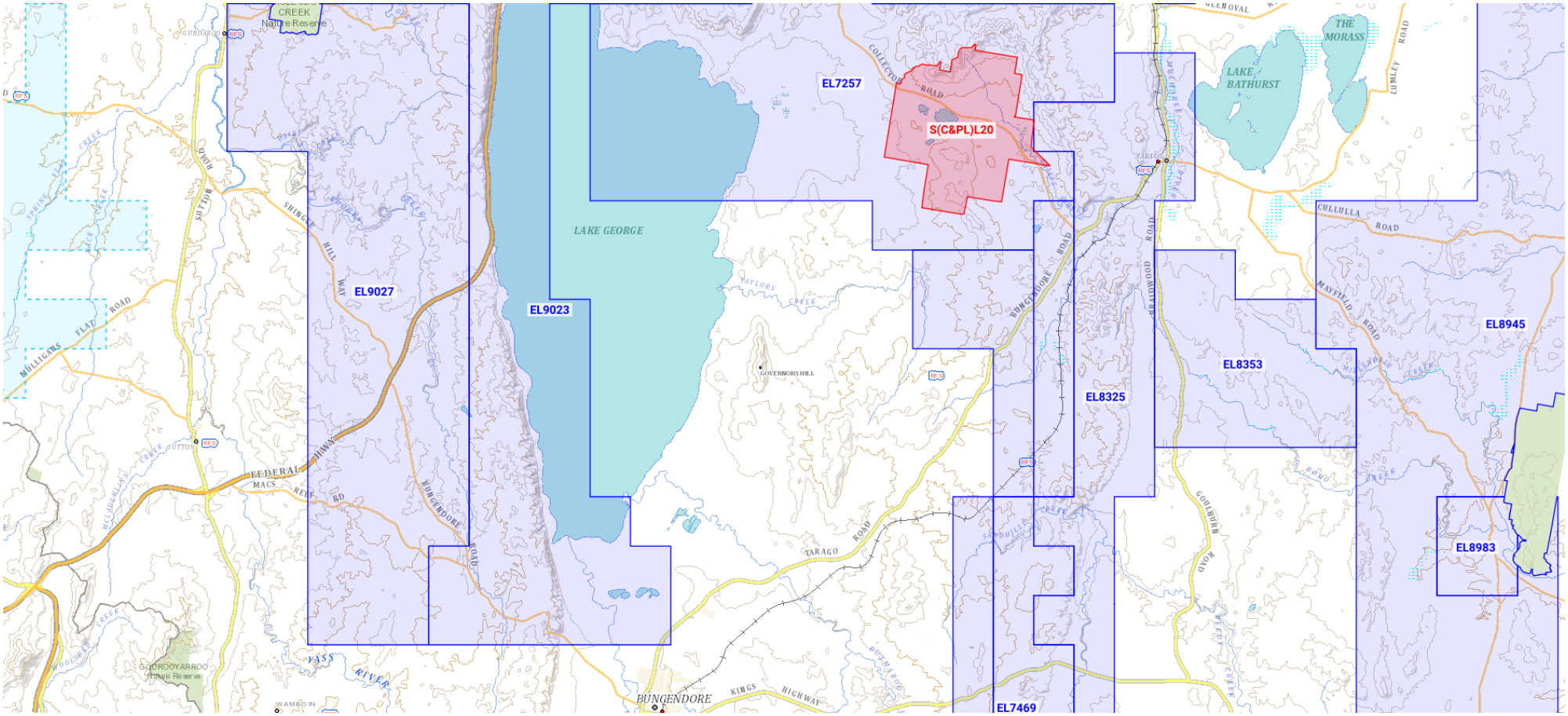
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LAKE GEORGE
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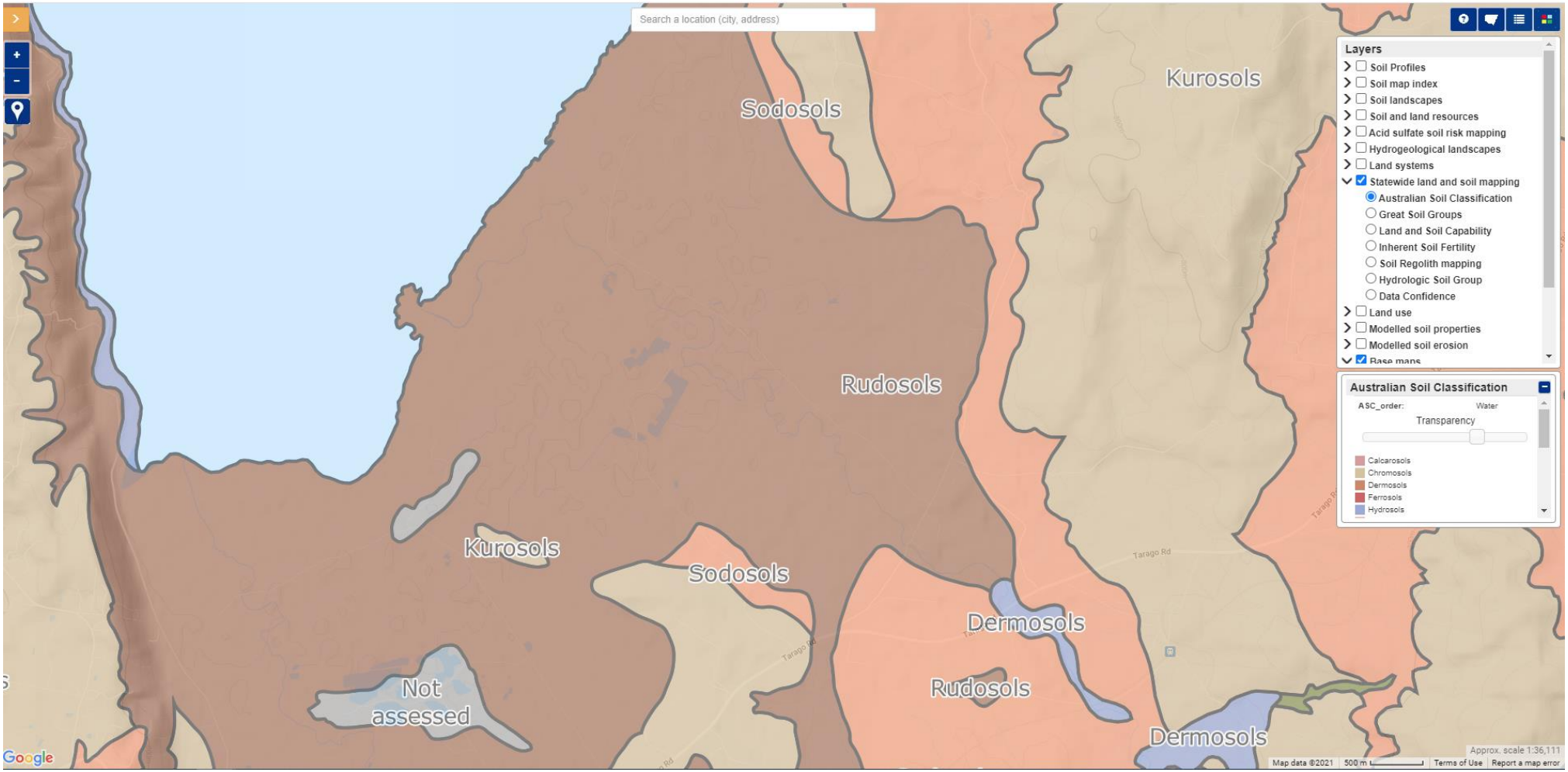
TARAGO
GOVERNORS HILL
COLLECTORS ROAD
BUNGENDORE ROAD
BROADWOOD ROAD
CULLULLA ROAD
MAYFIELD ROAD
LUMLEY ROAD
COULBURN ROAD
KINGS HIGHWAY
FEDERAL HIGHWAY
SHINGLE HILL WAY
FLAT ROAD
MILLIGANS
SUTTON ROAD
TARAGO ROAD
WAMBOIN
GOOROOYARROO Nature Reserve
CREEK Nature Reserve


Search a location (city, address)
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Data Confidence
Land use
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cp COOPERS Beach

Landscape— old lake beaches, dunes and sandsheet on Quaternary alluvium. Local relief <9 m; elevation 670 - 690 m. No rock outcrop. Cleared woodland.

Soils— deep to very deep (>100 cm), very poorly drained Hydrosols and Stratic Rudosols (Alluvial Soils) on Lake George. Moderately deep to very deep (>90 cm), imperfectly drained Brown Chromosols (Yellow Podzolic Soils) on old beaches. Well-drained Stratic Rudosols (Siliceous Sands) on beach dunes. Moderately deep to very deep, poorly drained Stratic Rudosols (Alluvial Soils) on swales.

Soil variant cpa— heavier textured soils.

Limitations— soils are non-cohesive, infertile, highly erodible and have low available waterholding capacity. Waterlogging (localised); groundwater pollution hazard; engineering hazard; poor moisture availability; seasonal waterlogging (localised); wind erosion hazard; run-on (localised); excessive drainage.

LOCATION

Old lake beaches and dunes on Quaternary alluvium of the Bungendore Plain. Occurs in the north-east of the mapped area. Type location is adjacent to a farm track, 2 km west from Taylors Creek Road. (Grid Reference: 7 **27**300E, 61 **17**700N).

Landscape variant **cpa** occurs in small patches to the south of Bungendore.

This soil landscape also occurs on the Braidwood 1:100 000 sheet (Jenkins 1996) as Cooper **(cp)** soil landscape.

LANDSCAPE

Geology

Quaternary alluvium-gravel, sand, silt and clay.

Topography

Old lake beaches, dunes with intervening swales and sand sheet. Local relief is <9 m at 670 - 690 m elevation. Forms part of the north-eastern and southern shores of Lake George. No rock outcrops are present.

Vegetation

Cleared woodland.

Land Use

Cattle and some sheep grazing mainly on improved pastures.

Land Degradation

No appreciable erosion other than streambank erosion (<1.5 m deep) on Allianoyonyiga Creek. Wind erosion has occurred in the past and could be expected to occur again during periods of drought or when ground cover is otherwise removed.

Landscape Variant

The areas marked on the map as **cpa** are areas of very poor drainage in which small swamps have developed. Soils are often heavier than for Coopers **(cp)** soil landscape.

Landscape Limitations and Qualities

Waterlogging (localised); groundwater pollution hazard; engineering hazard; poor moisture availability; seasonal waterlogging (localised); wind erosion hazard; non-cohesive soil; run-on (localised); excessive drainage.

SOILS **Soil Variation**

Lake George has a number of abandoned shorelines with the highest and oldest being 27 000 to 21 000 years before present and up to 37 m above lake bottom (Coventry 1976). This corresponds to the present day "full" level 4.6 m a.l.b. Five subsequent periods of shoreline aggradation were established by Coventry and Walker (1977).

Periods of instability between 23 000 - 2000 years before present are evidenced by the aeolian deposits (dunes) to the east of Lake George.

Beach deposits consist of sand of variable depth over clay. Dune materials are similar to the beach deposits, but generally lack gravel. Swales consist of generally saturated alluvial and lacustrine layers. The bed of Lake George consists of >1 m deep of very poorly drained anaerobic ooze as per the associated soil materials.

Dominant Soil Materials, Their Qualities and Limitations

cp1—Dark brown loamy sand (topsoil—A1 horizon). Dark brown loamy sand; single-grained; sandy; field pH 5.5 - 6.5; loose; highly permeable; none to few rounded gravels (beach closest to lake). Highly erodible; non-cohesive soils; high permeability; low fertility; salinity hazard; low available waterholding capacity.

cp2—Loose yellow sand (subsoil—A2 horizon). Light yellow sand; single-grained; sandy; field pH 6.0 - 7.0; loose; very high; none to few rounded gravels (beach closest to lake). Highly erodible; non-cohesive soils; high permeability; low fertility; salinity hazard; low available waterholding capacity.

cp3—Mottled sandy clay (subsoil—B2 horizon). Yellowish brown (with grey mottles) sandy medium clay; strongly to moderately pedal; smooth-faced peds; field pH 6.5 - 8.5; labile (moist); very plastic and moderately sticky (wet); hardset and hard (dry); slowly permeable; none to few rounded gravels (beach closest to lake). Hardsetting; low permeability; highly erodible; salinity hazard; dispersible; low wet bearing strength (localised).

Associated Soil Materials

Brownish black sandy loam. In isolated protected sites, a topsoil heavier than loamy sand may have developed. It is usually darker due to the presence of organic carbon.

Along the shores of Lake George, waterlogged soils occur. Materials present include—

Greenish sandy clay. This topsoil is typically waterlogged, alkaline (pH 10.0), greenish grey (10YR 5/1) with orange biological mottles, has an anaerobic smell and is 20 - 40 cm deep.

Olive sandy clay. This subsoil is waterlogged, alkaline (pH 10.0), olive grey (10YR 6/2), has calcareous concretions (2 - 6 mm), an anaerobic smell, an ooze-like consistency and is >40 cm deep.

Black clay loam. Swales in between beach dunes often have a black (10YR 2/2) clay loam topsoil thjat has high organic matter content, pH 7.0 - 8.5 and is often waterlogged.

Type Profiles

Type Profile 1: flat

Dominance: up to 35% of landscape
Basic Stratic Rudosol; non-gravelly, very fine, very deep, 1, (Siliceous Sand). Soft surface condition
Depth: 125 cm
Location: about 50 m north of a cattle grid on Wrights Creek Road; grid reference: 7 **26**200E, 61 **01**800N). Soil Data card 287. Voluntary/native pasture

Soil Material	Description
Layer 1, A_1, **cp1** 0 - 6cm	brownish black (10YR 3/1) loamy sand; single-grained; sandy; very weak force (moderately moist); very few fine quartz gravels; field pH 6.0; high permeability; clear, smooth boundary to…
Layer 2, A_2, **cp2** 6 – 65 cm	brown (10YR 4/6) sand; single-grained; sandy; loose (moderately moist); few fine quartz gravels; field pH 6.0; high permeability; clear, smooth boundary to…
Layer 3, B, **cp2** 65 - 125 cm	yellowish brown (10YR 5/8) sand; single-grained; sandy; loose (moderately moist); common fine quartz gravels; field pH 6.5; highly permeable; layer continues.

Type Profile 2: flat

Dominance: up to 60% of the landscape
Sodic Eutrophic Brown Chromosol; thick, non-gravelly, loamy, clayey, deep, 1, (Siliceous Sand). Soft surface condition
Depth: 120 cm
Location: about 30 m north-west of grid on road to Coarse Flat; grid reference: 7 **21**800E, 61 **01**350N. Soil Data card 292. Voluntary/native pasture

Soil Material	Description
Layer 1, A_1, **cp1** 0 – 8 cm	brownish black (7.5YR 3/1) sandy loam; massive; earthy; very weak force (moderately moist); no **(associated material)** coarse fragments evident; field pH 6.5; moderately permeable; clear boundary to…
Layer 2, A_2, **cp2** 8 – 25 cm	dull yellowish brown (10YR 5/3) sand; single-grained; sandy; loose (moderately moist); no coarse fragments evident; field pH 6.5; highly permeable; clear boundary to…
Layer 3, A_3, **cp2** 25 – 66 cm	dull yellowish brown (10YR 5/4) sand, single-grained; sandy; loose (moderately moist); no coarse fragments evident; field pH 7.5; highly permeable; clear boundary to…
Layer 4, B_2, **cp3** 66 – 120+ cm	yellowish brown (10YR 5/6) sandy light clay; strongly pedal smooth-faced peds; dry; no coarse fragments evident; field pH 8.0; moderately permeable; layer continues.

Notes on Soil Test Results

The entire profile of SDC 287 is highly saline. Topsoils have very low available phosphorus. The subsoil of SDC 292 is highly erodible.

Associated Soil Profiles

Hydrosols (less than 5% of the landscape) occur in the areas of poorest drainage. Many of the beach ridges have been reworked by wind, so many of the dunes have an aeolian component and may in part be considered Arenic subsoils.

Erodibility

	Non-concentrated flows	Concentrated flows	Wind
cp1	low	very high	very high
cp2	moderate	very high	very high
cp3	high	moderate	low

Erosion Hazard

	Non-concentrated flows	Concentrated flows	Wind
grazing	high	high	high

Urban Capability

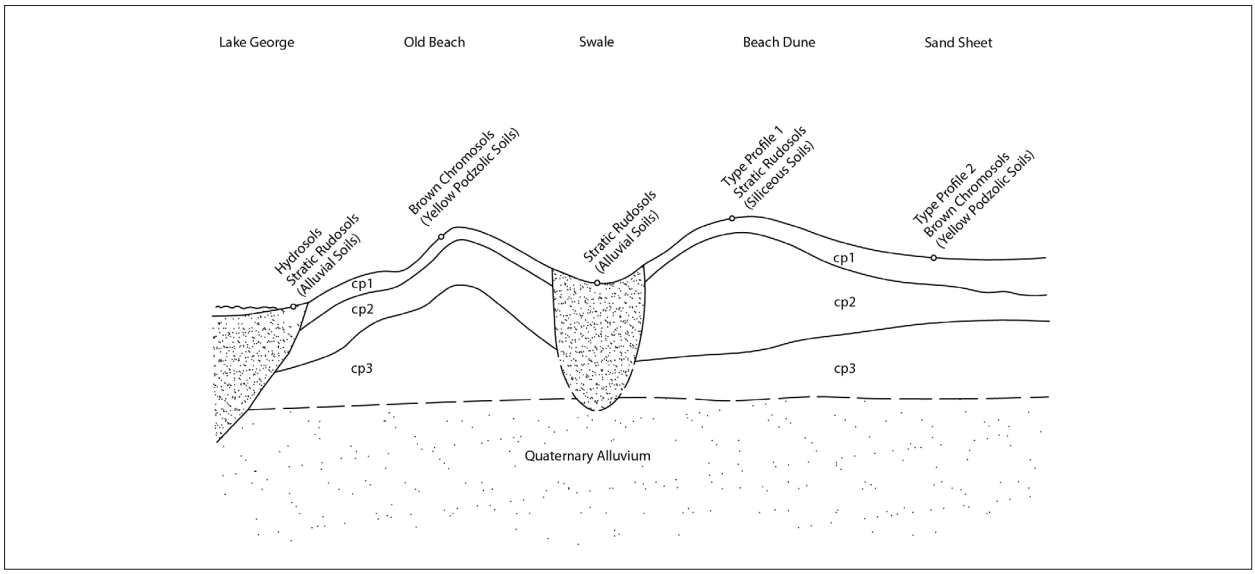
Moderate limitations for urban development. High foundation hazard due to non-cohesive sandy topsoils, plastic subsoils and waterlogged depressions. Very high effluent disposal hazard. Septic absorption potential is low because of highly porous (sandy) topsoils and slowly drained subsoils.

Rural Capability

General rural land capability is Class IV/VI. Generally high limitations for cultivation and moderate limitations for grazing. High limitations for earthworks. Soil materials are generally inappropriate for dam construction.

Sustainable Land Use Recommendations

Direct-drilling is the preferred method of pasture establishment due to sandy textured topsoil **(cp1).** Disc ploughing tends to break down soil coherence resulting in loose, single-grained soil material that is prone to erosion. Ground cover should be maintained as close to 100% as possible due to the high to very high wind erosion hazard.



❒ ***Distribution diagram of Coopers soil landscape illustrating occurrence and relationship of dominant soil materials.***

tc	TAYLORS CREEK	Erosional

Landscape— undulating low hills on granite. Local relief 50 - 90 m; elevation 680 - 860 m; slopes 5 - 10%. Rounded crests. Rock outcrops as tors are locally common. Predominantly cleared open-forest to woodland.

Soils— extremely shallow (<40 cm), well-drained Rudosols (Lithosols) and Tenosols (Earthy Sands) on crests or adjacent to outcrops. Moderately deep to shallow (<80 cm), moderately well-drained Red Kandosols (Red Earths) and Red Chromosols (Red Podzolic Soils) on upper and midslopes. Moderately deep (<130 cm), poorly drained Kurosols (Soloths) and Sodosols (Solodic Soils) on lower slopes and drainage lines.

Limitations— hardsetting, infertile soils of low wet bearing strength and low waterholding capacity. Seasonal waterlogging; gully erosion risk; sheet erosion risk (localised); shallow soil (localised); non-cohesive soil (localised); rock outcrop (localised); run-on (localised).

LOCATION

Undulating low hills on granite of Tallaganda physiographic region. Occurs along the eastern margin of the map sheet. Type location is about 2 km south of Governers Hill. (Grid Reference: 7 **26**150E, 61 **06**900N).

This soil landscape also occurs on the Braidwood 1:100 000 sheet (Jenkins 1996) as Taylors Creek **(tc)** soil landscape.

LANDSCAPE

Geology

Ellenden Granite, consisting of pink-grey and porphyritic adamellite and granodiorite, with minor quartz plagioclase porphyry.

Topography

Undulating low hills with local relief 50 - 90 m; elevation 680 – 860 m. Hillslopes are gently to moderately inclined (5 - 10%). Crests are rounded. Characteristic rock outcrops as tors range from few to abundant.

Land Use

Beef and sheep production on improved and voluntary pastures.

Vegetation

Predominantly cleared open-forest to woodland with isolated individuals and small stands of *Eucalyptus pauciflora* (snow gum), *E. viminalis* (ribbon gum), *E. melliodora* (yellow box), *Acacia dealbata* (silver wattle), *A. mearnsii* (black wattle), *A. melanoxylon* (blackwood) and *Hakea* spp. *Pteridium esculentum* (bracken) occurs on sand patches (associated soil material).

Land Degradation

Severe gully erosion (<1.5 m deep) and minor gully erosion (discontinuous gullies <1.5 m deep) is common. Streambank erosion occurs along parts of Taylors Creek and other watercourses. There are a number of isolated patches of severe sheet erosion associated with disturbance (e.g., ripping for rabbits).

Landscape Limitations and Qualities

Seasonal waterlogging; gully erosion risk; sheet erosion risk (localised); shallow soil (localised); non-cohesive soil (localised); rock outcrop (localised), run-on (localised).

SOILS **Soil Variation**

There is a distinct contrast between the sandy well-drained soils of the upper slopes and crests, and the imperfectly drained duplex soils of lower slopes and drainage lines.

Dominant Soil Materials, Their Qualities and Limitations

tc1—Brown sandy loam (topsoil—A_1 horizon). Brown coarse sandy loam to loam; massive; earthy; field pH 5.5 - 6.5; crumbles easily (dry or moist); non-plastic and non-sticky (wet); moderately to highly permeable. Low wet bearing strength; acid; low fertility.

tc2—Bright brown clay loam (AB, A_2 horizon). Bright brown to bright reddish brown clay loam to sandy loam to sandy clay (light); massive; earthy; field pH 6.0 - 6.5; crumbles with moderately weak force (moist); non-plastic and slightly sticky (wet); hardsetting, but shatters with moderate force (dry); moderately permeable; few strongly weathered gravels of parent material. Low wet bearing strength; acid; low fertility.

tc3—Reddish brown massive clay (subsoil—B_2 horizon). Reddish brown light clay; massive; earthy; field pH 6.0 - 7.0; crumbles with moderately weak force (moist); moderately plastic and moderately sticky (wet); hardset, hard (dry); moderately permeable; few to common weathered gravels as per parent material. Hardsetting; low fertility; highly plastic.

tc4—Dull yellowish sandy loam (A_2 horizon). Dull yellowish brown coarse sandy loam; massive; earthy; field pH 6.0 - 7.0; shatters with moderate force (moist); non-plastic and non-sticky (wet); hardset, hard (dry); moderately permeable; none to few gravels of parent material. Hardsetting; low wet bearing strength; low fertility.

tc5—Blocky mottled clay (subsoil—B2 horizon). Bright yellowish brown (usually mottled) medium clay; strongly pedal, smooth-faced peds; field pH 6.0 - 7.5; firm force to plastic (moist); very plastic and moderately sticky (wet); hardset, hard (dry); very slowly permeable; no gravels. Moderate shrink-swell; low wet bearing strength; hardsetting; very low permeability; low fertility; highly plastic.

Associated Soil Materials

Aeolian sand. Small patches of windblown fine yellowish sand occurs throughout the landscape. These areas are particularly prevalent on upper lee slopes and have a characteristic *Pteridium esculentum* (bracken) cover.

Type Profiles

Type Profile 1: simple slope

Dominance: about 40% of the landscape
Bleached-Sodic Mesotrophic Red Chromosol; medium, non-gravelly, loamy, clayey, moderate, 1, (Red Podzolic Soil). Firm surface condition
Depth: 60 cm
Location: on farm road to Red Hill, about 200 m south of farm road intersection; grid reference: 7 **26**150E, 61 **06**900N. Soil Data card 285. Improved pasture

Soil Material	Description
Layer 1, A_1, **tc1** 0 – 9 cm	brownish black (10YR 3/2) loam; massive; earthy; moderately weak force (moderately moist); field pH 5.5; moderately permeable; abrupt boundary to…
Layer 2, A_2, **tc2** 9 – 28 cm	dull yellowish brown (10YR 4/3) silty loam; massive; earthy; moderately weak force (moderately moist); field pH 6.0; moderately permeable; abrupt boundary to…
Layer 3, B_2, **tc3** 28 – 60 cm	dull reddish brown (5YR 4/4) light-medium clay; strongly pedal; polyhedral smooth-faced peds (2 - 5 mm); very firm force (moderately moist); field pH 6.0; moderately permeable; layer continues.

Type Profile 2: open-depression

Dominance: up to 25% of the landscape
Eutrophic Hypernatric Brown Sodosol; medium, non-gravelly, loamy, clayey, deep, 1, (Solodic Soil). Firm surface condition
Depth: 90 cm
Location: on Wrights Creek about 10 m south of farm track; grid reference: 7 **26**150E, 61 **06**900N. Soil Data card 286. Improved pasture

Soil Material	Description
Layer 1, A_1, **tc1** 0 – 17 cm	brownish black (10YR 3/2) loam; massive; earthy; moderately firm force (moderately moist); no coarse fragments evident; field pH 5.0; moderately permeable; sharp boundary to…
Layer 2, A_{2e}, **tc4** 17 – 40 cm	dull yellowish brown (10YR 5/3) silty loam; massive; earthy; moderately firm force (moderately moist); no coarse fragments evident; field pH 7.0; moderately permeable; sharp boundary to…

Layer 3, B_2, **tc5** 40 – 90 cm: yellowish brown (10YR 5/6) light-medium clay; strongly pedal; angular blocky smooth-faced peds (20 - 50 mm); moderately strong force (moderately moist); no coarse fragments evident; field pH 8.5; slowly permeable; layer continues.

Notes on Soil Test Results

Topsoils have very low available phosphorus. The proportion of relevant cations one to the other may well be more important to plant production than the actual levels (Hazelton & Murphy 1992). Lab results indicate that the topsoil of both profiles are relatively magnesium-deficient. Highly to extremely erodible throughout.

Associated Soil Profiles

On more highly leached midslope sites, various Kurosols (about 20% of the landscape) occur, rather than the closely related Red Chromosols (Type Profile 1). Leptic Rudosols and Tenosols (<15% of the landscape) occupy crests, upper slopes and areas adjacent to rock outcrop.

Erodibility

	Non-concentrated flows	Concentrated flows	Wind
tc1	high	very high	moderate
tc2	very high	very high	moderate
tc3	very high	high	very low
tc4	very high	very high	very low
tc5	moderate	high	very low

Erosion Hazard

	Non-concentrated flows	Concentrated flows	Wind
Grazing	high	high	moderate

Urban Capability

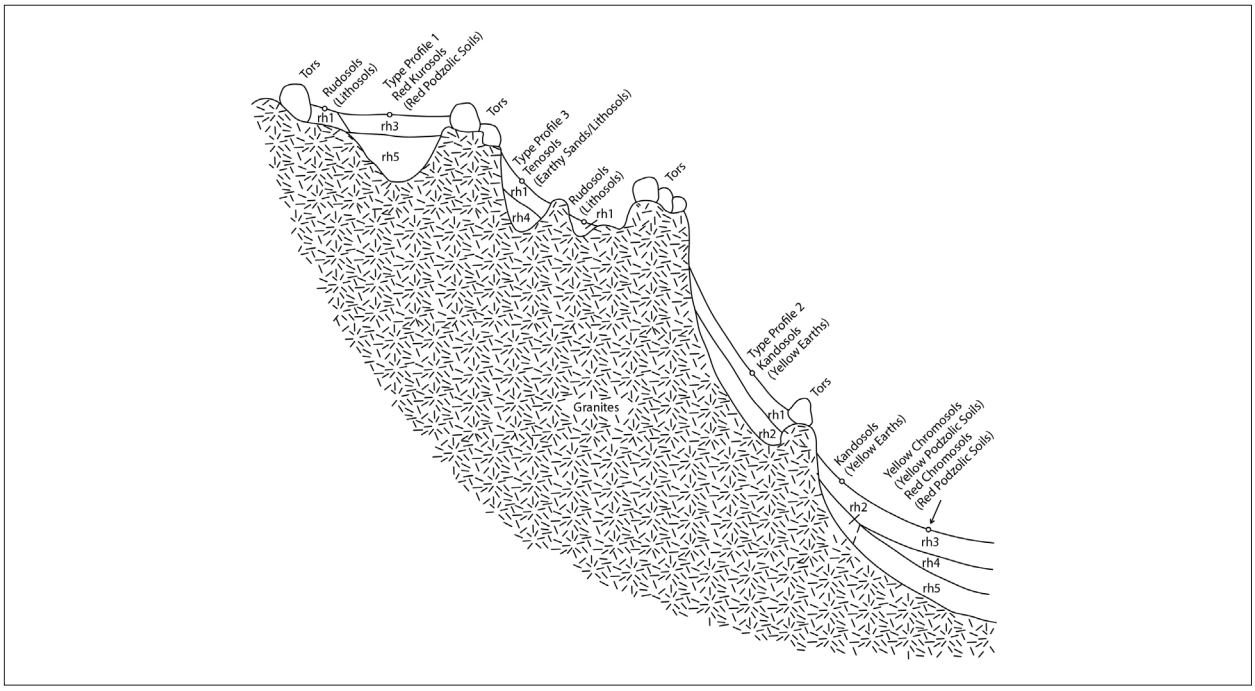
Low to moderate limitations for urban development. Very high effluent disposal hazard for crests, lower slopes and drainage lines. Septic absorption potential is very low in these areas due to shallow soils on crests, poorly drained lower slopes and seasonal waterlogging.

Rural Capability

General rural land capability is Class IV/V but ranges up to Class VII for some drainage lines of high erosion hazard. Generally high to severe limitations for cultivation and moderate limitations for grazing. A lot of work has been conducted as part of the Welcome Reef Dam project to stabilise a number of gully systems in this landscape. Generally moderate to high limitations for earthworks. Seasonal waterlogging may result in soils being too wet for earthwork construction during winter. Soil depth is often shallow and rock was reached during dam construction (S. Proust, pers. comm.). Adequate clay is needed to seal dam floors in these situations.

Sustainable Land Use Recommendations

Direct-drilling is the preferred method of pasture establishment due to sandy textured topsoil. Disc ploughing tends to break down soil coherence resulting in loose single-grained soil material which is prone to erosion.



❒ ***Distribution diagram of Taylors Creek soil landscape illustrating occurrence and relationship of dominant soil materials.***

Public registers

+ POEO Public Register
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  - List of notified sites
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Search results

Your search for: LGA: QUEANBEYAN-PALERANG REGIONAL COUNCIL

Matched 3 notices relating to 3 sites.

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Suburb	Address	Site Name	Notices related to this site
BUNGENDORE	Corner King Street and Butmaroo STREET	Former Timber Treatment Plant	1 former
CAPTAINS FLAT	1 Copper Creek Road ROAD	Rail corridor adjacent to Lake George Mine	1 current
LARBERT	Mayfield ROAD	Waste Oil Storage	1 current

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15 July 2021

Suburb	SiteName	Address	ContaminationActivityType	ManagementClass	Latitude	Longitude
BROOKVALE	Warringah Mall	Cnr Condamine Street, Old Pittwater Rd & Cross STREET	Other Industry	Regulation under CLM Act not required	-33.76729923	151.2657272
BROOKVALE	Littles Dry Cleaning	123 Old Pittwater ROAD	Other Industry	Regulation under CLM Act not required	-33.76759121	151.2625932
BROOMS HEAD	Former Brooms Head General Store and Service Station	92 Ocean ROAD	Service Station	Regulation under CLM Act not required	-29.60711599	153.3346312
BROWNSVILLE	Caltex Service Station	342 Kanahooka ROAD	Service Station	Regulation under CLM Act not required	-34.48591734	150.8064373
BRUNSWICK HEADS	Caltex Service Station	5 Tweed STREET	Service Station	Regulation under CLM Act not required	-28.5381619	153.5487135
BUDGEWOI	Colongra Power Station	Off Scenic DRIVE	Other Industry	Under assessment	-33.21463137	151.5529338
BULAHDELAH	Caltex Service Station	8 Red Gum Road, Corner Mahogany STREET	Service Station	Regulation under CLM Act not required	-32.39837094	152.2106015
BULAHDELAH	Former Caltex Service Station	53-59 Bulahdelah WAY	Service Station	Regulation under CLM Act not required	-32.40721638	152.2110291
BULAHDELAH	BP-branded (former Mobil) Service Station	73-75 Bulahdelah WAY	Service Station	Regulation under CLM Act not required	-32.40971018	152.2105785
BULLABURRA	Former Burmah Bullaburra Service Station	367 - 369 Great Western HIGHWAY	Service Station	Regulation under CLM Act not required	-33.72482995	150.4124537
BULLI	Scrap Yard	7 Molloy STREET	Other Industry	Contamination formerly regulated under the CLM Act	-34.33663195	150.9131154
BULLI	Bulli Brickworks	Quilkey PLACE	Other Industry	Regulation under CLM Act not required	-34.33263113	150.9086247
BUNGALORA	Former landfill area	Part of 840 Terranora ROAD	Other Industry	Regulation under CLM Act not required	-28.2424318	153.4789209
BUNGENDORE	Former Timber Treatment Plant	Corner King Street and Butmaroo STREET	Other Industry	Contamination formerly regulated under the CLM Act	-35.26151273	149.4434907
BURONGA	Caltex Service Station	Sturt Hwy Cnr Silver City HIGHWAY	Service Station	Regulation under CLM Act not required	-34.17056496	142.1813847

Suburb	SiteName	Address	ContaminationActivityType	ManagementClass	Latitude	Longitude
KOORINGAL	Caltex Service Station	265-267 Lake Albert ROAD	Service Station	Regulation under CLM Act not required	-35.14078443	147.3755442
KOORINGAL	Caltex-branded (former Mobil) Service Station	24 Lake Albert ROAD	Service Station	Regulation under CLM Act not required	-35.12239591	147.3769936
KOSCIUSZKO	Smiggin Holes Snow Clearing Shed	Link ROAD	Landfill	Regulation under CLM Act not required	-36.39098211	148.4304981
KOSCIUSZKO	Khancoban Spoil Dump	Alpine WAY	Landfill	Regulation under CLM Act not required	-36.21982803	148.1527401
KOSCIUSZKO	Sawpit Creek landfill	13km from Jindabyne, off Kosciuszko ROAD	Landfill	Regulation under CLM Act not required	-36.34858097	148.5673374
KURMOND	BP Service Station	501 Bells Line of road ROAD	Service Station	Contamination formerly regulated under the CLM Act	-33.55099195	150.6912536
KURNELL	Former Phillips Imperial Chemicals site	260 Captain Cook DRIVE	Chemical Industry	Regulation under CLM Act not required	-34.02493837	151.1952149
KURNELL	Caltex Kurnell Terminal (refer also to ID23868)	2 Solander STREET	Other Petroleum	Contamination currently regulated under POEO Act	-34.0175214	151.2159572
KURNELL	Abbott Australasia	Captain Cook DRIVE	Chemical Industry	Contamination formerly regulated under the CLM Act	-34.02339937	151.19921
KURNELL	Former Caltex Kurnell Service Station	Corner Captain Cook Drive and Solander STREET	Service Station	Regulation under CLM Act not required	-34.01269846	151.2094347
KURRI KURRI	United Petroleum Service Station Kurri Kurri	279-281 Lang STREET	Service Station	Contamination formerly regulated under the CLM Act	-32.82047175	151.477646
KURRI KURRI	Kurri Kurri Smelter	Hart ROAD	Metal Industry	Regulation under CLM Act not required	-32.7873063	151.4828827
KYOGLE	Caltex Service Station	22-24 Summerland WAY	Service Station	Regulation under CLM Act not required	-28.61806766	153.003862
LAKE HAVEN	Caltex Service Station	Goobarabah Ave Cnr Gorokan DRIVE	Service Station	Regulation under CLM Act not required	-33.24337276	151.5065335
LAKEMBA	Former Lakemba Police Station	59 Quigg STREET	Unclassified	Regulation under CLM Act not required	-33.92199239	151.079412

Suburb	SiteName	Address	ContaminationActivityType	ManagementClass	Latitude	Longitude
TAMWORTH	Proposed ALDI Store Tamworth	194-196 Peel STREET	Other Industry	Under assessment	-31.08522053	150.9260054
TARAGO	Tarago Railway Siding	Goulburn STREET	Other Industry	Contamination currently regulated under CLM Act	-35.0695949	149.6516166
TARCUTTA	Mobil Service Station	(Hume Highway) 32 Sydney STREET	Service Station	Contamination formerly regulated under the CLM Act	-35.2772942	147.73574
TAREE	Caltex Taree	12 Pitt STREET	Service Station	Regulation under CLM Act not required	-31.90551738	152.4783334
TAREE	Former Caltex Depot	44 Stevenson STREET	Other Petroleum	Regulation under CLM Act not required	-31.90563595	152.4640848
TAREE	Former BP Service Station (Reliance Petroleum)	150 Manning River DRIVE	Service Station	Regulation under CLM Act not required	-31.93842026	152.4682056
TAREE	Former Shell Depot	53-55 Stevenson STREET	Other Petroleum	Regulation under CLM Act not required	-31.90514622	152.4649706
TAREE	United Service Station and Former Mobil Depot	85 Muldoon Street, corner Grey Gum ROAD	Service Station	Regulation under CLM Act not required	-31.89744109	152.4508569
TAREE	Caltex Service Station	104-106 Commerce STREET	Service Station	Regulation under CLM Act not required	-31.90720519	152.4500926
TAREE	Footpath in front of the former BP service station	53-55 Victoria STREET	Service Station	Regulation under CLM Act not required	-31.91015653	152.4659073
TAREN POINT	Former Oyster Farm	Part 2R Alexander Avenue and part 98 Woodlands ROAD	Other Industry	Contamination was addressed via the planning process (EP&A Act)	-34.01714802	151.1252694
TAREN POINT	Former Oyster Farmer	1A Atkinson ROAD	Other Industry	Regulation under CLM Act not required	-34.02081803	151.1283282
TAREN POINT	Former manufacturing site	46-50 Bay ROAD	Other Industry	Regulation under CLM Act not required	-34.0236184	151.1231649
TAREN POINT	Mangrove Lane Cycle pathway	Mangrove LANE	Unclassified	Regulation under CLM Act not required	-34.02404025	151.1324783
TAREN POINT	Caltex Service Station	114 Taren Point ROAD	Service Station	Regulation under CLM Act not required	-34.02065958	151.1218938

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1100563	GOULBURN MULWAREE COUNCIL	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	31 May 2009
12834	SUZLON ENERGY AUSTRALIA PTY LTD	"Groses Hill", "Ellenden" and "Hammonds Hill", TARAGO, NSW 2580	POEO licence	No longer in force	04 Feb 2008
20821	TARAGO OPERATIONS PTY LTD	507 Collector Road, TARAGO, NSW 2580	POEO licence	Issued	29 Mar 2017
1551976	TARAGO OPERATIONS PTY LTD	507 Collector Road, TARAGO, NSW 2580	s.58 Licence Variation	Issued	12 May 2017
1563873	TARAGO OPERATIONS PTY LTD	507 Collector Road, TARAGO, NSW 2580	s.58 Licence Variation	Issued	07 May 2018
1572566	TARAGO OPERATIONS PTY LTD	507 Collector Road, TARAGO, NSW 2580	s.58 Licence Variation	Issued	18 Jan 2019
11436	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	POEO licence	Issued	05 Sep 2002
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1036988	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	26 Jul 2004
1036952	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	BUNGENDORE ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	26 Jul 2004
1039740	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	12 Aug 2004
1051064	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	04 Jan 2006
1051103	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	BUNGENDORE ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	04 Jan 2006
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1077947	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	18 Feb 2008
1092825	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	31 May 2009
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1512797	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	Compliance Audit	Complete	13 Mar 2013

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3085772975	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	Penalty Notice	Issued	23 Dec 2013
20476	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	619 Collector Road, TARAGO, NSW 2580	POEO licence	Issued	22 Dec 2014
3085776953	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	Penalty Notice	Issued	16 Jun 2015
1533738	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	08 Jul 2016
1544465	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	14 Oct 2016
1548651	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	619 Collector Road, TARAGO, NSW 2580	s.58 Licence Variation	Issued	03 Feb 2017
1550304	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	29 Mar 2017
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1558536	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	08 Nov 2017
1557352	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	BUNGENDORE ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	07 Mar 2018
1562544	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	22 Aug 2018
1569402	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	19 Sep 2018
1576804	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	06 May 2019
1583393	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	Compliance Audit	Complete	02 Aug 2019
1590396	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	04 Mar 2020
1607983	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	BUNGENDORE ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	26 Apr 2021
1607978	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	COLLECTOR ROAD, TARAGO, NSW 2580	s.58 Licence Variation	Issued	09 Jun 2021

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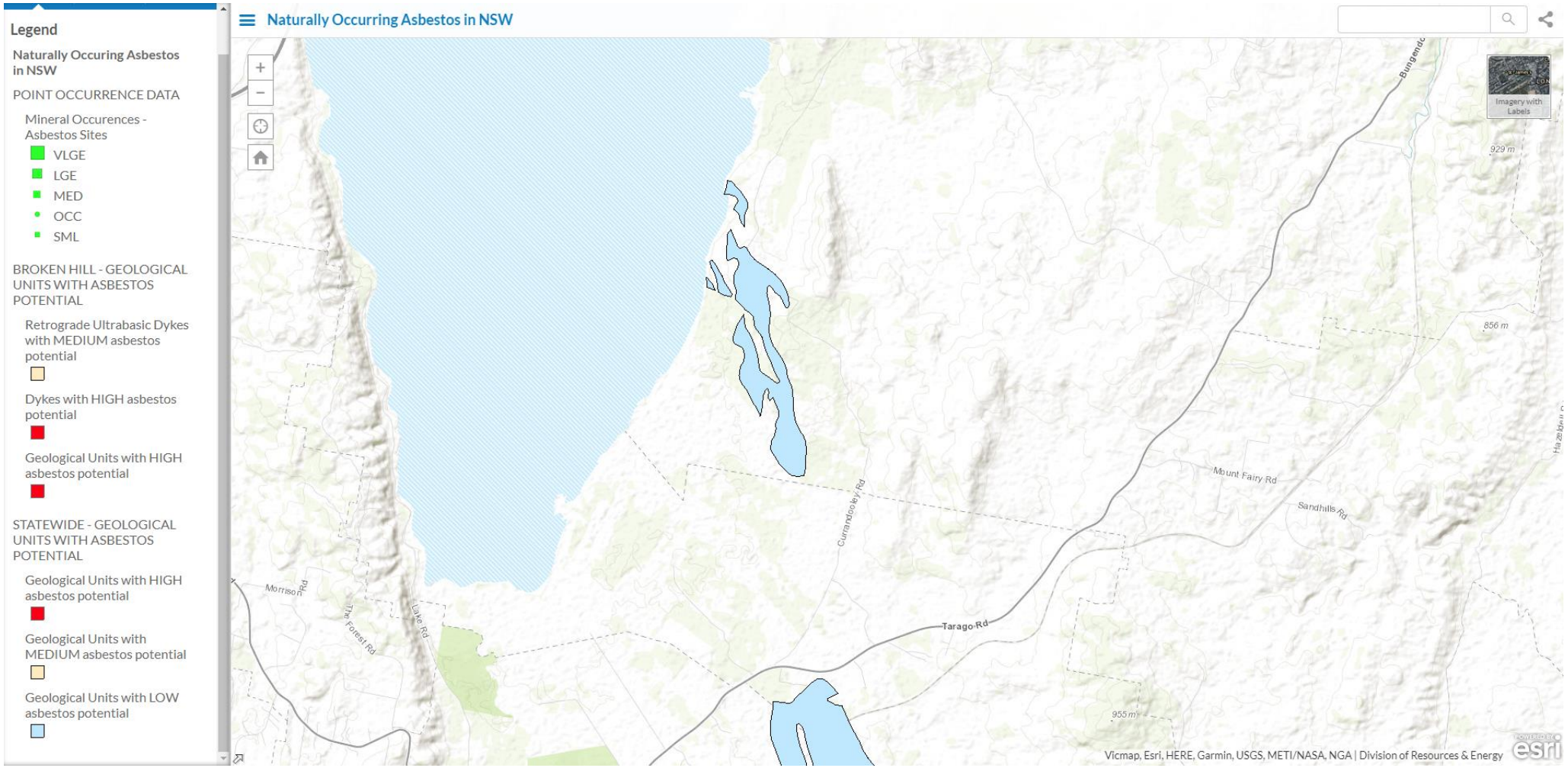
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Imagery with Labels
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856 m
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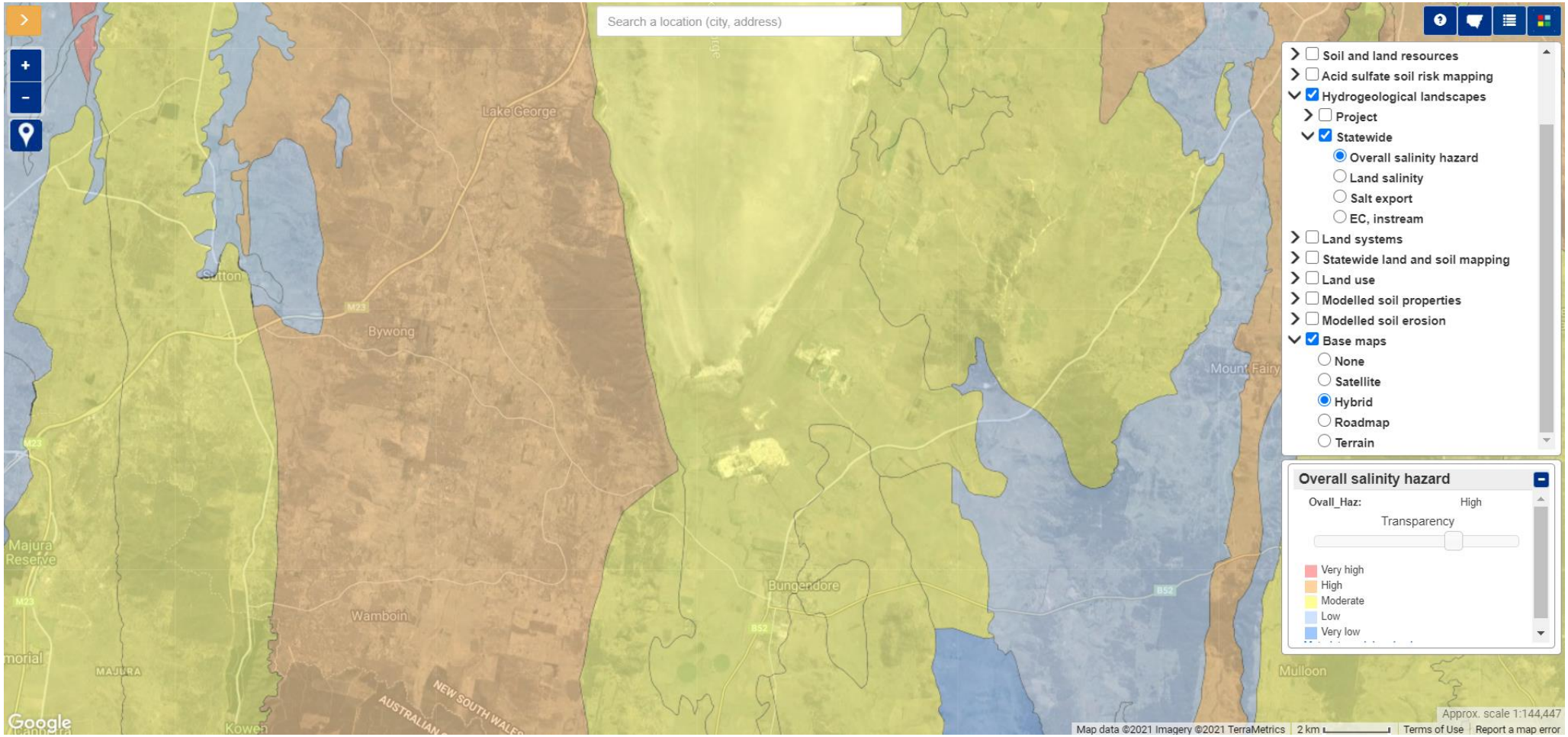
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Case name

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Determination type: ALL

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Ngambri Local Aboriginal Land Council #3	Ngambri Local Aboriginal Land Council v Attorney General of New South Wales	Unopposed	19/12/2012	Native title does not exist

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Report on
Preliminary Geotechnical Investigation

Proposed Blind Creek Solar Farm Development
Tarago Road, Lake George

Prepared for
Blind Creek Solar Farm Pty Ltd

Project 201482.00
May 2021

Document History

Document details

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Site address	Tarago Road, Lake George		
Report prepared for	Blind Creek Solar Farm Pty Ltd		
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Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	Sasi Sasiharan	Michael Jones	12 March 2021

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Status	Electronic	Paper	Issued to
Revision 0	1	0	Luke Osborne, Blind Creek Solar Farm 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.

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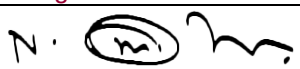
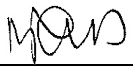
Author		12 March 2021
Reviewer		12 March 2021

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Report on Preliminary Geotechnical Investigation
Proposed Blind Creek Solar Farm Development
Tarago Road, Lake George

1. Introduction

This report presents the results of a preliminary geotechnical investigation undertaken for the proposed Blind Creek Solar Farm development at Tarago Road, Lake George. The investigation was commissioned in an email dated 15 February 2021 by Luke Osborne on behalf of Blind Creek Solar Farm Pty Ltd and was undertaken in accordance with Douglas Partners' proposal CAN200401 dated 9 February 2021.

It is understood that the proposed development of the site includes a farmer-led renewable energy development near Lake George, NSW. A preliminary geotechnical investigation of the site is required to assess the suitability of the site and risks associated with the potential solar farm development, particularly the suitability of driven piles for the solar panel footings.

The aim of the preliminary investigation was to broadly assess the subsurface soil and groundwater conditions to provide comments on:

- Subsurface and groundwater (if encountered) conditions at the field test locations;
- Site preparation and earthworks;
- Excavatability and temporary batter slopes;
- Site classification for soil reactivity based on the methods in AS 2870:2011;
- Suitability of driven steel or screw piles and strip/pad footings;
- Ultimate bearing pressures, shaft adhesion and possible shrink-swell related uplift pressures for the design of piles (founding within the depth of investigation);
- Allowable bearing pressures for shallow footing design;
- Subgrade California bearing ratios (CBRs) for the design of pavements (by others);
- Results of earth resistivity (ER) testing (for interpretation by others); and
- Comments on soil aggressivity to buried steel and concrete in accordance with AS 2159:2009.

The investigation included the drilling of eleven boreholes, excavation of two test pits, two electrical resistivity tests and laboratory testing of selected samples. The details of the field work are presented in this report, together with comments and recommendations on the items listed above.

2. Proposed Development

It is understood that the solar farm would comprise an array of solar panels and associated infrastructure including substations, inverters, batteries, underground cabling, pavements and fences. It is anticipated that driven steel piles will be the preferred method of panel support and only minor earthworks would be required over parts of the site to prepare level platforms for the substations, and shallow excavations for service trenches. Most excavations are expected to be less than about 1.5 m deep.

3. Site Description

The site is located near the shoreline of Lake George (which is predominantly dry), approximately 7.5 km north of Bungendore and 35 km north east of Canberra. The site is located on either side of Currandooley Road, approximately 1.5 km north of Tarago Road. The site is approximately 791 ha in size and can be divided into three main sections: the easternmost section for the proposed substation and battery platform, a section directly east of Currandooley Road, and the main section west of Currandooley Road.

The substation and proposed battery platform are proposed for the eastern section of the site, within a lot licensed for a sand quarry. This section of the site is approximately 15.2 ha in area and slopes from the north to the south. Pine trees from a previous tree plantation are located across the site, with heights of up to 30 m. A creek runs north-south along the eastern border of the site. Figure 1 below shows the proposed location of the substation, to the east of Pit 13.

The section directly southeast of Currandooley Road is made up of several paddocks, with an area of 32.3 ha and comprises of near-level paddocks with grassy vegetation. Silage pits were located within the central paddock, and a water trough is located in the south western corner of the section. A row of trees separates this section of the site from the substation/battery platform section.

The main section of the proposed solar development is located to the west of Currandooley Road and extends approximately 4.75 km north west to the edge of Lake George, with a total area of approximately 743.6 ha. The section is made up of near-level paddocks, with a maximum height difference within the section of approximately 12 m. At the time of site investigation, the paddocks were covered with moderate to dense natural and exotic grassy vegetation, with heights ranging from 0.5 m to 2.5 m. An ephemeral waterhole is located in the north western corner, which is understood to hold water in very wet periods for a short time, while a creek runs along the south western boundary of the site. Groups of trees are located sporadically across the site. A grassy airstrip and large aviation shed for an amateur aviation club is located in the north eastern section of the site. Small parts of the section had no vegetation growing and had exposed soil. Farm tracks for access through the paddocks were located across the site. Figure 2 and Figure 3 below show typical sections of the site with moderate to dense vegetation and sections of exposed sand.

Figure 1: View of proposed substation location

Figure 2: View looking north from Bore 6

Figure 3: View of dense vegetation along a farm track

4. Regional Geology

Reference to BMR (1992) indicates the western portion of the site is underlain by Quaternary aged deposits such as alluvium, colluvium, aeolian and strandline. Alluvium soils comprise gravel, sand, silty clay and black organic clay. Strandline deposits which are paleo-beach deposits that developed as sand spits along the shoreline and relate to the receding shore of the lake. The method of strandline formation generally results in a higher portion of sand and gravel than alluvium that has been deposited under quiescent conditions. Colluvium deposits comprise fanglomerate and poorly cemented conglomerate, gravel and sand. Aeolian deposits comprise fine quartz sand. The eastern section of the site is underlain by the Ellenden Granite of the Bega Batholith Group of early Devonian age.

5. Field Work

5.1 Field Work Methods

The fieldwork comprised the excavation of two test pits (Pits 1 and 13), drilling of 11 boreholes (Bores 2 - 12) and two ER tests. Dynamic cone penetrometer (DCP) tests were undertaken adjacent to all test pits and bores to depths of 1.2 m or prior refusal in accordance with test method AS 1289:6.3.2. The bores and pits were logged onsite by a geotechnical engineer and incorporated the collection of disturbed, auger and bulk samples to assist in strata identification and for laboratory testing. The approximate locations of the boreholes and test pits are shown on Drawing 1 (Appendix B).

The test pits were excavated using a Kobelco SK300C excavator (~30 tonne) fitted with a 1100 mm wide bucket to depths of 3 m and 5 m. Pit 1 was excavated within the proposed battery platform for the solar farm, whilst Pit 13 was excavated within the vicinity of the proposed substation. The boreholes were drilled using a Komatsu PC45MR mini-excavator (~4.5 tonne) fitted with a 450 mm diameter auger to depths of between 2.7 m and 3.2 m.

Electrical resistivity (ER) testing was undertaken using a Megger DET4TCR2 earth test, to take vertical electrical soundings (VES), in accordance with the four point "Wenner" soil resistivity method, as summarised in Appendix C of AS 1768:2007. The ER testing was undertaken at two locations, designated ER 1 and ER 2. ER 1 is located within the vicinity of the proposed substation, while ER 2 is located along the proposed energy transmission route. The electrodes were spaced at intervals of 0.5 m, 1 m, 2 m, 4 m, 6 m, 8 m, 10 m and 12 m in north-south and east-west orientations. All field measurements were stable and repeatable.

5.2 Field Work Results

Details of the conditions encountered in the boreholes and test pits are given in the logs included in Appendix C. These must be read in conjunction with the accompanying standard notes which define classification methods and descriptive terms. The results of the resistivity testing are provided in Appendix D.

The principal succession of strata encountered in the test pits and boreholes are summarised below.

Test Pits (Pits 1 and 13)

- TOPSOIL: SILTY SAND, very loose, fine to medium grained, trace low plasticity fines to a depth of between 0.25 m and 0.3 m.
- SAND: varying very loose to very dense, fine grained, trace low plasticity clay, from a depth of 0.25 m - 0.3 m to depths of 1.0 m and 2.0 m.
- CLAY/CLAYEY SAND: low to high plasticity, stiff to very stiff/dense to very dense, from depths of 1 m to 2 m to the termination depths of 5 m and 3 m.

Boreholes (Bores 2 – 12)

- TOPSOIL: SAND, varying loose to medium dense, to depths of between 0.15 m and 0.2 m in all bores.
- SAND: varying loose to very dense, fine to medium grained from depths of 0.15 m – 0.2 m to depths of 0.9 m – 3 m encountered in all bores except Bore 10. Bore 5 was terminated within this stratum.
- SILTY CLAY/SANDY CLAY/CLAYEY SAND: low to high plasticity, varying loose/soft to very dense/hard, from depths of 0.2 m – 2.1 m to depths of 2.05 m – 3.2 m, encountered in all bores except Bore 5.

Colluvial and strandline soils were not encountered in the test pits and bores. As the test locations are located approximately 1 km apart, these soil formations may have been missed.

5.3 Groundwater

Free groundwater was observed within Bores 3, 4, 6, 8, 9 and 10 from depths below 1.5 m to 2.8 m. Table 1 below shows the depths of groundwater encountered. It should be noted that groundwater conditions rarely remain constant and can change seasonally due to variations in rainfall and other factors.

Table 1: Summary of Groundwater Depths

Bore	Groundwater Depth (m) as of 17/2/2021
3	1.5
4	2.2
6	2.3
8	2.5
9	2.8
10	2.0

6. Laboratory Testing

14 samples collected from the site investigation were tested in DP's soil testing laboratory for measurement of plasticity properties, linear shrinkage, particle size distribution (PSD), Shrink/Swell index (Iss), California bearing ratio (CBR) and compaction properties. Soil aggressivity testing was carried out by Envirolab Services Pty Ltd. The detailed laboratory test report sheets are given in Appendix E with the results summarised in Tables 2 – 5.

Table 2: Results of Compaction and Soaked CBR Testing

Test Pit/Bore	Sample Depth (m)	Compaction Test			Soaked CBR Test		Material
		FMC (%)	OMC (%)	MDD (t/m^3)	CBR (%)	Swell (%)	
Bore 4	0.4 – 0.6	4.7	10	1.86	40	0	Sand
Bore 7	1.4 – 1.8	17.7	15.5	1.83	6	0	Clay
Bore 9	0.4 – 0.6	5.2	13.5	1.72	17	0	Sand
Bore 10	1.1 – 1.3	11.6	13.5	1.90	10	0	Clay
Pit 13	1.0 – 1.2	5.9	13.5	1.68	35	0	Sand

Where: FMC = Field Moisture Content MDD = Maximum dry density (standard)
OMC = Optimum Moisture Content CBR = California bearing ratio (soaked)

Table 3: Result of Moisture Content, Soil Index and Shrink Swell Tests

Test Pit/Bore	Sample Depth (m)	FMC (%)	W_L (%)	W_P (%)	PI (%)	LS (%)	Shrink Swell Index (%)	Material
Bore 2	1.3 – 1.4	14.4	NP	NP	NP	NP	-	Clayey Sand
Bore 6	1.5 – 1.7	20.9	40	16	24	7.5	2.1	Clay
Bore 7	1.4 – 1.6	17.1	26	19	7	4	1.3	Clay
Bore 9	1.1 – 1.2	9.0	27	14	13	5	-	Sandy Clay
Bore 10	1.1 – 1.3	11.7	23	14	9	3	1.5	Clay
Bore 12	1.4	17.5	34	15	19	8	-	Clay

Where: FMC = Field moisture content W_P = Plastic limit W_L = Liquid limit
PI = Plasticity index LS = Linear shrinkage NP = Non Plastic

Table 4: Results of Particle Size Distribution Tests

Test Pit	Sample Depth (m)	Percent passing sieve size (%)						Material
		53.0 mm	26.5 mm	6.7 mm	4.75 mm	2.36 mm	0.075 mm	
Bore 2	1.3 – 1.4	100	100	98	98	98	17	Clayey Sand
Bore 9	1.1 – 1.2	100	100	99	97	88	2	Sand

Table 5: Results of pH, Conductivity, Chloride and Sulfate Testing

Pit/Bore No.	Depth (m)	Field Description	pH	Chloride (mg/kg)	Sulphate (mg/kg)	Electrical Conductivity (µS/cm)	Resistivity (2) (ohm.cm)
13	2.7	Clayey Sand	5.8	<10	<10	10	100000
3	0.6	Sand	6.4	<10	<10	13	76923
5	1.5	Sand	8.1	<10	<10	35	28571
8	1.4	Clayey Sand	7.4	<10	10	37	27027
11	0.6	Sand	6.8	<10	20	39	25641
Criteria for "Non-aggressive" Soil Conditions (low permeability soils or soils above the groundwater table) (1)			>5.5 (concrete) >5.0 (steel)	<5,000 (steel)	<5,000 (concrete)	-	>5,000 (steel)

7. Comments

7.1 Appreciation of Subsurface Conditions

The subsurface conditions were relatively consistent across the site, with deep sand profiles across the site interspersed with layers of clays and clayey sands with varying (low to medium) plasticity. Rock was not encountered within any of the pits or bores.

Free groundwater was observed during the field investigation within six of the bores. Due to the close proximity of the Lake George, the groundwater levels at the site are highly likely to be affected by seasonal rainfall and may vary considerably from time of investigation compared to at the time of construction.

The laboratory testing indicates that the clayey soils tested have a moderate propensity for shrinking and swelling with soil moisture content fluctuations.

7.2 Geotechnical Constraints

It is understood that the solar panel piling methodology is the primary geotechnical consideration for this project. The site is underlain by deep aeolian or alluvial soils, for which it is expected that driven or screw piles will not be problematic. Although not encountered in the test pits or bores, there may be possibility for colluvial cobbles and boulders to be buried within the aeolian/alluvial soils, particularly near Pits 1 and 13 due to their proximity to neighbouring hills. This should be assessed during the detailed geotechnical investigation.

During fieldwork, apparently very loose to loose sand and soft clay towards Lake George were observed below depths of approximately 1.7 m – 2.9 m within Bores 4, 7, 9 and 10. As DCP testing was terminated at 1.8 m or prior refusal, such densities and strengths are approximations only. Due to the low strength properties combined with shallow groundwater table, pile footings may need to penetrate through these layers of low strengths and to be founded in deeper soils with a higher bearing capacity.

7.3 Excavation Conditions

The natural soils should be excavatable using conventional earthmoving plant such as scrapers (with push loading and some pre-ripping in very stiff and hard soils to assist with production rates) and small excavators (i.e. up to about 15 tonne operating mass). The exception would be difficulties arising from any buried obstructions within the soil matrix such as boulders. No cemented sands or desiccated clays were encountered during the field investigations; however, should cemented/desiccated soils be encountered they should also be excavatable with such plant potentially at a slower progress. It is not anticipated that excavation of bedrock will be required during construction.

7.4 Temporary Batters

The following short term temporary batter slopes are suggested for excavations up to 3 m depth:

Table 6: Recommended Maximum Temporary Batter Slopes in Cut

Strata	Temporary Batters
Soft to firm Clay	2(H):1(V)
Stiff to hard Clay	1(H):1(V)
Loose Sand (above groundwater)	3(H):1(V)
Medium dense to dense Sand (above groundwater)	2(H):1(V)

Should limited space or other reasons prevent sides of excavations being battered at the slopes recommended in Table 6, and if excavation depths are greater than 3 m then structural supports would be required. If excavation below groundwater level is required, it should be assessed by a qualified geotechnical engineer.

7.5 Re-Use of Excavated Materials

Any topsoils and heavily rootlet or root affected soils are considered unsuitable for re-use in engineering applications. The low to high plasticity clays and sands/clayey sands are considered suitable for re-use in engineered fill provided they are blended to produce a well graded material of sufficient plasticity for moisture conditioning and compaction.

Prior to re-use as engineered fill, the site soils will need to be conditioned to within 2% of OMC. Based on the CBR testing, the site soils are between 2.2% wet and 8.3% dry of OMC, however moisture conditioning required will depend largely on the location and depth of source soils within the site and the soil moisture content at the time of construction works.

7.6 Site Preparation Measures

The silty topsoil, and where present any underlying silts, are expected to experience significant reduction in shear strength on becoming wet and can quickly become boggy. To help overcome this during construction, a layer of coarse rock fill or recycled concrete at least 300 mm thick could be placed where concentrated traffic is expected.

It is recommended that subgrade areas that are to support ground slabs and vehicular pavements should be prepared in accordance with the following general guidelines:

- Strip and excavate all existing fill, topsoil, roots, vegetation, silts, moisture weakened soils and any other potentially deleterious materials. Deeper excavation may be necessary should thicker topsoils or unsuitable materials be encountered, especially if inclement weather precedes construction or if the contractor adopts inappropriate stripping methods;
- Obtain a preliminary inspection by a geotechnical engineer who should assess whether the exposed subgrade is suitable or whether further excavation or other treatment may be required; Tyne and homogenise the subgrade to at least 150 mm depth, adjust the moisture content of the mixed material to within about 2% optimum moisture content (OMC), and leave long enough or overnight to allow the soil to “cure” ;
- Roll the tyned, moisture conditioned surface with at least six passes of a minimum 10 tonne deadweight roller with a final test roll pass in the presence of a geotechnical engineer. The subgrade surface should not exhibit excessive deformation or springing under test roll.
- Areas of prepared subgrade that are found to deform significantly under test rolling should be either excavated and replaced with compacted approved fill or improved by other method as advised by the geotechnical engineer. Depth of over-excavation should not exceed 500 mm depth without further geotechnical advice.
- Place and compact new fill in horizontal layers up to 150 mm compacted thickness. In confined working areas or in situations where compaction may be difficult to achieve, thinner layers may be required. Uniformly moisture condition the fill material to within 2% of OMC. Suggested compaction requirements for the fill are presented in Table 7.

Table 7: Suggested Compaction Requirements

Purpose	Minimum Dry Density Ratio
Lightly loaded* and non-structural	95% standard
Heavy floor load support	98% standard
Footing support	100% standard
Pavements : > 500 mm below subgrade level < 500 mm below subgrade level	98% standard 100% standard

Note: * - < 10 kPa including low level small structures

Full time supervision of fill placement and compaction testing to a Level 1 standard, as defined in Section 8 of AS 3798:2007 is required where structural loads are supported on compacted fill. A Level 1 report should be prepared at the completion of the works stating that the fill has been satisfactorily constructed and capable of supporting building slabs and light weight footings.

7.7 Reactive Soil Movements

Site classification in accordance with AS 2870:2011 can be used to assess reactive movements of foundation soils and hence indicate the potential for cracking in brittle materials such as concrete, blockwork and tiles. Although strictly only applicable to low level residential buildings (up to two storeys), AS 2870:2011 may be considered at this site to assist with the design of structures supported by slab on ground, or separate single storey control and equipment rooms, provided that the footing loads and layouts are similar to those in AS 2870:2011. For this development, site classification is considered likely to be relevant only to future ancillary buildings.

From investigation results, the site is found to be covered by a sand layer with thickness varying between 0.8 m and 3 m. Therefore, reactive movement of foundation soils within the design suction depth is likely to be very low. The shrink-swell index values indicated that the clayey soils at the site is slightly to moderately reactive. Considering the above, the site would be classified as Class S (slightly reactive site).

Comments on site maintenance, vegetation and drainage are given in CSIRO (2003). As a brief guide, the characteristic surface movement estimates given above rely on appropriate precautions against adverse seasonal moisture variation in founding soils. Site maintenance for this development should as a minimum include the following:

- Providing adequate surface drainage, accessible for maintenance; and
- Careful backfilling of service trenches (i.e. limited use of permeable backfill materials so as not to provide a conduit for groundwater or a high level of connectivity with surface water).
- Any landscaping/trees/vegetation management requirements.

7.8 Indicative Strength Parameters

Table 8 below presents suggested indicative drained and undrained strength parameters for the range of soils encountered during the investigation. These parameters are based on presumptive values presented in published literature, including Appendix D of AS 4678:2002.

Table 8: Indicative Strength Parameters - Preliminary

Material	Bulk Unit Weight (kN/m^3)	Effective Friction Angle, φ' (degrees)	Effective Cohesion, c' (kPa)	Undrained Shear Strength (kPa)
Firm clays	17	22	1	25
Stiff clays	18	25	2	50
Very stiff clays	19	25	5	100
Hard clays	20	25	10	200
Loose to medium dense sand	17	28	0	-
Medium dense to dense sand	20	35	0	-

7.9 Shallow Footings

High level conventional small pad or strip footings would be suitable for the support of lightly loaded structures, if they found in 'controlled' fill or natural soils of sufficient strength.

A maximum allowable bearing pressure of 50 kPa is suggested for the design of high level pad or strip footings founding in either at least firm clays or loose sand, 100 kPa for stiff clays or controlled fill, and 200 kPa for very stiff clays or medium dense sand soils.

The settlement of a spread footing is dependent on the stiffness of the founding stratum, dimensions of the footing and the load applied. As a guide, a 1 m wide footing proportioned on the basis of the above parameters would experience settlement of less than about 10 mm to 20 mm (1% to 2% of the footing width) under application of the indicated allowable bearing pressures. Differential settlements between adjacent footings founded in similar strata are expected to be less than about 50% of the total settlement values. Regardless, it is recommended a detailed settlement analysis undertaken once the footing dimension and loading are determined.

7.10 Pile Footing

Driven piles, Continuous Flight Auger (CFA), screw or bored piles are considered suitable for the subsurface conditions encountered at the sites. Pile length and size would depend on the structural loading and settlement criteria for the solar panels.

Bored and CFA piles would likely provide a more controlled and effectively designed mechanism for resisting lateral and uplift loading (such as due to swelling forces) than driven piles or screw piles, however, they are likely to be considerably more expensive.

For comparison purposes, design parameters for both driven steel piles and screw piles have been provided below. It is recommended that input from a specialist pile designer and contractor be obtained.

7.10.1 Driven Steel Piles

The ultimate parameters shown in Table 9 are suggested for the design of driven steel piles with length on diameter ratios of at least four, subject to vertical compressive and uplift loads.

The shaft adhesion developed over the upper 1 m should be ignored in pile capacity calculations due to seasonal soil cracking or soil disturbance occur during driving.

Table 9: Ultimate Unfactored Driven Steel Pile Design Parameters – Preliminary

Founding Material	Ultimate Unfactored Pressure (kPa)		
	End Bearing	Shaft Adhesion	
		Compression	Tension
Firm to stiff clays (i.e. $c_u \geq 50$ kPa)	450	25	15
Very stiff clays (i.e. $c_u \geq 100$ kPa)	900	50	30
Loose to medium dense sand	$200H_1$	$5H_2$	$2H_2$
Medium dense to dense sand	$500H_1$	$10H_2$	$5H_2$

Notes:

All pile end bearing parameters are based on pile penetration of at least four pile diameters or 3 m whichever is greater, below the ground surface.

H_1 – depth to pile toe (in metres), limited to 8 times pile diameter in medium dense sand

H_2 – depth to centre of pile shaft within sand layer (in metres), limited to 8 pile diameters in medium dense sand

The pile parameters presented above are unfactored ultimate values. A basic geotechnical strength reduction factor (ϕ_{gb}) of 0.4 is recommended for limit state design of piles in accordance with AS 2159:2009. This is based on the data presented in this report, the method of soil strength assessment used in this investigation and after assessing the overall design average risk rating (ARR) for the site, design and installation risk factors anticipated for a low redundancy piling system. Higher values of ϕ_{gb} may be applied if additional investigation is carried out at the site, or higher geotechnical strength reduction factor (ϕ_g) may be adopted if selected piles are subjected to confirmatory load testing.

7.10.2 Screw Piles

Steel screw piles typically have a circular hollow section (CHS) shaft, with a diameter of 130 mm to 220 mm, and a helical steel plate (up to 750 mm diameter) welded to the base of the shaft.

It is suggested that steel screw piles be founded in at least very stiff clays or dense sand. Table 10 presents the parameters for screw pile design. Due to installation disturbance, it is recommended that the shaft friction on screw piles should be ignored, which is beneficial with respect to uplift pressure alleviation in this instance.

Table 10: Ultimate Unfactored Pile Design Parameters for Steel Screw Piles - Preliminary

Founding Material	Ultimate Unfactored Pressure (kPa)	
	End Bearing	Shaft Adhesion
Firm to stiff clays	450	-
Very stiff clays	900	-
Loose to medium dense sand	600	-
Medium to dense sand	1200	-

Notes:

All pile end bearing parameters are based on pile penetration of at least four pile diameters or 3 m whichever is greater, below the ground surface.

For uplift, screw pile capacity may be checked using the weight of soil in a cylinder above the helix, using an average buoyant (assuming a high groundwater table in the worst case) soil density of 9 kN/m^3. As previously indicated, shaft adhesion is normally ignored for screw piles.

If steel screw piles are used, piles should be installed by experienced contractors, then capacities checked by field load testing. Installation torque measurement should not be relied upon to indicate pile capacity, as it has been documented that significantly misleading results can be obtained. It is also important that steel screw piles are carefully installed so they are not 'overspun' prior to design founding level. In this scenario, pile over-rotation disturbs the soils above the helix, potentially reducing helix bearing capacity and/or increasing pile movements. This phenomenon is often encountered where piles encounter an underlying harder stratum and the penetration rates are lower than pile pitch.

Steel screw pile structural capacity should be checked, and due allowance made for inclined or eccentric loads, and possible corrosion effects. To minimise deflection under load, helix plate thickness should be at least 40 mm (or 25 mm if pile working loads are less than about 600 kN). For helix outstand to plate thickness ratios of greater than approximately 10, consideration should be given to possible plastic hinge formation, which would reduce the effective helix diameter and the pile capacity. Although the test load nominated by AS 2159:2009 is unlikely to be achieved for piles with insufficient helix plate thickness, failure would not be expected to occur at normal serviceability loads.

In this regard, it should be noted that AS 2159:2009 requires compressive load testing of piles to be undertaken to a test load of E_d/ϕ_g. For a typical geotechnical strength reduction factor (ϕ_g) of approximately 0.4, this test load is 2.5 times the design action effect (E_d). The results of steel screw pile load tests, however, typically indicate that plastic deformation of the helix can occur when a screw pile is loaded to only 1.5 times E_d approximately, for piles with a helix outstand to plate thickness ratio of greater than about 10. For these piles, therefore, failure can occur prior to achieving required test load.

7.10.3 Lateral Load

Lateral capacity of piles can be estimated using Broms' Theory and the parameters as indicated in Table 11.

Table 11: Ultimate Unfactored Lateral Design Parameters - Preliminary

Material	Passive Earth Pressure Coefficient, K_p	Ultimate Passive Pressure (kPa)
Firm clays	2.1(1)	50(2)
Stiff clays	2.2(1)	100(2)
Very stiff clays	2.4(1)	200(2)
Hard clays	2.8(1)	400(2)
Loose sand	2.6	$3K_p\sigma_v'$(3)
Medium dense to dense sand	3.6	$3K_p\sigma_v'$(3)

Where σ_v' – average vertical overburden pressure

Notes: (1) use K_P for sustained long term loading in clays (2) use passive pressure for short duration loading in clays

(3) applicable for pile spacing greater than 5xD (diameter); reduction factors should be applied for pile spacing less than 5xD

The response of piles to lateral load can alternatively be assessed by p-y curves, elastic continuum or finite element methods.

It should also be noted that the above parameters (both for the assessment of lateral load resistance and deflection) are ultimate values and do not incorporate a factor of safety. Because the stress-strain relationship curve for lateral loading is not linear, relatively large strains are required to mobilise full passive pressure but only relatively small strains are required to mobilise half the passive pressure, therefore it would be prudent to incorporate a factor of safety of at least two.

As for vertical loading, the upper 1 m depth of soil should be ignored due to seasonal cracking and soil disturbance.

For a large solar farm development, the lateral capacity often governs the pile depth. It is noted that the pile design parameters provided in Table 11 may be conservative for the pile design. A detailed pile capacity assessment combined with pile load testing is recommended during detailed design stage to optimise the pile size and lengths for the site conditions.

7.11 Earthquake Loading

Reference to Figure 3.2(A) of AS 1170.4:2007 indicates a hazard factor (Z) of 0.09 for Lake George. As bedrock was not encountered in any of the test locations, and the maximum depth of investigation is 5 m, the depth to bedrock could not be established. As such, based on the results of the investigation, the site could be given a subsoil classification of 'Class D_e', deep or soft soil site.

Deep boreholes are required to assess that the site could be classified as 'Class C_e', shallow soil site.

7.12 Soil Aggressivity

The soil aggressivity test results are included in Appendix D and are summarised in Table 5 in Section 6. The results indicate that based on the soils/rock the exposure classification for concrete and steel is *Non-Aggressive*.

7.13 Design Subgrade CBR

Laboratory testing undertaken on two samples of the dominant natural clay subgrade returned CBR values of 6 and 10 %, whereas sandy soils returned the values of 17, 35 and 40 %. Based on these results, and our experience, it is suggested that a design subgrade CBR of 4% be adopted for the natural clayey soils and 9% for sandy soils, subject to inspection and confirmation by a geotechnical engineer, and adoption of the subgrade preparation treatment described in Section 6.2.

8. References

AS 1170.4:2007, *Structural design actions, Part 4: Earthquake actions in Australia*, Standards Australia.

AS 2159:2009, *Piling – Design and Installation*, Standards Australia.

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

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

AS 4678:2002, *Earth-Retaining Structures*, Standards Australia.

CSIRO (2003), *BTF 18, Foundation Maintenance and Footing Performance: A Homeowner's Guide*, Commonwealth Scientific and Industrial Research Organisation.

BMR. (1992). *Geology of Canberra 1:100 000 Geological Series Sheet 8727.* Bureau of Mineral Resources.

9. Limitations

Douglas Partners (DP) has prepared this report for this project at Tarago Road, Lake George in accordance with DP's proposal CAN200401.00.P.001.Rev 2 dated 9 February 2021 and acceptance received from Luke Osborne on behalf of Blind Creek Solar Farm Pty Ltd dated 15 February 2021. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Blind Creek Solar Farm Pty Ltd 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 for 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 filling 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 filling 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

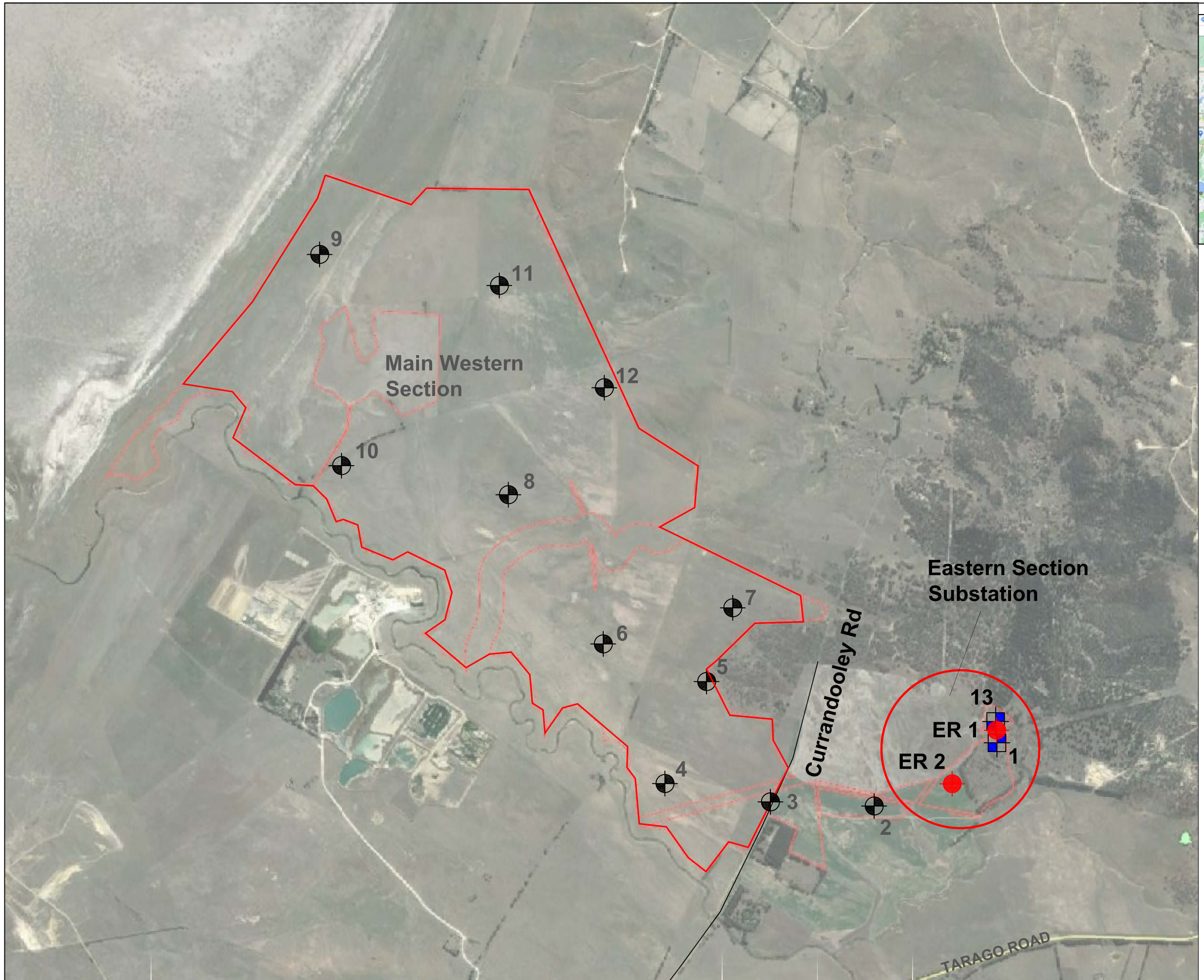
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate 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

Drawing 1



Locality Plan

LEGEND

- Test Pit Location
- Test Bore Location
- ER Test Location
- Approximate Site Boundary

0 250 500 750 1000 12500

1:25000 @ A3

NOTE: Base drawing from Google Earth (dated 4/8/2019)
Scales are approximate and not to be relied upon

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Blind Creek Solar Farm Pty Ltd		TITLE: **Test Location Plan**	PROJECT No: 201482.00
OFFICE: Canberra	DRAWN BY: ADFH	**Proposed Solar Development - Blind Creek Solar Farm**	DRAWING No: 1
SCALE: As Shown	DATE: 18.02.2021	**Tarago Road, Lake George**	REVISION: 0

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

Douglas Partners

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approximate Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

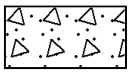
Symbols & Abbreviations

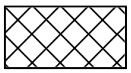
Graphic Symbols for Soil and Rock

General

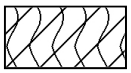

Asphalt

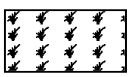

Road base

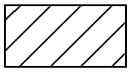

Concrete

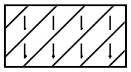

Filling

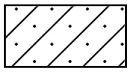
Soils


Topsoil

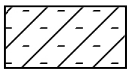

Peat

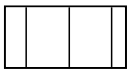

Clay

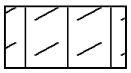

Silty clay

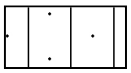

Sandy clay

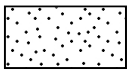

Gravelly clay

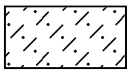

Shaly clay

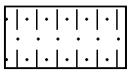

Silt


Clayey silt


Sandy silt

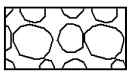

Sand

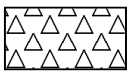

Clayey sand


Silty sand


Gravel

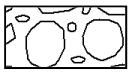

Sandy gravel


Cobbles, boulders

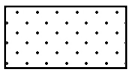

Talus

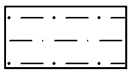
Sedimentary Rocks

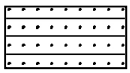

Boulder conglomerate

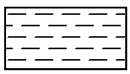

Conglomerate


Conglomeratic sandstone

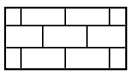

Sandstone


Siltstone

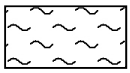

Laminite

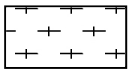

Mudstone, claystone, shale

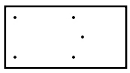

Coal


Limestone

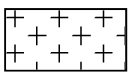
Metamorphic Rocks

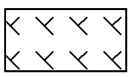

Slate, phyllite, schist

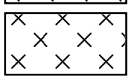

Gneiss

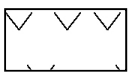

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

TEST PIT LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 720 AHD
EASTING: 727966
NORTHING: 6102635

PIT No: 1
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
720		TOPSOIL/Silty SAND (SM): fine to medium grained, grey brown, poorly graded, low plasticity fines, with rootlets, moist, very loose, TOPSOIL							
	0.3	SAND (SP): fine grained, pale grey/brown, poorly graded, trace silt, moist, very loose to loose, aeolian							
719	1 1.0	CLAY (CI/CH): medium to high plasticity, red/grey, brown, with fine grained sand, moist, w<PL, stiff to very stiff, alluvial							
	1.1	Clayey SAND (SC): fine grained, yellow brown, poorly graded, low plasticity clay, moist to dry, dense to very dense, alluvial							
718	2			B	2.0				
					2.2				
717	3	-from 3.0m, loose to medium dense		E	3.0				
				B	3.1				

RIG: Kobelco SK300C excavator fitted with a 1100mm bucket

LOGGED: ADFH

SURVEY DATUM: MGA94 Zone 55

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 720 AHD
EASTING: 727966
NORTHING: 6102635

PIT No: 1
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
716	4	Clayey SAND (SC): fine grained, yellow brown, poorly graded, low plasticity clay, moist to dry, dense to very dense, alluvial *(continued)* -from 3.5m, dense to very dense		B	4.5 4.6				4
715	5	5.0 Pit discontinued at 5.0m -limit of investigation							5
714	6								6

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Kobelco SK300C excavator fitted with a 1100mm bucket

LOGGED: ADFH

SURVEY DATUM: MGA94 Zone 55

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 716 AHD
EASTING: 727976
NORTHING: 6102744

PIT No: 13
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
716		TOPSOIL/Silty SAND (SM): fine to medium grained sand, grey brown, poorly graded, low plasticity fines, with rootlets, moist, very loose, TOPSOIL							
	0.25	SAND (SP): fine grained sand, pale yellow/grey, poorly graded, trace silt, moist, very loose to loose, alluvial							
		-from 0.8m, moist to dry							
715	1				1.0				1
		-from 1.05m, medium dense		B					
		-from 1.2m, dense to very dense			1.2				
714	2 2.0	Clayey SAND (SC): fine grained, yellow brown, poorly graded, low plasticity clay, moist to dry, dense to very dense, alluvial							2
				E	2.5				
				D	2.7				
713	3 3.0	Pit discontinued at 3.0m -limit of investigation							3

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Kobelco SK300C excavator fitted with a 1100mm bucket

LOGGED: ADFH

SURVEY DATUM: MGA94 Zone 55

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 694 AHD
EASTING: 727119
NORTHING: 6102202
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
694	0.2	TOPSOIL/SAND (SM): fine to medium grained, grey brown, poorly graded, trace low plasticity fines, with rootlets, moist, medium dense, TOPSOIL							
		SAND (SP): fine grained, pale yellow grey, poorly graded, trace silt, moist to dry, loose to medium dense, aeolian		B	0.5				
					0.7				
		-from 0.75m, medium dense							
693	1	-from 0.95, dense to very dense							1
	1.2	Silty SAND (SC): fine grained, grey brown, poorly graded, non plastic silt, moist to dry, dense to very dense, alluvial		B	1.3				
					1.4				
	1.6	Clayey SAND (SC): fine to coarse grained, grey brown, low plasticity clay, trace gravel to 60mm and cobble to 120mm, moist, dense, alluvial		A	1.7				
692	2			A	2.1				2
	2.3	CLAY (CL/CI): low to medium plasticity, brown, with silt and fine grained sand, trace very high strength cobbles to 75mm, moist to dry, w<PL, very stiff to hard, alluvial		E	2.4				
				A	2.5				
	2.7	Bore discontinued at 2.7m -slow progress							
691	3								3

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 688 AHD
EASTING: 726441
NORTHING: 6102229
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
688	0.2	TOPSOIL/SAND (SM): fine to medium grained, grey brown, poorly graded, trace low plasticity fines, with rootlets, moist, loose, TOPSOIL							
		SAND (SP): fine grained, pale yellow/grey, poorly graded, trace silt, moist to dry, medium dense, aeolian		B	0.5				
				E	0.6				
	0.9								
687	1	SAND (SP): fine to medium grained, orange/grey brown, poorly graded, trace silt, moist to dry, dense, alluvial			1.1				1
				B	1.3				
				A	1.5			▽	
	1.9								
686	2	CLAY (CI/CH): medium to high plasticity, red/grey brown, with fine to coarse grained sand, moist, w<PL, very stiff, alluvial		A	2.0				2
	2.05	Clayey SAND (SC): fine grained, pale yellow/grey, low plasticity clay, moist to dry, dense to very dense, alluvial							
				B	2.4				
					2.5				
	2.7	Bore discontinued at 2.7m -side wall collapse							
685	3								3

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: Free groundwater observed at 1.5m, moderate inflow

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 684 AHD
EASTING: 725752
NORTHING: 6102349
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
684	0.2	TOPSOIL/SAND (SM): fine to medium grained, grey brown, poorly graded, trace low plasticity fines, with rootlets, moist, very loose, TOPSOIL							
		SAND (SP): fine grained, pale grey brown, poorly graded, trace silt, moist to dry, very loose to loose, aeolian		B	0.4				
					0.6				
		-from 0.75m, medium dense							
683	1	-from 1.1m, orange brown		E	1.4				
				B	1.5				
					1.6				
	1.8	SAND (SW): fine to coarse grained sand, dark grey brown, well graded, trace silt and low plasticity clay, moist to wet, medium dense, alluvial							
682	2	-from 2.2m, wet, loose to medium dense		A	2.2			▽	
	2.8	SAND (SP): fine grained quartz sand, orange brown, mottled grey, poorly graded, trace silt, wet, apparently loose to medium dense, alluvial		A	2.9				
681	3								
	3.1	Bore discontinued at 3.1m -limit of investigation							

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: Free groundwater observed at 2.2m, moderate inflow

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 686 AHD
EASTING: 726024
NORTHING: 6103015
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
686	0.2	TOPSOIL/SAND (SM): fine to medium grained, grey brown, poorly graded, trace low plasticity fines, with rootlets, moist, loose, TOPSOIL							
		SAND (SP): fine to medium grained, pale grey brown, poorly graded, trace silt, moist to dry, loose to medium dense, aeolian		B	0.7				
					0.9				
685	1.0	SAND (SP): fine grained, pale yellow, poorly graded, trace silt, moist, medium dense, aeolian		B	1.1				
					1.2				
				A E	1.5				
684	2	-from 2.3m, yellow brown		A	2.1				
				A	2.7				
683	3.0	Bore discontinued at 3.0m -limit of investigation							

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 683 AHD
EASTING: 725349
NORTHING: 6103261
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
683	0.2	TOPSOIL/SAND (SP): fine grained, grey, poorly graded, trace silt, moist to dry, medium dense, TOPSOIL							
		SAND (SP): fine grained, pale grey, poorly graded, moist to dry, medium dense, aeolian		B	0.4				
					0.6				
		-from 0.7m, orange brown		A	0.8				
682	1								1
	1.4	CLAY (CI): medium plasticity, grey/orange brown, with fine to coarse grained sand, trace silt, moist to dry, w<PL, hard, alluvial			1.5				
				E	1.6				
				B	1.7				
681	2			A	2.0				2
	2.3	Clayey SAND (SC): fine to coarse grained, grey brown, well graded, low to medium plasticity clay, moist to wet, medium dense to dense, alluvial		A	2.4			▽	
	2.7	CLAY (CI): medium plasticity, grey, mottled orange brown, with silt, trace fine to coarse grained sand, moist to wet, w>PL, apparently firm, alluvial		A	2.8				
680	3								3
	3.2	Bore discontinued at 3.2m -limit of investigation							

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: Free groundwater observed at 2.3m, moderate inflow

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 688 AHD
EASTING: 726195
NORTHING: 6103497
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
688		TOPSOIL/SAND (SM): fine to medium grained, grey brown, poorly graded, trace low plasticity fines, with rootlets, moist, very loose, TOPSOIL							
	0.2	SAND (SP): fine grained, pale grey, poorly graded, trace silt, moist, loose, aeolian							
				B	0.5				
		-from 0.6m, medium dense			0.6				
				A	0.9				
687	1 1.0	CLAY (CI): medium plasticity, brown, with fine to coarse grained, trace silt, moist, w~PL, very stiff, alluvial							1
		-from 1.35m, hard			1.4				
				B					
					1.8				
	1.9	CLAY (CI): medium plasticity, grey brown, trace fine to coarse grained, silt and gravel to 6mm, moist, w<PL, very stiff to hard, alluvial							
686	2			A	2.1				2
				E	2.3				
	2.55	Sandy CLAY (CL/CI): low to medium plasticity, brown, fine to coarse grained sand, trace gravel to 5mm, moist, w>PL, stiff to very stiff, alluvial		A	2.6				
	2.85	SAND (SP): fine to medium grained, grey/brown, poorly graded, trace silt, wet, apparently loose, alluvial							
685	3								3
	3.1	Bore discontinued at 3.1m -limit of investigation							

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 681 AHD
EASTING: 724729
NORTHING: 6104236
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
681		TOPSOIL/SAND (SP): fine grained, grey, poorly graded, trace silt, moist to dry, medium dense, TOPSOIL							
	0.2	SAND (SP): fine grained, pale grey brown, poorly graded, with low plasticity silt, moist to dry, medium dense, aeolian							
				B	0.4				
					0.6				
		-from 0.75m, dense to very dense							
680	1								1
	1.2	Clayey SAND (SC): fine grained, grey brown, mottled orange, low plasticity clay, trace medium to high plasticity clay seams, moist to dry, dense to very dense, aeolian			1.4				
				B	1.5				
				E	1.6				
679	2								2
	2.1	CLAY (CL/CI): low to medium plasticity, pale grey brown, mottled orange, with silt and fine to coarse grained sand, moist to wet, w>PL, firm to stiff, alluvial							
				A	2.5			▽	
678	3								3
	3.0	Bore discontinued at 3.0m -limit of investigation							

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: Free groundwater observed at 2.5m, light inflow

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 678 AHD
EASTING: 723497
NORTHING: 6105806
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
678	0.15	TOPSOIL/SAND (SP): fine grained, grey, poorly graded, trace silt, moist to dry, medium dense, TOPSOIL							
		SAND (SP): fine grained, pale grey, poorly graded, trace silt, moist to dry, medium dense, aeolian		B	0.4				
				E	0.6 0.7				
677	0.9	SAND (SP): fine to coarse grained, brown, low to medium plasticity clay, moist, w<PL, very stiff, alluvial		B	1.1 1.2				
676	1.7	CLAY (CI): medium plasticity, brown, with silt and fine grained sand, moist, w<PL, hard, alluvial		A	2.1				
	2.4	CLAY (CI): medium plasticity, brown, mottled orange, with silt and fine to medium grained sand, wet, w>PL, firm, alluvial		A	2.7			▽	
675	2.9	SAND (SP): fine grained sand, orange/yellow brown, poorly graded, wet to saturated, loose, alluvial							
	3.1	Bore discontinued at 3.1m -limit of investigation							

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: Free groundwater observed at 2.8m, light inflow

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 679 AHD
EASTING: 723639
NORTHING: 6104426
DIP/AZIMUTH: 90°/--

BORE No: 10
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
679	0.2	TOPSOIL/SAND (SP): fine grained, grey, poorly graded, trace silt, moist to dry, medium dense, TOPSOIL							
		SAND (SP): fine to medium grained, brown, poorly graded, with low plasticity clay, moist to dry, dense, alluvial		B	0.5				
					0.7				
	0.8	CLAY (CL): low plasticity, brown, with silt and fine to medium grained sand, moist to dry, w<PL, hard, alluvial							
678	1			B	1.1				1
					1.3				
	1.7	SAND (SW): fine to coarse grained, brown, trace silt, wet, apparently loose, alluvial		A	1.8				
677	2							▼	2
	2.3	Silty CLAY (CI): medium plasticity, with fine grained sand, moist to wet, w>PL, apparently soft to firm, alluvial		A	2.5				
		-from 2.6m, wet to saturated							
				E	2.9				
676	3	3.0 Bore discontinued at 3.0m -limit of investigation							3

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: Free groundwater observed at 2.0m, heavy inflow

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 681 AHD
EASTING: 724670
NORTHING: 6105603
DIP/AZIMUTH: 90°/--

BORE No: 11
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
681	0.2	TOPSOIL/SAND (SP): fine grained, grey, poorly graded, trace silt, moist to dry, very loose, TOPSOIL							
		SAND (SP): fine grained, pale grey brown, poorly graded, trace silt, moist, loose to medium dense, aeolian		B	0.5				
				E	0.6				
680	0.9	Clayey SAND (SC): fine to medium grained, orange brown/brown, poorly graded, low plasticity clay, dense to very dense, alluvial							
	1			B	1.4				
					1.6				
679	1.9	CLAY (CI): medium plasticity, dark grey brown, with silt and fine grained sand, moist, w<PL, hard, alluvial		A	2.0				
	2	-from 2.6m, moist, w~PL, very stiff							
678	3.0	Bore discontinued at 3.0m -limit of investigation							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Blind Creek Solar Farm Pty Ltd
PROJECT: Proposed Solar Development
LOCATION: Tarago Road, Lake George

SURFACE LEVEL: 688 AHD
EASTING: 725356
NORTHING: 6104935
DIP/AZIMUTH: 90°/--

BORE No: 12
PROJECT No: 201482.00
DATE: 17/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
688		TOPSOIL/SAND (SP): fine grained, grey, poorly graded, trace silt, moist to dry, medium dense, TOPSOIL							
	0.2	SAND (SP): fine grained, pale grey brown, poorly graded, with silt, moist, loose, aeolian							
		-from 0.45m, medium dense			0.5				
		-from 0.6m, dense		B					
					0.7				
		-from 0.85m, orange brown, trace clay							
687	1	-from 0.9m, dense			1.0				1
				B					
					1.1				
	1.25	CLAY (CL/CI): low to medium plasticity, grey brown, with silt, trace fine grained sand, moist, w<PL, very stiff, alluvial							
				A	1.4				
				E	1.8				
686	2								2
	2.1	CLAY (CI): medium plasticity, grey brown, with silt, trace fine grained sand, moist, w<PL, very stiff, alluvial							
				A	2.6				
685	3								3
	3.0	Bore discontinued at 3.0m -limit of investigation							

RIG: Komatsu PC 45MR mini excavator **DRILLER:** D Group **LOGGED:** ADFH **CASING:** N/A

TYPE OF BORING: 450mm diameter auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coorindates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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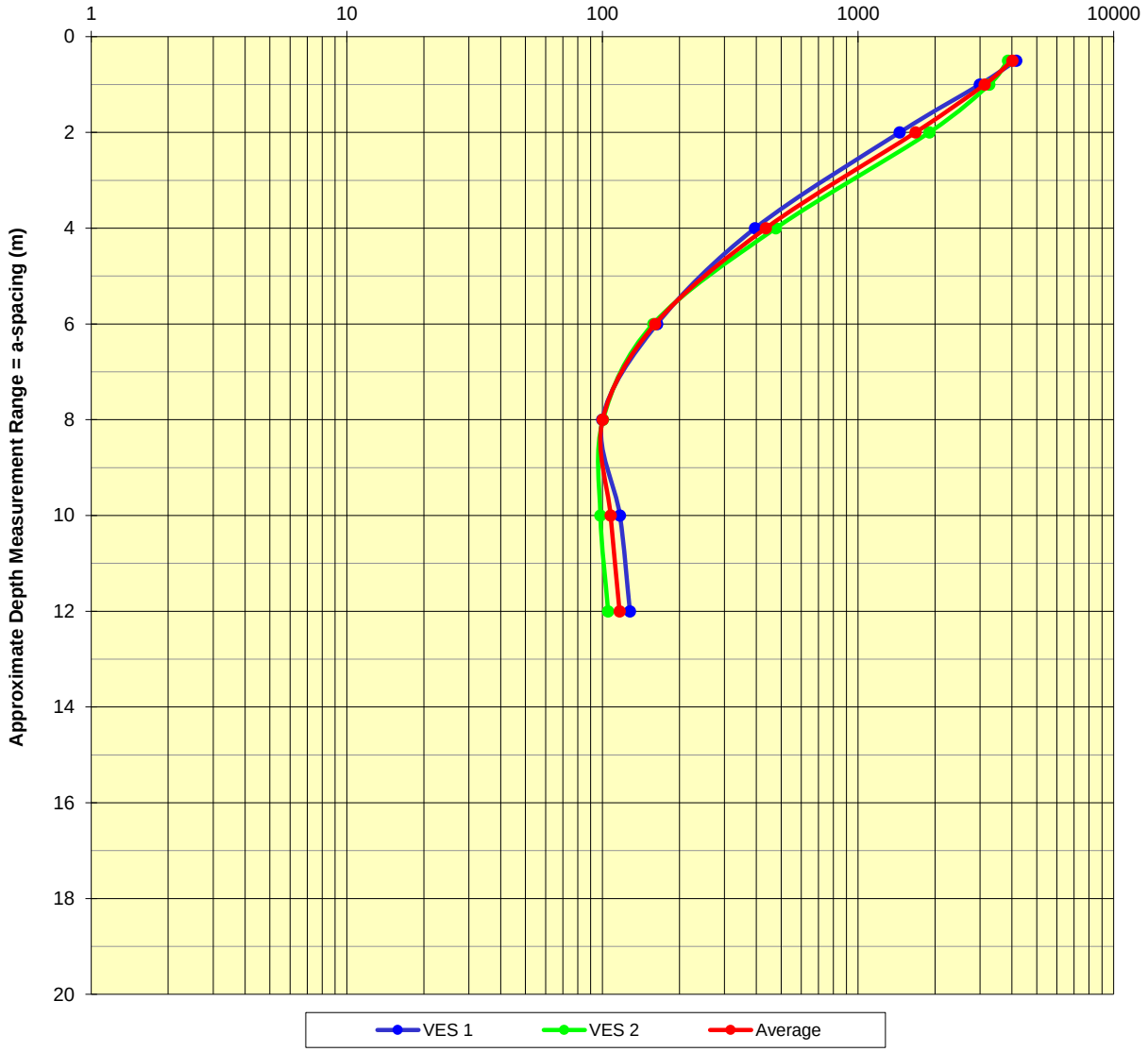
Appendix D

Electrical Resistivity Test Results

Electrode a-spacing (m)	Resistance (R)			Apparent Resistivity (ρ_a = 2πaR)		
	VES 1 (Ω)	VES 2 (Ω)	Average (Ω)	VES 1 (Ω-m)	VES 2 (Ω-m)	Average (Ω-m)
0.5	1325.00	1230.00	1277.50	4162.61	3864.16	4013.38
1.0	477.00	519.00	498.00	2997.08	3260.97	3129.03
2.0	115.80	151.30	133.55	1455.19	1901.29	1678.24
4.0	15.74	18.96	17.35	395.59	476.52	436.05
6.0	4.34	4.19	4.27	163.61	157.96	160.79
8.0	1.99	2.00	1.99	99.84	100.53	100.19
10.0	1.86	1.56	1.71	117.06	98.21	107.63
12.0	1.70	1.40	1.55	128.09	105.28	116.69

Location:	ER 1		**Centre E, N:**	727995 mE, 6102688 mN GDA94 Zone 55
Orientations:	E - W	N - S	**Equipment:**	ABEM Terrameter SAS 300C
Description:	Substation			

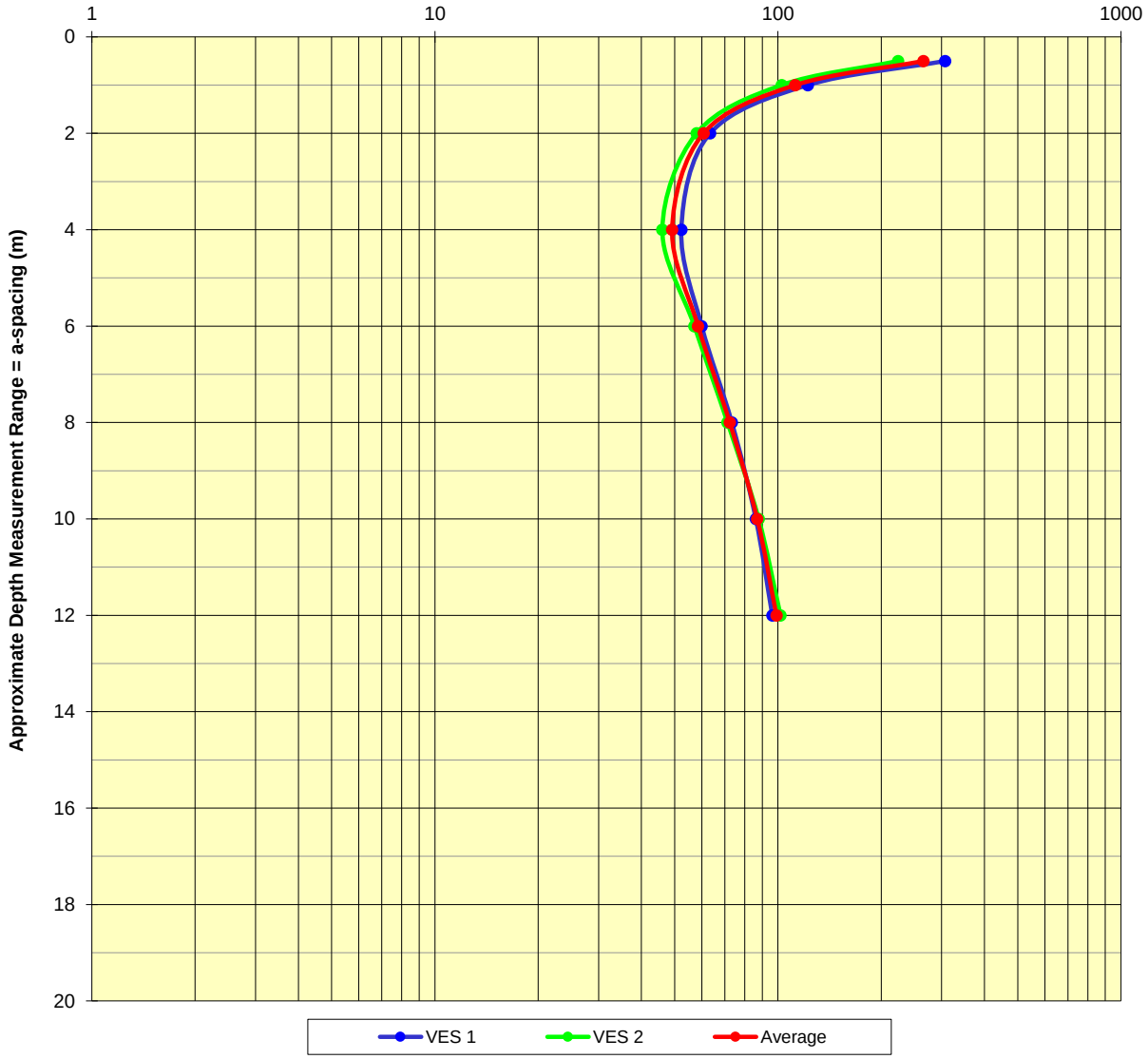
Apparent Resistivity (Ohm-m)
measured using the Wenner Alpha Array



Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	201482.00
	Proposed Solar Development	DWG No:	ER 1
	Tarago Road, Lake George	REV:	0
	CLIENT: Blind Creek Solar Farm Pty Ltd	DATE:	11-Mar-21

Electrode a-spacing (m)	Resistance (R)			Apparent Resistivity (ρ_a = 2πaR)		
	VES 1 (Ω)	VES 2 (Ω)	Average (Ω)	VES 1 (Ω-m)	VES 2 (Ω-m)	Average (Ω-m)
0.5	97.85	71.30	84.58	307.40	224.00	265.70
1.0	19.45	16.31	17.88	122.21	102.48	112.34
2.0	5.05	4.61	4.83	63.46	57.93	60.70
4.0	2.08	1.83	1.96	52.28	46.03	49.15
6.0	1.59	1.51	1.55	59.94	57.06	58.50
8.0	1.46	1.42	1.44	73.38	71.27	72.33
10.0	1.37	1.40	1.39	86.19	87.86	87.03
12.0	1.28	1.35	1.31	96.28	101.73	99.00

Location:	ER 2		**Centre E, N:**	727694 mE, 6102370 mN GDA94 Zone 55
Orientations:	E - W	N - S	**Equipment:**	ABEM Terrameter SAS 300C
Description:	Substation			



Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	201482.00
	Proposed Solar Development	DWG No:	ER 2
	Tarago Road, Lake George	REV:	0
	CLIENT: Blind Creek Solar Farm Pty Ltd	DATE:	11-Mar-21

Appendix E

Laboratory Test Results

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Anes Ibricic
Laboratory Manager
Laboratory Accreditation Number: 828

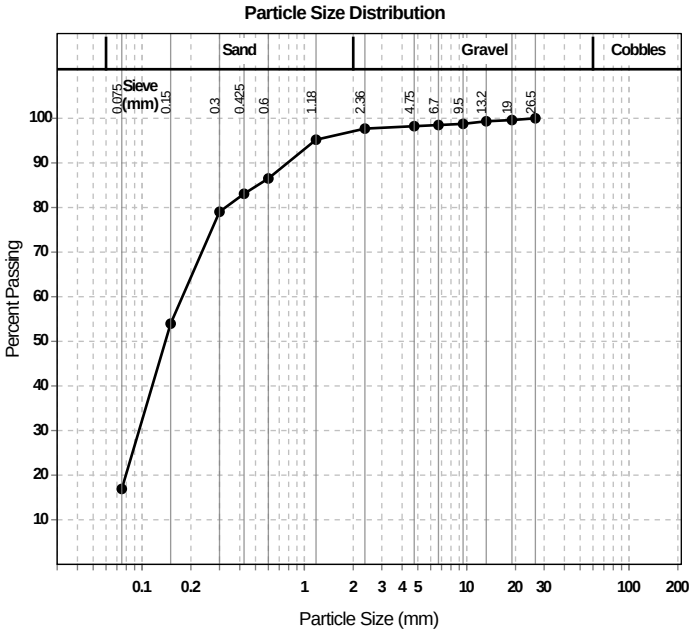
Report Number: **201482.00-1**
Issue Number: 1
Date Issued: 04/03/2021
Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856A
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 03/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 2 , Depth: 1.3-1.4m**
Material: Clayey Sand

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	Not Obtainable		
Plastic Limit (%)	Not Obtainable		
Plasticity Index (%)	**Non Plastic**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1 / AS 1289.3.1.2 / AS 1289.3.9.1 / AS 1289.3.9.2		
Linear Shrinkage (%)			
Cracking Crumbling Curling			

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
26.5 mm	**100**		
19 mm	**100**		
13.2 mm	**99**		
9.5 mm	**99**		
6.7 mm	**98**		
4.75 mm	**98**		
2.36 mm	**98**		
1.18 mm	**95**		
0.6 mm	**87**		
0.425 mm	**83**		
0.3 mm	**79**		
0.15 mm	**54**		
0.075 mm	**17**		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	14.4



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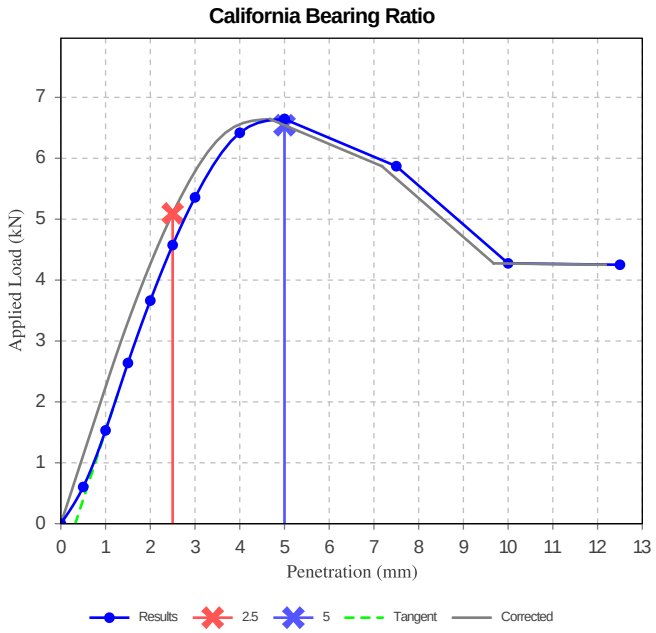
Issue Number: 1
Date Issued: 04/03/2021
Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856B
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 02/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 4 , Depth: 0.4-0.6m**
Material: Sand

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**40**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.86		
Optimum Moisture Content (%)	10.0		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.82		
Field Moisture Content (%)	4.7		
Moisture Content at Placement (%)	9.9		
Moisture Content Top 30mm (%)	13.8		
Moisture Content Rest of Sample (%)	13.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	49.7		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**1**		
Soil Description	Sand		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	4.9



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Date Issued: 04/03/2021
Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856C
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 02/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 7 , Depth: 1.4-1.8m**
Material: Clay (medium plasticity)

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	26		
Plastic Limit (%)	19		
Plasticity Index (%)	**7**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	4.0		
Cracking Crumbling Curling	Cracking		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**1**		
Soil Description	Clay (medium plasticity)		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	22		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	17.1

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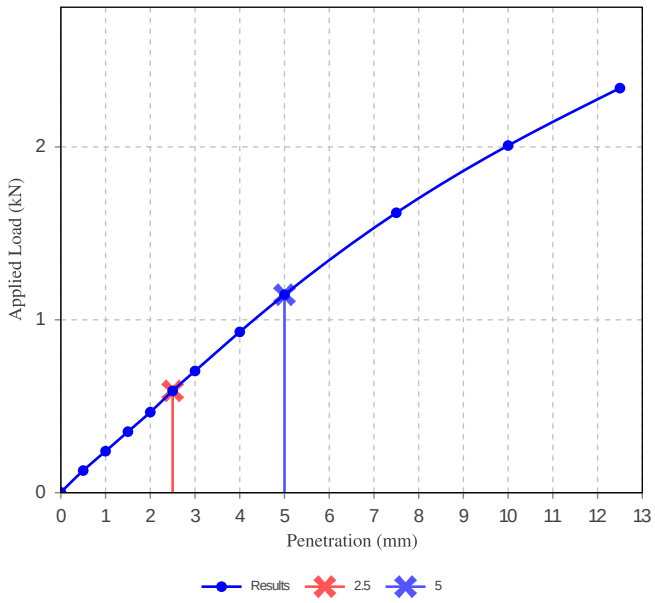
Issue Number: 1
Date Issued: 04/03/2021
Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856C
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 02/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 7 , Depth: 1.4-1.8m**
Material: Clay (medium plasticity)

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**6**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.83		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	97.5		
Laboratory Moisture Ratio (%)	101.5		
Dry Density after Soaking (t/m^3)	1.79		
Field Moisture Content (%)	17.7		
Moisture Content at Placement (%)	15.5		
Moisture Content Top 30mm (%)	18.1		
Moisture Content Rest of Sample (%)	16.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.5		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

California Bearing Ratio



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Issue Number: 1
Date Issued: 04/03/2021
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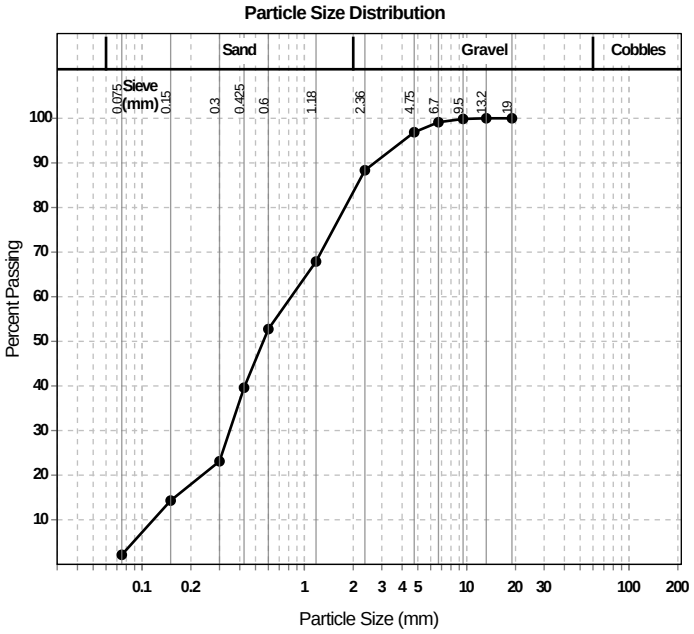
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856D
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 03/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 9 , Depth: 1.1-1.2m**
Material: Sandy Clay (low to medium plasticity)

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	27		
Plastic Limit (%)	14		
Plasticity Index (%)	**13**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	5.0		
Cracking Crumbling Curling	None		

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
19 mm	**100**		
13.2 mm	**100**		
9.5 mm	**100**		
6.7 mm	**99**		
4.75 mm	**97**		
2.36 mm	**88**		
1.18 mm	**68**		
0.6 mm	**53**		
0.425 mm	**40**		
0.3 mm	**23**		
0.15 mm	**14**		
0.075 mm	**2**		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	9.0



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Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856E
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 02/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 10 , Depth: 1.1-1.3m**
Material: Clay (medium plasticity)

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	23		
Plastic Limit (%)	14		
Plasticity Index (%)	**9**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	3.0		
Cracking Crumbling Curling	Cracking		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**1**		
Soil Description	Clay (medium plasticity)		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	22		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	11.7

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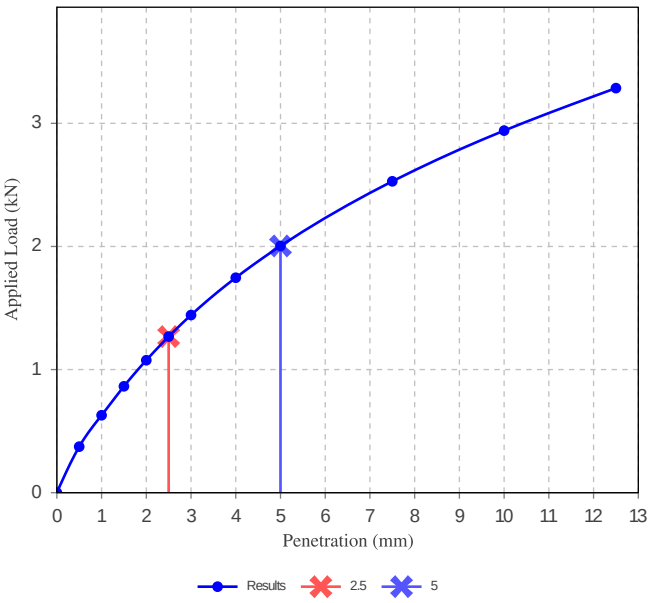
Report Number: **201482.00-1**
Issue Number: 1
Date Issued: 04/03/2021
Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856E
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 02/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 10 , Depth: 1.1-1.3m**
Material: Clay (medium plasticity)

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**10**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.90		
Optimum Moisture Content (%)	13.5		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	98.5		
Dry Density after Soaking (t/m^3)	1.86		
Field Moisture Content (%)	11.6		
Moisture Content at Placement (%)	13.2		
Moisture Content Top 30mm (%)	15.4		
Moisture Content Rest of Sample (%)	14.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

California Bearing Ratio



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Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856F
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 02/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 12 , Depth: 1.4-1.4m**
Material: Clay (medium to high plasticity)

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	34		
Plastic Limit (%)	15		
Plasticity Index (%)	**19**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	8.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	17.5

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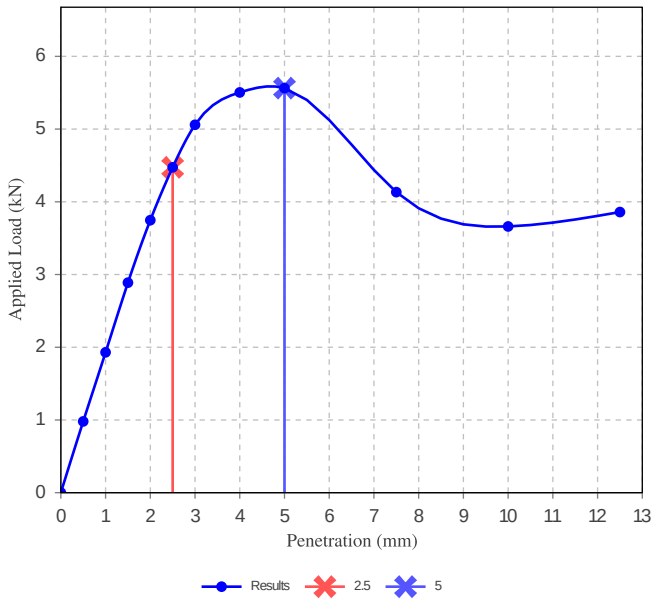
Issue Number: 1
Date Issued: 04/03/2021
Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856G
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 02/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Pit 13 , Depth: 1.0-1.2m**
Material: Sand

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**35**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.68		
Optimum Moisture Content (%)	13.5		
Laboratory Density Ratio (%)	97.5		
Laboratory Moisture Ratio (%)	102.0		
Dry Density after Soaking (t/m^3)	1.64		
Field Moisture Content (%)	5.9		
Moisture Content at Placement (%)	14.0		
Moisture Content Top 30mm (%)	20.1		
Moisture Content Rest of Sample (%)	17.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	47.4		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**1**		
Soil Description	Sand		
Nature of Water	Distlled		
Temperature of Water (^{o}C)	22		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	6.4

California Bearing Ratio



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Material Test Report

Douglas Partners
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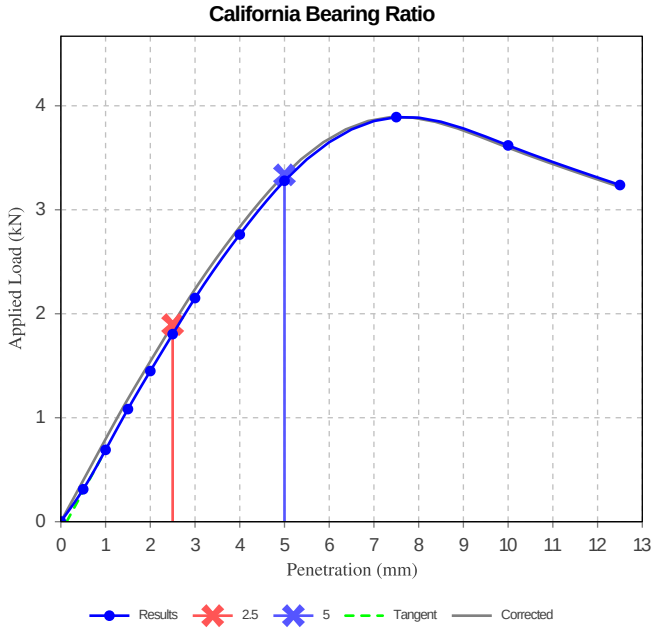
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Anes Ibricic
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **201482.00-1**
Issue Number: 1
Date Issued: 04/03/2021
Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856H
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 02/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 9 , Depth: 0.4-0.6m**
Material: Sand

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**17**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.72		
Optimum Moisture Content (%)	13.5		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.68		
Field Moisture Content (%)	5.2		
Moisture Content at Placement (%)	13.6		
Moisture Content Top 30mm (%)	18.1		
Moisture Content Rest of Sample (%)	16.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	46		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	5.9



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Report Number: **201482.00-1**
Issue Number: 1
Date Issued: 04/03/2021
Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856I
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 02/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 6 , Depth: 1.5-1.7m**
Material: Clay (medium to high plasticity)

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	40		
Plastic Limit (%)	16		
Plasticity Index (%)	**24**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	7.5		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	20.9

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Report Number: **201482.00-1**
Issue Number: 1
Date Issued: 04/03/2021
Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Sample Number: WO-6856J
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 02/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 3 , Depth: 0.5-0.6m**
Material: Sand

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**1**		
Soil Description	Sand		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	22		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	5.2

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Report Number:	**201482.00-1**
Issue Number:	1
Date Issued:	04/03/2021
Client:	Stride Renewables Pty Ltd
	Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact:	Luke Osborne
Project Number:	201482.00
Project Name:	Proposed Solar Development - Blind Creek Solar Farm
Project Location:	Tarago Road, Lake George
Work Request:	6856
Sample Number:	WO-6856K
Date Sampled:	17/02/2021
Dates Tested:	22/02/2021 - 24/02/2021
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Sample Location:	**Bore 4 , Depth: 2.2-2.2m**

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	11.8

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Report Number:	**201482.00-1**
Issue Number:	1
Date Issued:	04/03/2021
Client:	Stride Renewables Pty Ltd
	Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact:	Luke Osborne
Project Number:	201482.00
Project Name:	Proposed Solar Development - Blind Creek Solar Farm
Project Location:	Tarago Road, Lake George
Work Request:	6856
Sample Number:	WO-6856L
Date Sampled:	17/02/2021
Dates Tested:	22/02/2021 - 24/02/2021
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Sample Location:	**Bore 8 , Depth: 2.5-2.5m**

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	25.0

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Report Number:	**201482.00-1**
Issue Number:	1
Date Issued:	04/03/2021
Client:	Stride Renewables Pty Ltd
	Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact:	Luke Osborne
Project Number:	201482.00
Project Name:	Proposed Solar Development - Blind Creek Solar Farm
Project Location:	Tarago Road, Lake George
Work Request:	6856
Sample Number:	WO-6856M
Date Sampled:	17/02/2021
Dates Tested:	22/02/2021 - 24/02/2021
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Sample Location:	**Bore 10 , Depth: 1.8-1.8m**

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	10.7

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Report Number:	**201482.00-1**
Issue Number:	1
Date Issued:	04/03/2021
Client:	Stride Renewables Pty Ltd
	Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact:	Luke Osborne
Project Number:	201482.00
Project Name:	Proposed Solar Development - Blind Creek Solar Farm
Project Location:	Tarago Road, Lake George
Work Request:	6856
Sample Number:	WO-6856N
Date Sampled:	17/02/2021
Dates Tested:	22/02/2021 - 24/02/2021
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Sample Location:	**Bore 11 , Depth: 1.4-1.6m**

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	9.1

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Date Issued: 04/03/2021
Client: Stride Renewables Pty Ltd
Suite 6, 4 Nuyts Street, Red Hill ACT 2603
Contact: Luke Osborne
Project Number: 201482.00
Project Name: Proposed Solar Development - Blind Creek Solar Farm
Project Location: Tarago Road, Lake George
Work Request: 6856
Date Sampled: 17/02/2021
Dates Tested: 22/02/2021 - 01/03/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received

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Laboratory Manager
Laboratory Accreditation Number: 828

Shrink Swell Index AS 1289 7.1.1 & 2.1.1					
Sample Number	WO-6856C	WO-6856E	WO-6856I		
Date Sampled	17/02/2021	17/02/2021	17/02/2021		
Date Tested	01/03/2021	01/03/2021	01/03/2021		
Material Source	Insitu	Insitu	Insitu		
Sample Location	Bore 7 (1.4-1.8m)	Bore 10 (1.1-1.3m)	Bore 6 (1.5-1.7m)		
Inert Material Estimate (%)	10	10	10		
Pocket Penetrometer before (kPa)	270	340	310		
Pocket Penetrometer after (kPa)	340	290	180		
Shrinkage Moisture Content (%)	14.5	12.7	17.4		
Shrinkage (%)	**2.4**	**2.7**	**3.6**		
Swell Moisture Content Before (%)	14.0	12.4	19.1		
Swell Moisture Content After (%)	18.3	15.2	20.6		
Swell (%)	**-0.1**	**-0.1**	**0.3**		
Shrink Swell Index Iss (%)	**1.3**	**1.5**	**2.1**		
Visual Description	Clay (medium plasticity)	Clay (medium plasticity)	Clay (medium to high plasticity)		
Cracking	UC	UC	UC		
Crumbling	No	No	No		
Remarks	Non standard remoulded method	Non standard remoulded method	Non standard remoulded method		

Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.
Cracking Terminology: UC Uncracked, SC Slightly Cracked, MC Moderately Cracked, HC Highly Cracked, FR Fragmented.
NATA Accreditation does not cover the performance of pocket penetrometer readings.

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www.envirolab.com.au

CERTIFICATE OF ANALYSIS 262230

Client Details

Client	Douglas Partners Canberra
Attention	Sasi Sasiharan
Address	PO Box 1487, Fyshwick, ACT, 2609

Sample Details

Your Reference	**201482.00, Proposed Solar Development**
Number of Samples	5 soil
Date samples received	19/02/2021
Date completed instructions received	19/02/2021

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	26/02/2021
Date of Issue	25/02/2021

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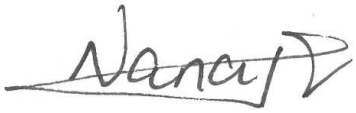
Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

Soil Aggressivity						
Our Reference		262230-1	262230-2	262230-3	262230-4	262230-5
Your Reference	UNITS	Pit 13 - 2.7m	Bore 3 - 0.6m	Bore 5 - 1.5m	Bore 8 - 1.4m	Bore 11 - 0.6m
Type of sample		soil	soil	soil	soil	soil
Date Sampled		17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021
pH 1:5 soil:water	pH Units	5.8	6.4	8.1	7.4	6.8
Electrical Conductivity 1:5 soil:water	µS/cm	10	13	35	37	39
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	<10	<10	<10	10	20

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Soil Aggressivity						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	2	6.4	6.6	3	99	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	2	13	14	7	101	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	2	<10	<10	0	103	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	2	<10	<10	0	100	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.