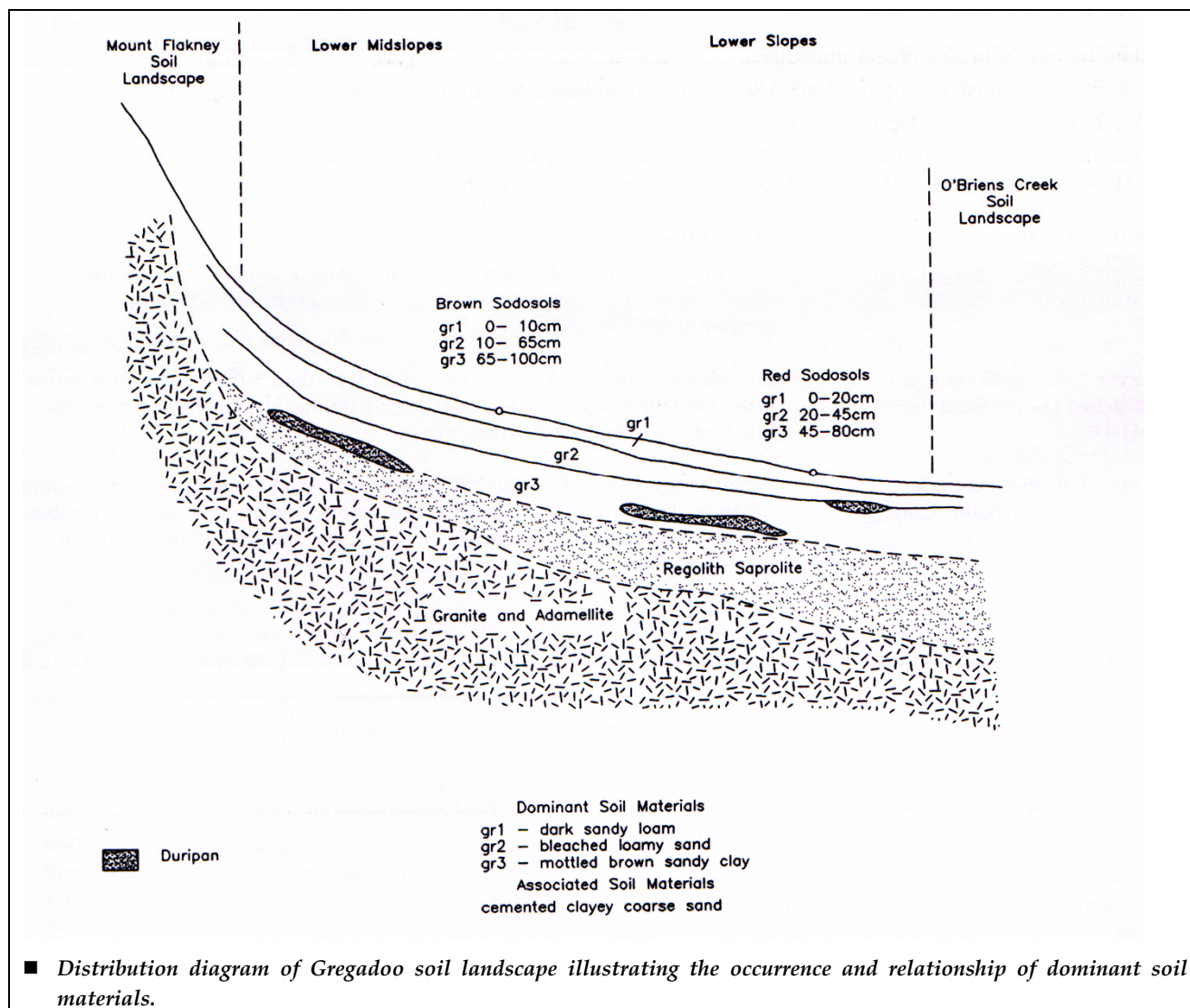
Low wet bearing strength, sodicity, low fertility, high erodibility.

gr3— Mottled brown sandy clay (subsoil— B horizon). Dull yellowish brown to reddish brown, coarse sandy light clay to coarse sandy medium clay, moderately pedal; field pH 5.5 – 6.5.

Low fertility, low wet bearing strength (localised), sodicity, strong acidity, hardpan (localised).

Associated Soil Materials

Cemented clayey coarse sand. This occurs very locally near some drainage lines and on lower slopes as a buried discontinuous duripan up to 50 cm thick and can occur with multiple layers which harden on exposure.



Type Profile 1: Lower midslopes

Dominance: >50% of soil landscape.

Imperfectly drained, Eutrophic Mottled Hypernatric Brown Sodosols (Soloths). No surface gravels.

Depth: 100 cm, rooting depth about 80 cm.

Location: roadside of highway to Mangoplah, 5 km south of Wagga Wagga (Map reference: 5 30075°E, 61 04325°N), Soil Data System card 182. Voluntary/native pasture.

Soil Material	Description
Layer 1, A ₁ , 0 – 10 cm gr1 . Dark Sandy Loam. Field pH 5.5	dark brown (10YR 3/3), coarse sandy loam, massive, earthy, firm (dry), coherent, highly permeable, <2% fine quartz gravels (2 – 6 mm), many roots, clear smooth boundary to—
Layer 2, A ₂ , 10 – 65 cm gr2 . Bleached Loamy Sand. Field pH 5.5	greyish yellow brown (10YR 6/2), bleached (dry colour 10YR 8/2), clayey coarse sand, massive, firm (dry), hardsetting, coherent, highly permeable, many (20 – 50%) fine quartz gravels (2 – 6 mm), few roots, clear smooth boundary to—
Layer 3, B, 65 – 100 cm, gr3 . Mottled Brown Sandy Clay. Field pH 6.0	dull yellowish brown (10YR 5/4), 10 – 20% distinct orange mottles, coarse sandy light medium clay, moderate pedality, 20 – 50 mm sub-angular blocky peds, smooth-faced, very firm (dry), coherent, slowly permeable, few (2 – 10%) fine quartz gravels (2 – 6 mm), few roots, underlain by slope-washed clays and sands.

Type Profile 2: Lower slopes

Dominance: about 33% of soil landscape.

Imperfectly drained, Eutrophic Mottled Subnatic Red Sodosols. No surface gravels.

Depth: 160 cm, rooting depth about 100 cm.

Location: roadside near Valley Field, 5 km south of Wagga Wagga (Map reference: 5 31930*E, 61 03850*N), Soil Data System card 3. Voluntary/native pasture.

Soil Material	Description
Layer 1, A, 0 – 20 cm gr1 . Dark Sandy Loam. Field pH 5.5	dark brown (7.5YR 3/4), loamy fine sand, massive, earthy, weak (moist), slightly coherent, highly permeable, no coarse fragments, common roots, gradual smooth boundary to—
Layer 2, A ₂ , 20 – 45 cm gr2 . Bleached Loamy Sand. Field pH 6.0	dull yellow orange (10YR 6/4), bleached (dry colour (10YR 8/3), loamy coarse sand, massive, sandy, loose (moist), highly permeable, no coarse fragments, few roots, clear smooth boundary to—
Layer 3, B, 45 – 80 cm gr3 . Mottled Brown Sandy Clay. Field pH 5.5	reddish brown (5YR 4/8), 20 - 50% prominent red and faint grey mottles, sandy medium clay, weakly pedal, earthy, firm (moist), coherent, slowly permeable, few (2 - 10%) fine quartz gravels (2 - 6 mm), few roots, underlain by alluvial sands and clays.



Landscape— gently inclined footslopes adjacent to hills of Ordovician metasedimentary rocks. Local relief 5 - 15 m; slope gradients 2 - 4%. Long (>300 m) waning slopes and mostly parallel, shallow drainage lines. Almost completely cleared tall woodland.

Landscape Variant— bka— similar to **bk** but in areas with convergent drainages, with higher run-on and higher erosion hazard.

Soils— moderately deep (80 - 100 cm) Haplic and Bleached Red and Brown Chromosols on slopes, and moderately deep (80 - 150 cm) Bleached Mottled and Bleached Brown Dermosols near drainage lines.

Limitations— high erosion hazard, foundation hazard (localised), acidity and locally hardsetting soil.

LOCATION

Long footslopes adjacent to hills and rises of mainly metasedimentary rocks. Distributed widely in marginal zones of Malebo-Mt Burngoogee Ranges, Clenroy Rises and Low Hills, Bomen Rises and Low Hills and O'Briens Creek Valley Alluvial Plains. Type location is along Becks Lane, north of Wagga Wagga city (Map reference: 5 2670°E, 61 2230°N).

LANDSCAPE

Geology and Regolith

Thick (>2 m) slope-washed and alluvial-colluvial sands, clays and gravels, mostly derived from Ordovician metasedimentary rocks.

Topography

Very gently to gently inclined (2 – 4%), long (>300 m) footslopes and piedmonts adjacent to hills and rises. Local relief is mostly 5 – 15 m within an elevation range of 200 – 300 m. Unidirectional (mostly parallel) drainage lines are shallow and narrow (<60 m).

Vegetation

Almost completely cleared except for scattered trees along some roads and drainage lines. Most common tree species include white box, grey box and yellow box. Understorey species include kangaroo grass, tussock grass, plains grass, spear grass, wallaby grass. In intensively grazed areas, pitted blue grass and paterson's curse are particularly common. In waterlogged areas, clustered dock and curled dock are common.

Climate and Hydrology

Annual rainfall ranges from 550 mm near Wagga Wagga up to 650 mm in the Kyeamba Valley. The soil is moderately moist to moist during winter and spring but dry in summer and early autumn. Moderate run-on occurs, especially near drainage lines when land cover is least during harvest and cultivation (late summer and autumn). Otherwise, relatively low run-on occurs for most slopes. Waterlogging may occur locally near and along some drainage lines during winter and spring.

Land Use/Existing Land Degradation

Cropping for wheat, with minor barley and cereal rye, and improved pasture of dryland lucerne. Moderate gully erosion (up to 2 m deep) occurs along some (<40% of total) major drainage lines. Severe gully erosion (>2 m) is common in the landscape variant **bka**. Minor to moderate sheet erosion commonly occurs in intensively cultivated areas.

Included Soil Landscapes

Small areas of Pulletop (**pu**) soil landscape have been included near the upper boundary to Livingstone (**li**) and Lloyd (**ld**) soil landscapes.

Landscape Variants

The areas mapped as **bka** are partly surrounded by hilly areas with convergent drainage lines. Thick (usually >3 m) alluvial, slope-washed sediments underlie most soils. Run-on is higher and more severe gully erosion occurs. Otherwise, this variant has similar landscape features to Becks Lane (**bk**) soil landscape.

QUALITIES AND LIMITATIONS

Landscape Limitations

Moderate to high water erosion hazard.
Foundation hazard (localised).

Erodibility

	Non-concentrated flows	Concentrated flows	Wind
bk1	moderate	moderate	low
bk2	moderate	high	low
bk3	moderate	moderate	low
bk4	moderate	high	low

Erosion Hazard

	Non-concentrated flows	Concentrated flows	Wind
grazing	slight	moderate	slight
cultivation	moderate	high	slight
urban	slight	moderate	slight

Foundation Hazard and Urban Capability

Mostly low but may be locally moderate to high near drainage lines.

Generally slight but locally moderate to high limitations for urban development near drainage lines.

Rural Capability and Land Management Recommendations

Generally slight to moderate but locally (in landscape variant **bka**) high limitations for cultivation and grazing.

As some areas are sodic, minimal disturbance of the subsoil (A₂ - B horizons) should occur. Eroded drainage lines and gullies should be fenced off and revegetated.

SOILS

Dominant Soil Materials and Their Qualities

bk1 – Dark clay loam (topsoil – A₁ or A horizon). Dark brown to reddish brown, clay loam to loam, massive; field pH 5.5 – 6.5.

Hardsetting (localised), low wet bearing strength, low fertility, highly erodible.

bk2 – Bleached sandy clay loam (topsoil – A₂ horizon). Dull brown to reddish brown, fine sandy loam to fine sandy clay loam, massive; field pH 5.5 – 7.0.

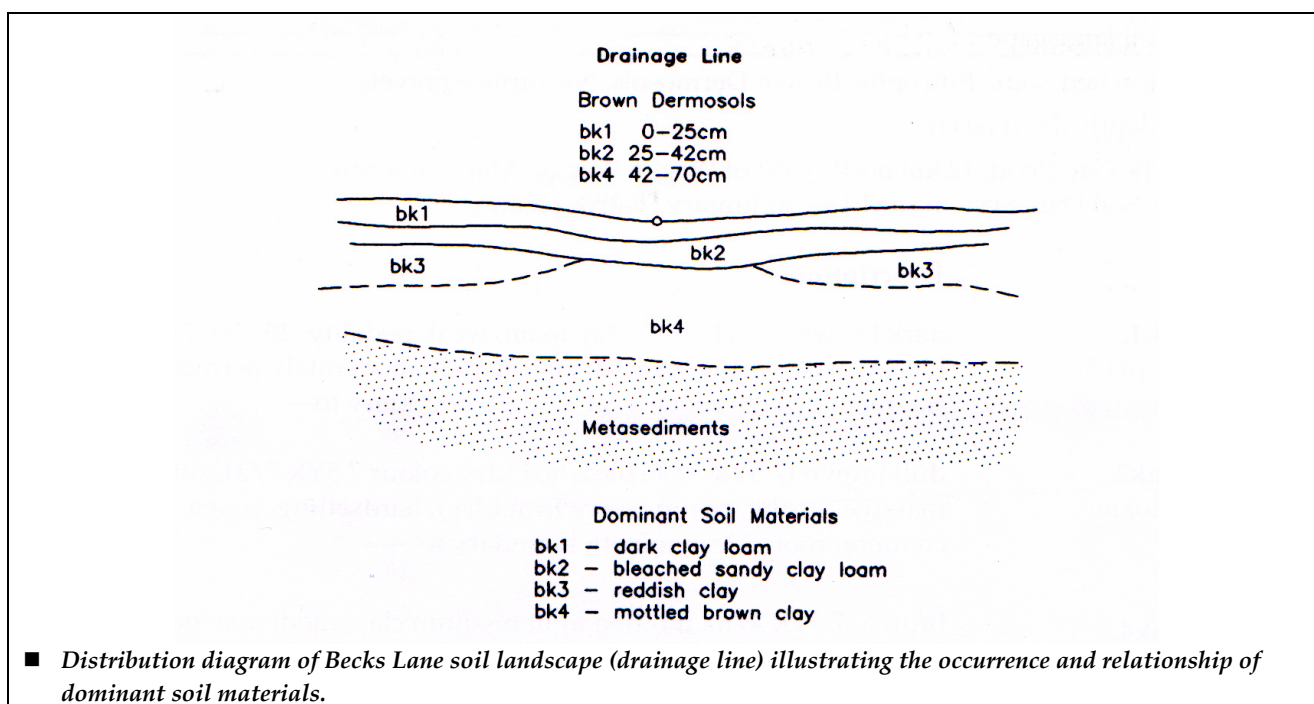
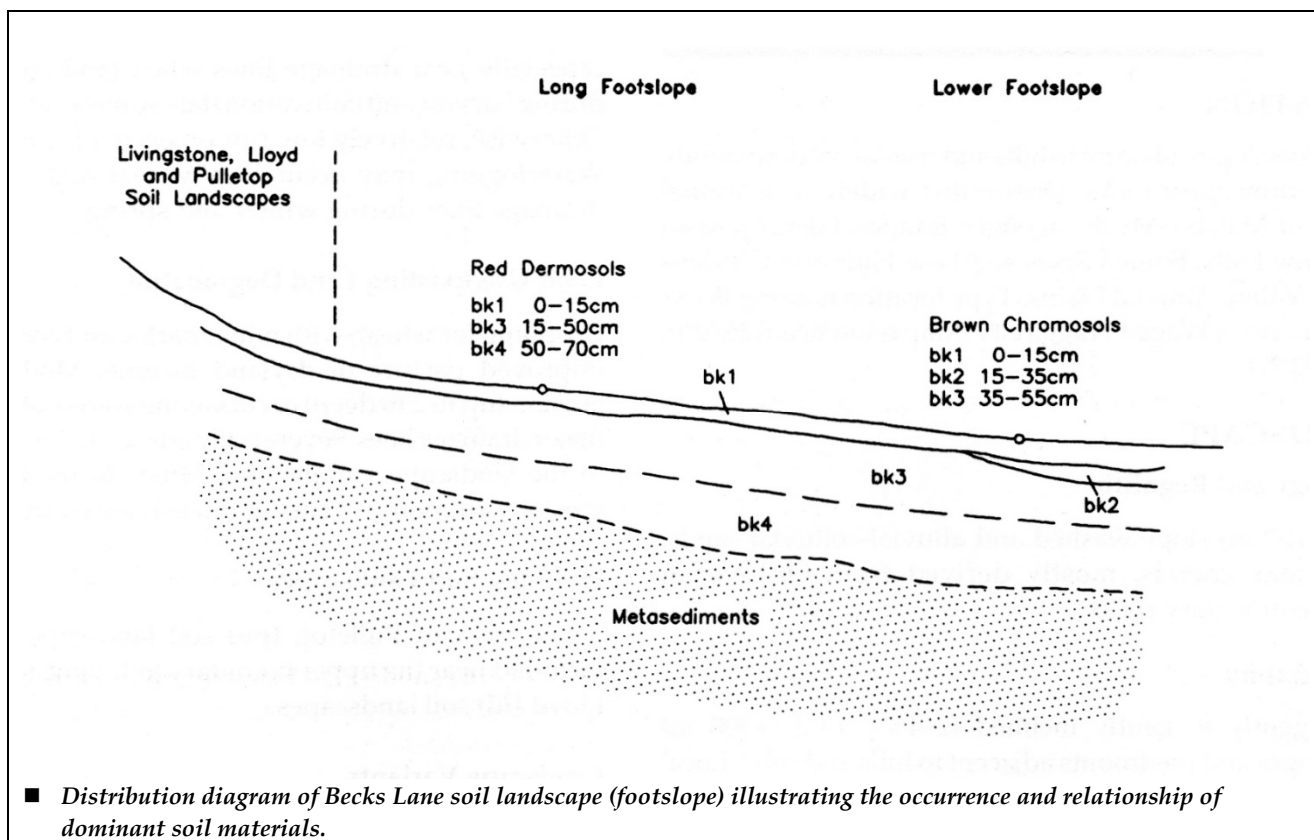
Strong acidity, low fertility, low wet bearing strength, highly erodible, sodicity (localised).

bk3 – Reddish clay (subsoil – B horizon). Reddish brown to dark reddish brown, light clay to light medium clay, moderately pedal; field pH 6.0 – 7.0.

Low fertility, low wet bearing strength, sodicity (localised).

bk4 – Mottled brown clay (subsoil – B horizon). Mottled brown to bright brown, light medium to medium clay, moderately to strongly pedal; field pH 5.5 – 7.0.

Low fertility, low permeability, sodicity, low wet bearing strength.



Type Profile 1: Slopes

Dominance: >33% of soil landscape.

Moderately well-drained, Haplic Mesotrophic Red Dermosols (Non-calci Brown Soils). No surface gravels.

Depth: 70 cm, rooting depth about 60 cm.

Location: roadside of Cambourne Lane, near T junction, 8 km north-west of Wagga Wagga (Map reference: 5 26850*E, 61 22875*N), Soil Data System card 15. Voluntary/ native pasture.

Soil Material	Description
Layer 1, A ₁ , 0 – 15 cm bk1 . Dark Clay Loam. Field pH 5.5	dull reddish brown (5YR 4/4), sandy clay loam, massive, earthy, porous, firm (moist), coherent, moderately permeable, no coarse fragments, many roots, gradual smooth boundary to—
Layer 2, B ₂ 15 – 50 cm bk3 . Reddish Clay. Field pH 7.0	reddish brown (5YR 4/6), light clay, weakly pedal, earthy, firm (moist), coherent, moderately permeable, no coarse fragments, common roots, gradual smooth boundary to—
Layer 3, BC, 50 – 70 cm bk4 . Mottled Brown Clay. Field pH 7.0	bright brown (7.5YR 5/6), medium clay, moderate pedality, 2 – 5 mm polyhedral peds, rough-faced, firm (moist), slowly permeable, no coarse fragments, few roots, underlain by clayey sediments.

Type Profile 2: Slopes

Dominance: 33% of soil landscape.

Moderately well-drained, Haplic Eutrophic Brown Chromosols. No surface gravels.

Depth: 55 cm, rooting depth <55 cm.

Location: roadside of Einlaysons Lane, 1.5 km south of Yerong Creek township (Map reference: 5 05000*E, 60 82700*N), Soil Data System card 301. Voluntary/native pasture.

Soil Material	Description
Layer 1, A ₁ , 0 – 15 cm bk1 . Dark Clay Loam. Field pH 5.5	dull reddish brown (5YR 4/4), clay loam massive, earthy, firm (dry), coherent, moderately permeable, no coarse fragments, many roots, diffuse smooth boundary to—
Layer 2, A ₂ 15 – 35 cm bk2 . Bleached Sandy Clay Loam. Field pH 5.5	dull reddish brown (5YR 5/4), fine sandy clay loam, massive, earthy, firm (dry), hardsetting, coherent, moderately permeable, no coarse fragments, common roots, clear smooth boundary to—
Layer 3, B, 35 – 55 cm bk3 . Reddish Clay. Field pH 6.0	bright brown (7.5YR 5/6), light medium clay, moderate pedality, 10 – 20 mm polyhedral peds, smooth-faced peds, strong (dry), coherent, moderately permeable, coarse fragments, few roots, underlain by clayey sediments.

Type Profile 3: Drainage lines

Dominance: <20% of soil landscape.

Imperfectly drained, Bleached Sodic Eutrophic Brown Dermosols. No surface gravels.

Depth: 70 cm, rooting depth about 60 cm.

Location: roadside of The Cap Road, 12 km north-west of Wagga Wagga (Map reference: 5 26125°E, 61 25750°N), Soil Data System card 153. Voluntary/native pasture.

Soil Material	Description
Layer 1, A ₁ , 0 – 25 cm bk1 . Dark Clay Loam. Field pH 5.5	dark brown (7.5YR 3/3), clay loam, weak pedality, 20 – 50 mm sub-angular blocky peds, earthy, firm (dry), coherent, moderately permeable, no coarse fragments, many roots, clear smooth boundary to—
Layer 2, A ₂ , 25 – 42 cm bk2 . Bleached Sandy Clay Loam. Field pH 5.5	dull brown (7.5YR 5/3), bleached (dry colour 7.5YR 7/3), silty clay loam, massive, earthy, porous, very firm (dry), hardsetting, coarse fragments absent, common roots, clear smooth boundary to—
Layer 3, B, 42 – 70 cm bk4 . Mottled Brown Clay. Field pH 5.5	brown (7.5YR 4/6), mottled light medium clay, moderate pedality, 5 – 10 mm polyhedral peds, rough-faced, very firm (dry), coherent, slowly permeable, no coarse fragments, few roots, underlain by clayey sediments.

GW403836

Site Details

Construction

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	15.00	88			Rotary Air
1		Annulus	Waterworn/Rounded	10.50	15.00				Graded, PL:Poured/Shovelled
1	1	Casing	Pvc Class 18	0.00	12.00	60	50		Seated on Bottom, Screwed
1	1	Opening	Slots - Horizontal	12.00	15.00	60		0	Casing - Machine Slotted, PVC Class 18, Screwed, SL: 30.0mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
12.00	15.00	3.00	Unknown	8.60					

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.40	0.40	BROWN SANDY CLAY TOPSOIL	Topsoil	
0.40	2.10	1.70	RED MEDIUM CLAY	Invalid Code	
2.10	5.30	3.20	YELLOW RED SILTY CLAY	Invalid Code	
5.30	9.50	4.20	GREY SILTY CLAY	Invalid Code	
9.50	12.00	2.50	RED SANDY CLAY	Invalid Code	
12.00	15.20	3.20	DECOMPOSED GRANITE - COARSE FRAGMENTS - 60% MOISURE AT 14.5 M	Invalid Code	

Remarks

24/05/2007: Form A Remarks:

ENTERED BY PATRICIA EWERS 8TH NOVEMBER 2007.

MONITORING BORE FOR WAGGA CITY COUNCIL SALINITY BOREFIELD

INFORMATION NOT INCLUDED ON FORM:

NO INFORMATION ON YIELD AND DRAWDOWN LEVEL

NO INFORMATION ON WATER TASTE

NO INFORMATION ON PUMPING TESTS ON BORE COMPLETION

NO DETAILS ON BORE DEVELOPMENT

*** End of GW403836 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

WaterNSW

Work Summary

GW403837

Licence:	Licence Status:
Authorised Purpose(s):	
Intended Purpose(s): MONITORING BORE	
Work Type: Bore	
Work Status: New Bore	
Construct.Method: Rotary Air	
Owner Type: Local Govt	
Commenced Date:	Final Depth: 15.00 m
Completion Date: 24/05/2007	Drilled Depth: 15.00 m
Contractor Name: (None)	
Driller: David, Michael McMahon	
Assistant Driller: Tim McGarry	
Property:	Standing Water Level (m):
GWMA:	Salinity Description:
GW Zone:	Yield (L/s):

Site Details

Site Chosen By:	County	Parish	Cadastre
	Form A: WYNYARD	ROWAN	18/1054800
	Licensed:		
Region: 40 - Murrumbidgee	CMA Map: 8327-1S		
River Basin: 410 - MURRUMBIDGEE RIVER	Grid Zone:	Scale:	
Area/District:			
Elevation: 0.00 m (A.H.D.)	Northing: 6106586.000	Latitude: 35°10'59.7"S	
Elevation Source: Unknown	Easting: 529978.000	Longitude: 147°19'45.3"E	
GS Map: -	MGA Zone: 55	Coordinate Source: GIS - Geogra	

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	15.00	88			Rotary Air
1		Annulus	Waterworn/Rounded	11.00	15.00				Graded, PL:Pour
1	1	Casing	Pvc Class 18	0.00	12.00	60	50		Seated on Bottom, Screw
1	1	Opening	Slots - Horizontal	12.00	15.00	60		0	Casing - Machine Slotted, PVC Class 18, Screw

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.40	0.40	BROWN CLAY LOAM	Loam	
0.40	2.50	2.10	YELLOW RED MEDIUM CLAY	Invalid Code	
2.50	5.20	2.70	YELLOW SILTY CLAY	Invalid Code	
5.20	5.70	0.50	SILTY CLAY 30% COARSE FRAGMENTS	Invalid Code	
5.70	7.50	1.80	GREY MEDIUM CLAY	Invalid Code	

7.50	10.20	2.70	MEDIUM CLAY (GREY)	Clay	
10.20	11.50	1.30	GREY SILTY CLAY	Invalid Code	
11.50	15.00	3.50	DECOMPOSED GRANITE (50% COARSE FRAGMENTS)	Granite	

Remarks

24/05/2007: Form A Remarks:

ENTERED BY PATRICIA EWERS 8TH NOVEMBER 2007

DRY HOLE

MONITORING BORE FOR WAGGA CITY COUNCIL SALINITY NETWORK.

*** End of GW403837 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

WaterNSW

Work Summary

GW057259

Licence: 40WA409091

Licence Status: CURRENT

Authorised Purpose(s): STOCK,DOMESTIC
Intended Purpose(s): STOCK, DOMESTIC

Work Type: Bore

Work Status:

Construct.Method: Cable Tool

Owner Type: Private

Commenced Date:
Completion Date: 01/12/1982

Final Depth: 8.50 m
Drilled Depth: 8.50 m

Contractor Name: (None)
Driller: Glen William Lutze
Assistant Driller:

Property: ROWAN NSW

GWMA: -
GW Zone: -

Standing Water Level
(m):
Salinity Description: 0-500 ppm
Yield (L/s):

Site Details

Site Chosen By:

County
Form A: WYNYARD
Licensed: WYNYARD
Parish
ROWAN
ROWAN
Cadastre
68
Whole Lot //

Region: 40 - Murrumbidgee
River Basin: 410 - MURRUMBIDGEE RIVER
Area/District:

CMA Map: 8327-1S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6104900.000
Easting: 529874.000
Latitude: 35°11'54.4"S
Longitude: 147°19'41.4"E

GS Map: -
MGA Zone: 55
Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	8.50	152			Suspended in Clamps
1	1	Opening	Slots - Vertical	5.10	8.40	152		1	Oxy-Acetylene Slotted, A: 1.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
4.80	8.20	3.40	Unconsolidated	4.60		0.13			

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.80	1.80	Loam Sandy	Loam	

1.80	4.80	3.00	Clay Sandy	Clay	
4.80	8.20	3.40	Sand Water Supply	Sand	
8.20	8.50	0.30	Clay	Clay	

*** End of GW057259 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

GW403838

[illegible]

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	RED BROWN SANDY LOAM	Loam	
0.30	2.50	2.20	RED MEDIUM CLAY - CC	Invalid Code	
2.50	4.80	2.30	YELLOW RED SILTY CLAY	Invalid Code	
4.80	7.80	3.00	GREY MEDIUM CLAY	Invalid Code	
7.80	8.20	0.40	DECOMPOSED GRANITE < 5MM	Granite	
8.20	8.50	0.30	GREY MEDIUM CLAY	Invalid Code	
8.50	9.20	0.70	DECOMPOSED GRANITE < 20 MM	Granite	
9.20	10.00	0.80	YELLOW GREY MEDIUM CLAY	Invalid Code	
10.00	10.50	0.50	DECOMPOSED GRANITE - MOISTURE ENCOUNTERED AT 9.00 M - REFUSAL AT 10.7 M	Granite	

Remarks

07/06/2007: Form A Remarks:

ENTERED BY PATRICIA EWERS 8TH NOVEMBER 2007.

MONITORING BORE FOR WAGGA CITY COUNCIL SALINITY BOREFIELD.

INFORMATION NOT INCLUDED ON FORM:

NO INFORMATION ON YIELD AND DRAWDOWN LEVEL

NO INFORMATION ON WATER TASTE

NO INFORMATION ON PUMPING TESTS ON BORE COMPLETION

NO DETAILS ON BORE DEVELOPMENT

*** End of GW403838 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

GW403840

[illegible]

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.40	0.40	RED BROWN SANDY CLAY LOAM	Invalid Code	
0.40	2.50	2.10	YELLOW RED MEDIUM CLAY	Invalid Code	
2.50	8.60	6.10	YELLOW GREY MEDIUM CLAY - STIFF - MOISTURE PRESENT AT 8.0 M	Invalid Code	

Remarks

31/05/2007: Form A Remarks:

ENTERED BY PATRICIA EWERS ON 8TH NOVEMBER 2007.

MONITORING BORE FOR WAGGA CITY COUNCIL SALINITY BOREFIELD

INFORMATION NOT INCLUDED ON FORM:

NO INFORMATION ON YIELD AND DRAWDOWN LEVEL

NO INFORMATION ON WATER TASTE

NO INFORMATION ON PUMPING TESTS ON BORE COMPLETION

NO DETAILS ON BORE DEVELOPMENT

***** End of GW403840 *****

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

WaterNSW

Work Summary

GW404190

Licence: 40WA410328

Licence Status: CURRENT

Authorised Purpose(s): STOCK,DOMESTIC
Intended Purpose(s): DOMESTIC, STOCK

Work Type: Bore

Work Status: Supply Obtained

Construct.Method:

Owner Type: Private

Commenced Date:

Completion Date: 01/07/2005

Final Depth: 108.00 m

Drilled Depth: 108.00 m

Contractor Name: DAYMAN DRILLING &
ENGINEERING

Driller: Brian Keith Dayman

Assistant Driller:

Property: N/A 7 Ironbark Place WAGGA
WAGGA 2650 NSW

GWMA: -

GW Zone: -

Standing Water Level 64.000
(m):

Salinity Description:

Yield (L/s): 1.000

Site Details

Site Chosen By:

County
Form A: WYNYARD
Licensed: WYNYARD

Parish
ROWAN
ROWAN

Cadastre
10//881515
Whole Lot 10//881515

Region: 40 - Murrumbidgee

River Basin: 410 - MURRUMBIDGEE RIVER
Area/District:

CMA Map: 8327-1S

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6107499.000
Easting: 530601.000

Latitude: 35°10'30.0"S
Longitude: 147°20'09.8"E

GS Map: -

MGA Zone: 55

Coordinate Source: GIS - Geogra

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	108.00	200			(Unknown)
1	1	Casing	Pvc Class 12	0.00	108.00	150			
1	1	Opening	Slots	96.00	99.00	150		0	Stainless Steel, ()

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	6.00	6.00	CLAY - BROWN	Clay	
6.00	8.00	2.00	CLAYBOUND SAND - BROWN CLAY	Invalid Code	
8.00	36.00	28.00	CLAY - BROWN	Clay	
36.00	48.00	12.00	CLAY - BROWN - SILTY	Clay	
48.00	55.00	7.00	CLAY - BROWN	Clay	
55.00	61.00	6.00	CLAY - BROWN - SILTY - SOME BROWN	Clay	

			SAND		
61.00	79.00	18.00	CLAYBOUND SAND - PINK - SILTY	Invalid Code	
79.00	81.00	2.00	SAND - BROWN AND WHITE	Sand	
81.00	94.00	13.00	CLAYBOUND SAND - WHITE, PINK AND BROWN	Invalid Code	
94.00	95.00	1.00	SAND - BROWN - CLAYBOUND	Sand	
95.00	100.00	5.00	SAND - WHITE AND BROWN	Sand	
100.00	108.00	8.00	CLAYBOUND SAND - BROWN	Invalid Code	

Remarks

01/07/2005: Form A Remarks:

ENTERED BY PATRICIA EWERS ON 12TH FEBRUARY 2008. FORM AG - VERY FEW DETAILS PROVIDED.

INFORMATION NOT PROVIDED ON FORM:

NO INFORMATION ON BORE CONSTRUCTION METHOD

NO INFORMATION ON DRAWDOWN LEVEL

NO INFORMATION ON SALINITY AND WATER TASTE

NO INFORMATION ON PUMPING TESTS ON BORE COMPLETION

NO DETAILS ON WATER BEARING ZONE/S

NO DETAILS ON CASING ATTACHMENT METHOD

NO DETAILS ON SLOT OPENING TYPE, ATTACHMENT METHOD AND APERTURE SIZE

NO DETAILS ON GRAVEL PACK

NO DETAILS ON BORE DEVELOPMENT

NO INFORMATION ON WHO CHOSE BORE LOCATION

***** End of GW404190 *****

Warning To Clients: This raw data has been supplied to the WaterNSW by drillers, licensees and other sources. WaterNSW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

WaterNSW

Work Summary

GW403835

Licence:	Licence Status:
Authorised Purpose(s):	
Intended Purpose(s): MONITORING BORE	
Work Type: Bore	
Work Status: New Bore	
Construct.Method: Rotary Air	
Owner Type: Local Govt	
Commenced Date:	Final Depth: 15.20 m
Completion Date: 08/06/2007	Drilled Depth: 15.30 m
Contractor Name: (None)	
Driller: David, Michael McMahon	
Assistant Driller: Tim McGarry	
Property:	Standing Water Level (m):
GWMA:	Salinity Description:
GW Zone:	Yield (L/s):

Site Details

Site Chosen By:	County	Parish	Cadastre
	Form A: WYNYARD	ROWAN	10//881515
	Licensed:		
Region: 40 - Murrumbidgee	CMA Map: 8327-1S		
River Basin: 410 - MURRUMBIDGEE RIVER	Grid Zone:	Scale:	
Area/District:			
Elevation: 0.00 m (A.H.D.)	Northing: 6107571.000	Latitude: 35°10'27.7"S	
Elevation Source: Unknown	Easting: 530267.000	Longitude: 147°19'56.6"E	
GS Map: -	MGA Zone: 55	Coordinate Source: GIS - Geogra	

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	15.20	88			Rotary Air
1		Annulus	Waterworn/Rounded	11.00	15.20				Graded, PL:Poured/Shovelled
1	1	Casing	Pvc Class 18	0.00	12.20	60	50		Seated on Bottom, Screwed
1	1	Opening	Slots - Horizontal	12.20	15.20	60		0	Casing - Machine Slotted, PVC Class 18, Screwed, SL: 30.0mm, A: 5.00mm

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.40	0.40	RED BROWN CLAY LOAM	Loam	
0.40	3.40	3.00	YELLOW RED MEDIUM CLAY	Invalid Code	
3.40	5.50	2.10	YELLOW SILTY CLAY	Invalid Code	
5.50	6.70	1.20	YELLOW SILTY CLAY - SHALE 5<20MM 30% COARSE FRAGMENTS	Invalid Code	

6.70	8.50	1.80	YELLOW SILTY CLAY - 20% COARSE FRAGMENTS	Invalid Code	
8.50	15.30	6.80	GREY MEDIUM CLAY	Invalid Code	

Remarks

08/06/2007: ENTERED BY PATRICIA EWERS 8TH NOVEMBER 2007

MONITORING BORE FOR WAGGA CITY COUNCIL SALINITY BOREFIELD

INFORMATION NOT PROVIDED ON FORM:

NO INFORMATION ON YIELD AND DRAWDOWN LEVEL
 NO INFORMATION ON SALINITY AND WATER TASTE
 NO INFORMATION ON PUMPING TESTS ON BORE COMPLETION
 NO DETAILS ON WATER BEARING ZONE/S
 NO DETAILS ON BORE DEVELOPMENT

*** End of GW403835 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

WaterNSW

Work Summary

GW403839

Licence:	Licence Status:
Authorised Purpose(s): Intended Purpose(s): MONITORING BORE	
Work Type: Bore	
Work Status: New Bore	
Construct.Method: Rotary Air	
Owner Type: Local Govt	
Commenced Date:	Final Depth: 15.30 m
Completion Date: 06/06/2007	Drilled Depth: 15.30 m
Contractor Name: (None)	
Driller: David, Michael McMahon	
Assistant Driller: Tim McGarry	
Property:	Standing Water Level (m):
GWMA:	Salinity Description:
GW Zone:	Yield (L/s):

Site Details

Site Chosen By:	County Form A: WYNYARD Licensed:	Parish ROWAN	Cadastre 14//260479
Region: 40 - Murrumbidgee	CMA Map: 8327-1S		
River Basin: 410 - MURRUMBIDGEE RIVER Area/District:	Grid Zone:	Scale:	
Elevation: 0.00 m (A.H.D.) Elevation Source: Unknown	Northing: 6107404.000 Easting: 531895.000	Latitude: 35°10'32.9"S Longitude: 147°21'01.0"E	
GS Map: -	MGA Zone: 55	Coordinate Source: GIS - Geogra	

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	15.30	88			Rotary Air
1		Annulus	Waterworn/Rounded	11.00	15.30				Graded, PL:Pour
1	1	Casing	Pvc Class 18	0.00	12.30	60	50		Seated on Bottom, Screw
1	1	Opening	Slots - Horizontal	12.30	15.30	60		0	Casing - Machine Slotted, PVC Class 18, Screw

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	BROWN SILTY LOAM	Loam	
0.30	1.10	0.80	RED MEDIUM CLAY	Invalid Code	
1.10	2.40	1.30	YELLOW GREY MEDIUM CLAY	Invalid Code	
2.40	3.20	0.80	WHITE SILTY CLAY - 50% CARBONATE	Invalid Code	
3.20	4.00	0.80	YELLOW GREY MEDIUM CLAY	Invalid Code	

4.00	7.00	3.00	WHITE SILTY CLAY - 30% CARBONATE	Invalid Code	
7.00	8.50	1.50	YELLOW GREY MEDIUM CLAY	Invalid Code	
8.50	10.40	1.90	YELLOW GREY MEDIUM CLAY - STIFF - HARD DRILLING	Invalid Code	
10.40	14.00	3.60	YELLOW GREY SILTY CLAY	Invalid Code	
14.00	15.30	1.30	DECOMPOSED GRANITE, YELLOW RED - 50% GRAVEL AND SAND	Granite	

Remarks

06/06/2007: Form A Remarks:
ENTERED BY PATRICIA EWERS 8TH NOVEMBER 2007.

DRY HOLE

MONITORING BORE FOR WAGGA WAGGA CITY COUNCIL SALINITY BOREFIELD

*** End of GW403839 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

WaterNSW

Work Summary

GW416362

Licence: 40WA412183

Licence Status: CURRENT

Authorised Purpose(s): DOMESTIC

Intended Purpose(s): STOCK, DOMESTIC

Work Type: Bore

Work Status: Supply Obtained

Construct.Method: Rotary - Percu

Owner Type: Private

Commenced Date:

Completion Date: 26/07/2013

Final Depth: 216.00 m

Drilled Depth: 216.00 m

Contractor Name: Britt's Water Solutions

Driller: Darren James Britt

Assistant Driller:

Property: N/A 10 Mallee Rd WAGGA WAGGA
2650 NSW

GWMA: 998 - TEST

GW Zone: 097 - INLAND

Standing Water Level 49.000
(m):

Salinity Description: Fresh

Yield (L/s): 2.100

Site Details

Site Chosen By:

County
Form A: WYNYARD
Licensed: WYNYARD

Parish
ROWAN
ROWAN

Cadastre
21//260479
Whole Lot 21//260479

Region: 40 - Murrumbidgee

CMA Map: 8327-1S

River Basin: 410 - MURRUMBIDGEE RIVER
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6107523.000
Easting: 531739.000

Latitude: 35°10'29.1"S
Longitude: 147°20'54.8"E

GS Map: -

MGA Zone: 55

Coordinate Source: GPS - Global

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	90.00	200			Rotary - Percussion (Down Hole H
1		Hole	Hole	90.00	216.00	168			Rotary - Percussion (Down Hole H
1	1	Casing	Pvc Class 9	-0.30	96.00	160	148		Driven into Hole, Screwed and Glued, S: 204.00-216.00m

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
204.00	204.30	0.30	Unknown	49.00		2.10		00:30:00	

Drillers Log

From	To	Thickness	Drillers Description	Geological Material	Comments
------	----	-----------	----------------------	---------------------	----------

(m)	(m)	(m)			
0.00	0.30	0.30	topsoil	Topsoil	
0.30	6.00	5.70	clay, puggy	Clay	
6.00	6.50	0.50	clay, white	Clay	
6.50	10.00	3.50	granite, decomposed	Granite	
10.00	83.50	73.50	assorted clays, sands and decomposed granite bands	Unknown	
83.50	216.00	132.50	granite, blue and white	Granite	

Remarks

26/07/2013: Form A Remarks:

Helen Lester: Coordinates are taken from charted licence location.

*** End of GW416362 ***

Warning To Clients: This raw data has been supplied to the WaterNSW by drillers, licensees and other sources. WaterNSW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.