SOIL SURVEY REPORT

AVONLIE SOLAR FARM

March 2018

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Project brief

At the request of Sarah Hillis of NGH Environmental Pty Ltd, soil sampling, analysis and reporting was carried out to assess the site on 7 and 8 March 2018. The document provides information about the site and soil conditions from field observations and laboratory analysis.

Site identification

Address: 2025 Sandigo Road, Sandigo NSW 2700
Real property description: Lot 1 DP100042
Centre co-ordinate: 465889 6134139 MGA GDA z55
Property size: approx. 630Ha
Owner: c/o NGH Environmental Pty Ltd
Local Council Area: Narrandera Shire Council
Present use: Agriculture
Development Application Reference: not known
Report identification: 5034 - Avonlie

Certification

Name	Signed	Date	Revision Number
David McMahon **BAppSc** **GradDip WRM**		22/03/18	0

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1.0 Introduction

The report presents the results of a soil survey carried out by DM McMahon Pty Ltd (McMahon) for the proposed Avonlie Solar Farm near Narrandera, NSW.

The soil and land survey work was commissioned by Sarah Willis of NGH Environmental Pty Ltd and was undertaken in general accordance with an email dated 16 February 2018. The survey was carried out utilising a drilling rig for evaluation to a depth of approximately 1.0m. Alice Debney and Shaun Driscoll of DM McMahon Pty Ltd conducted a free soil survey on 7 and 8 March 2018 using standard soil surveying techniques. Sampling and classification of in situ soils was carried out as per the Australian Soil and Land Survey Field Handbook (2009) and The Australian Soil Classification (Isbell, 1996). Density of investigation pits was determined via Guidelines for Surveying Soil and Land Resources (McKenzie et al. 2008) where selection of a 'Moderately High (Detailed)' intensity level was deemed appropriate for satisfying the objectives for detailed project planning. The sampling intensity was one hole per 5 to 25ha which equates to 30 investigation points across the farm.

2.0 Site Characteristics

A desktop review and investigation of the topography, hydrology, soil, lithology, geology and hydrogeology of the site has been undertaken and are as follows:

2.1 Topography

The Berembed Weir 1:50,000 Topographic map sheet (8228-S) indicates that the site is located at an elevation of approximately 150m AHD. The site slope is classed as level and the landform is a flat.

2.2 Vegetation

The site is used for agricultural production, predominantly cropping. Remnant vegetation consists of wheat stubble, broadleaf weeds and heliotrope. A more detailed assessment of vegetation present can be seen in NGH Environmental scoping report.

2.3 Weather

The mean rainfall for Narrandera the average rainfall for Narrandera is approximately 482.8mm per annum, with the wettest months being October, August and September. Annual mean evaporation for the region is 1715.5mm with mean daily evaporation ranges from 1.2mm in July to 9.2mm in January. Narrandera is characterised by cold wet winters and hot dry summers with mean maximum temperatures ranging from 14.6ºC in July to 32.4 ºC in January and mean minimum temperatures ranging from 3ºC in July to 16.9ºC in February. Rainfall and temperature data from Narrandera Golf Club 74221 and evaporation data from Wagga Wagga Agricultural Institute 73127, located 79km away (www.bom.gov.au).

2.4 Hydrology

The site is located on the drainage plains in the Murrumbidgee River system catchment area. Natural watercourses have been extensively modified and altered with the introduction of irrigation and drainage channels. These channels include gravity-fed irrigation and drainage channels that have been privately constructed irrigation and managed. Run-off of surface waters from precipitation is unlikely, this can be attributed to the construction of flood irrigation banks on relatively impermeable vertosols.

2.5 Soil & Landform

The site and nearby surrounds lies within the mapping units **Oc3** and **Oc7** from the Digital Atlas of Australian Soils (CSIRO, 1991).

The map unit **Oc3** is described as:

"Oc3"

"Plains with domes, lunettes, and swampy depressions, and divided by continuous or discontinuous low river ridges associated with prior stream systems--the whole traversed by present stream valleys; layered soil or sedimentary materials common at fairly shallow depths: chief soils are hard alkaline red soils (Dr2.33), grey and brown cracking clays, commonly (Ug5.24) and (Ug5.35), and other (D) soils in a complex soil pattern with the following general features: (i) well-drained to moderately drained plains of (Dr2.33) with (Db1.33 and Db1.43), often with thin A horizons (<4 in. thick); (ii) moderately to poorly drained gilgai plains subject to some seasonal flooding of (Ug5.3), (Dr2.33), (Db1.43), (Dy2.33 and Dy2.43), and (Ug5.2) soils; (iii) poorly drained gilgai plains subject to frequent seasonal flooding of (Ug5.2), (Ug5.3), (Db1.43), (Dy2.43), (Dd1.33 and Dd1.43), and (Ug5.4) soils; (iv) swampy depressions of (Dd1.33 and Dd1.43), (Db1.43), (Dy2.43), (Dy3.43), and (Ug5) soils; (v) domes and/or lu.

The map unit **Oc7** is described as:

"Oc7"

"Undulating country with broad slopes and low, narrow, often gravelly or stony ridges: chief soils are hard alkaline red soils (Dr2.33) throughout the undulating terrain. Associated are: red earths (Gn2.12 and Gn2.13), sometimes with clay D horizons, in depositional sites; gravelly or stony ridges of hard neutral red soils (Dr2.32 and Dr2.42) and shallow loams (Um4.1) similar to unit Qc3; and small gilgai areas with some cracking clays (Ug5.2 and Ug5.3). Data are limited. Occurs on sheet(s): 3"

2.6 Lithology and Geology

The site geology is distributed over one unit: Cainozoic alluvium.

2.7 Hydrogeology

From the Geoscience Australia hydrogeology dataset, the groundwaters beneath the site are described as fractured or fissured, extensive aquifers of low to moderate productivity.

3.0 Scope of Works

The specifications for the soil survey are as follows, Table 1:

Table 1: Scope of Works

Item	Description
1.	Where available, review plans and other general related documents provided to us to gain a comprehensive understanding of the proposed project.
2.	Undertake a desktop study of local landform, geological, lithological & hydrogeological conditions.
3.	Conduct Dial Before You Dig search.
4.	Formulate soil survey program based on the sampling intensity of 'Moderately High (Detailed)' with site objectives being: 'Moderately intensive uses at field level, detailed planning' by reference to the Guideline for Surveying Soil and Land Resources, McKenzie et al 2008. The sampling intensity is one hole per 5 to 25ha which at the high-scale equates to 30 investigation points across the farm (~630ha). The farm is across the two soil landscapes being Oc3 & Oc7 so the intensity will be acceptable, BRS 2000.
5.	Conduct work to the following specification: • Sampling of 30 soil cores over the farm. • Detailed profile descriptions and representative testing of pH, EC, dispersion, nutrients, and cations. • Categorisation of soil by reference to The Australian Soil Classification, Isbell, 1996. • Map of soil sample points overlaid on aerial photo and soil atlas. • Comments on potential erosion risk of the land per soil type and management recommendations. • Comprehensive reporting to recognised standards.

4.0 Results

4.1 Field Survey

A free soil survey was conducted using standard soil surveying techniques. Sampling and classification of in situ soils was carried out as per the Australian Soil and Land Survey Field Handbook (2009) and The Australian Soil Classification (Isbell, 1996). Density of investigation pits was determined via Guidelines for Surveying Soil and Land Resources (2008) where selection of a 'Moderately High (Detailed)' intensity level was deemed appropriate for satisfying the objectives for detailed project planning. Soils encountered were typical of the locale, generally falling into reconnaissance survey classes. Slight variations in profiles exist due to remnant channels and the complex soil sequences that are associated with such. Soil moisture contents varied considerably between soil types but were generally found to be moderately moist to wet at depth. Free groundwater was not encountered to the investigated depths.

As follows is a map of the investigated site and approximate investigation pit locations, Figure 1.

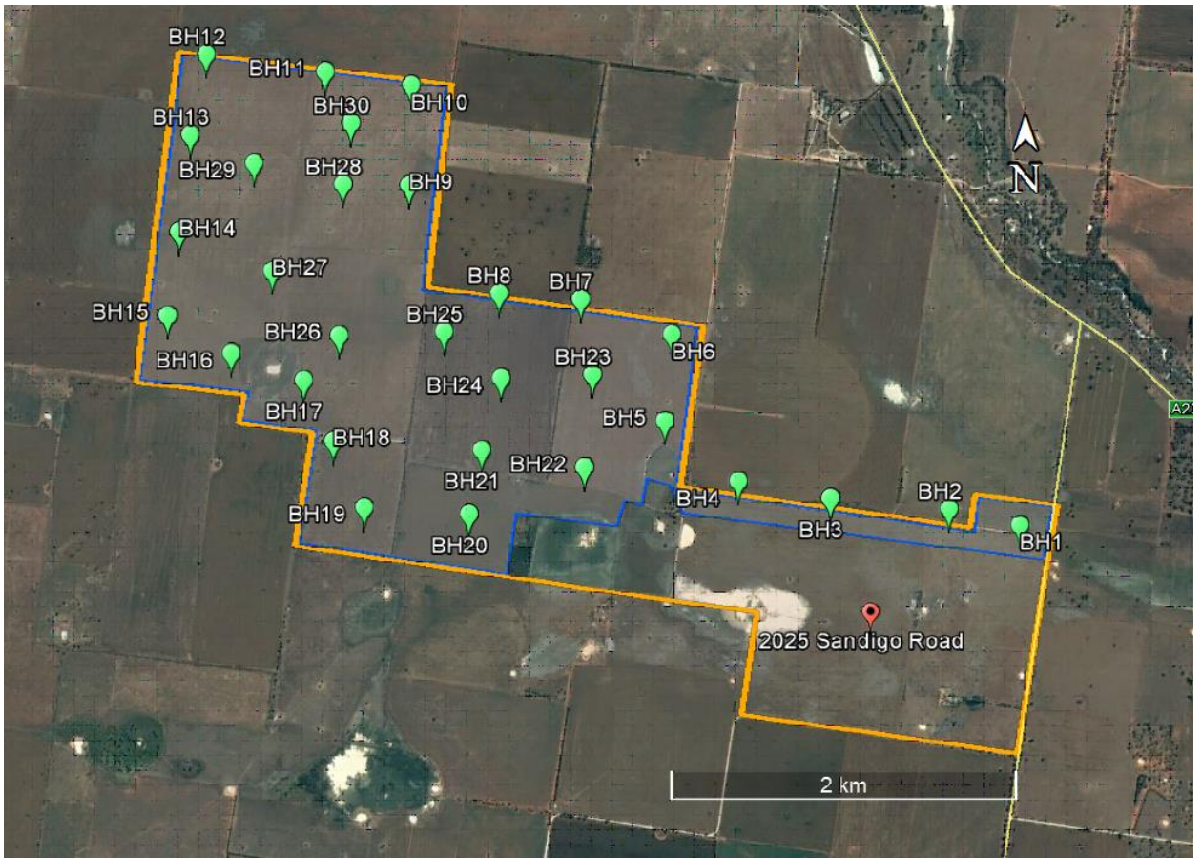

Figure 1: Soil Survey Core Locations

4.2 Typical Soil Profiles

Soils can be classified into a typical soil profiles across the site as per the Australian Soil Classification system (Isbell, 1996). A brief description of the profile characteristics of a Chromosol and Sodosol can be seen below. All soil bore holes investigated were located on managed agricultural lands and field soil log sheets can be seen attached.

4.2.1 Chromosols

Chromosols have a strong texture contrast between A and B horizons. There is a clear or abrupt textural B horizon in which the upper portion of the horizon (0.2m) is not strongly acid and not sodic. These soils are the most commonly encountered soils under agricultural use in Australia.

4.2.2 Sodosols

Sodosols have a clear or abrupt textural B horizon in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is sodic and not strongly acid. Sodic soils are dispersive, as confirmed by the Emerson test performed on all samples. Australia is noteworthy for the extent and diversity of sodic soils. Sodosols found within the investigated area are in the drainage lines of the Redbank Soil Landscape and classed as Mottled Subnatric Brown Sodosols, and those found within the O'Brien's Creek Soil Landscape are classed as Mottled Subnatric Red Sodosols and Mottled Mesonatric Brown Sodosols near some channel zones. In Subnatric soils a major part of the top 0.2m of the B2 horizon has an Exchangeable Sodium Percentage (ESP) of between 6 and less than 15, classifying it as sodic. In Mesonatric soils a major part of the top 0.2m of the B2 horizon has an ESP of between 15 and 25, classifying it as strongly sodic.

4.3 Laboratory Analysis

Six representative topsoil samples were obtained and analysed at a NATA accredited laboratory for the establishment of baseline soil data that may be referred to and used in preparation of a site decommissioning plan. Laboratory COAs can be found in the attachments and soil parameters can be seen summarised in table 2. Six subsoil samples were also analysed for pH, EC and tested for dispersion (table 3).

4.3.1 Topsoil Analysis

4.3.1.1 pH & Electrical Conductivity

Topsoil pH (1:5 soil:water) ranged from 5.7 to 8.0 and can be classed as within 'ideal pH range for plant growth' (NSW Agriculture, 2000). Electrical conductivity (EC) ranged from 60 – 160µS/cm and the salinity rating is 'very low' (Agriculture Victoria, 2017).

4.3.1.2 Cation Exchange Capacity, Exchangeable Sodium Percentage & Dispersion

Cation Exchange Capacity (CEC) ranges from 6.3 to 22.8 cmol(+)/kg. CEC of the soils is rated by Hazelton and Murphy, (2007) from low (6-12) to moderate (12-25). Sodium percentage of cations ranges from 0.05 to 13%. One sample, sample 20/1 indicated an Exchangeable Sodium Percentage (ESP) of >6%, and field determination of dispersion indicated that some dispersion occurred, therefore some of the soils present on site are considered sodic, which are located in the southern end of the site (Agriculture Victoria, 2017).

4.3.1.3 Colwell Phosphorus and Phosphorus Buffering Index

Colwell P (plant available phosphorus) ranges from 5 to 33 mg/kg, which is classed as 'extremely low' to 'low' . Phosphorus Buffering Index (PBI) ranged from 43 to 99 and is classed from 'very low' to 'low' (Agriculture Victoria, 2017).

4.3.1.4 Calcium:Magnesium Ratio

Ca:Mg ratio should be at least 2:1. Higher calcium contents are ok however higher magnesium content may result in soil dispersion. Ca:Mg determined for topsoils returned results ranging from 0.7 to 5.1, indicating that there is low potential for swelling of topsoils upon wetting.

4.3.2 Subsoil Analysis

4.3.2.1 pH & Electrical Conductivity

Subsoil pH ranged from 5.5 to 7.3 (1:5 soil/water) and can be classed as within 'ideal pH range for plant growth' (NSW Agriculture, 2000). EC ranged from 700 - 1500µS/cm and are rated as 'non-saline' (Richards, 1954). Electrical conductivity (EC) ranged from 102 – 545 µS/cm and the salinity rating is 'very low' (Agriculture Victoria, 2017).

4.3.2.2. Dispersion

Field determination of dispersion determined that nil, partial and complete dispersion occurred, indicating some subsoils may be sodic.

5.0 Summary of Test Results

Table 2: Topsoils - Results of Laboratory Testing

Pit/Sample	pH (1:5 Water)	pH (1:5 CaCl2)	Electrical Conductivity	Chloride	Nitrate Nitrogen	Ammonium Nitrogen	Colwell P	Phosphorus Buffer Index	Sulphur – KCl40	CEC	Calcium	Magnesium	Sodium	Potassium	Available Potassium	Aluminium	Aluminium % of Cations	Calcium % of Cations	Magnesium % of Cations	Sodium % of Cations	Potassium % of Cations	Ca/Mg Ratio
Units	-	-	**dS/m**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	-	**mg/kg**	**cmol(+)/kg**	**cmol(+)/kg**	**cmol(+)/kg**	**cmol(+)/kg**	**cmol(+)/kg**	**mg/kg**	**Cmol(+)/kg**	**%**	**%**	**%**	**%**	**%**	-
BH2/1	5.7	4.8	0.07	25	17	6	18	66	9	6.3	3.9	1.1	0.05	1.1	1.1	0.1	1.8	63.0	18.0	0.05	17.0	3.5
BH5/1	6.4	5.6	0.06	<10	11	2	25	50	4	8.2	4.7	29	0.12	1.0	400	<0.1	<0.1	58.0	29.0	1.4	12.0	2.0
BH10/1	5.8	5.0	0.11	26	21	2	33	63	7	6.8	3.9	1.4	0.1	1.4	560	<0.1	<0.1	57.0	20.0	1.5	21.0	2.8
BH20/1	8.0	6.8	0.16	20	4	<1	5	99	11	22.8	8.0	11.0	3.0	0.92	360	<0.1	<1.0	35.0	48.0	13.0	4.0	0.7
BH24/1	6.6	5.6	0.06	<10	8	1	25	84	3	16.0	9.4	5.0	0.34	1.30	490	<0.1	<1.0	59.0	31.0	2.1	7.8	1.9
BH29/1	6.7	6.1	0.09	13	9	3	32	43	3	8.0	5.6	1.1	0.03	1.30	500	<0.1	<1.0	70.0	13.0	0.03	16.0	5.1

Table 3: Topsoil/Subsoils - Results of Laboratory Testing

Pit/Sample	Horizon	pH (1:5 soil/water)	Electrical Conductivity	Dispersion	Pit/Sample	Horizon	pH (1:5 soil/water)	Electrical Conductivity	Dispersion
Units	-	-	µS/cm	-	Units	-	-	µS/cm	-
BH2/1	A	-	-	N*	BH20/1	A	-	-	C
BH2/2	B	5.5	102	C	BH20/2	B	6.6	545	P
BH5/1	A	-	-	P	BH24/1	A	-	-	C
BH5/2	B	5.8	206	C	BH24/2	B	6.7	330	P
BH10/1	A	-	-	N	BH29/1	A	-	-	N*
BH10/2	B	6.2	156	C	BH29/2	B	6.7	330	N*
BH18/1	A	-	-	C	BH30/1	A	-	-	N
BH18/2	B	6.1	362	P	BH30/2	B	7.3	142	P

- *Dispersion testing results were rated N, P or C being Nil, Partial or Complete dispersion. " * " denotes slaking.*

6.0 Comments and Recommendations

The discussion and recommendations provided below are based on field observations and testing at discrete locations.

6.1 Potential Limitations

Potential landscape limitations have been summarised in table 4 below.

Table 4: Potential Landscape Limitation Assessment

Soil Type	Erosion Hazard	Salinity Risk	Acid Soil	Waterlogging Risk	Acid Sulfate Soils	Infrastructure
Chromosol	LOW	LOW	NO	MODERATE (localised)	NO	MODERATE
Sodosol	MODERATE	MODERATE	NO	MODERATE (localised)	NO	MODERATE

As follows are the soil mapping units of the Digital Atlas of Australian Soils (1991) that has been generally validated by the soil survey through laboratory and field techniques with soils across the majority of the site being Chromosol with Sodosols to the south, Figure 2. As such, management practices can be grouped into management classes of either soil mapping units or Australian Soil Classification (ASC) units. This report identifies management practices for equivalent ASC units in section 6.5 below.

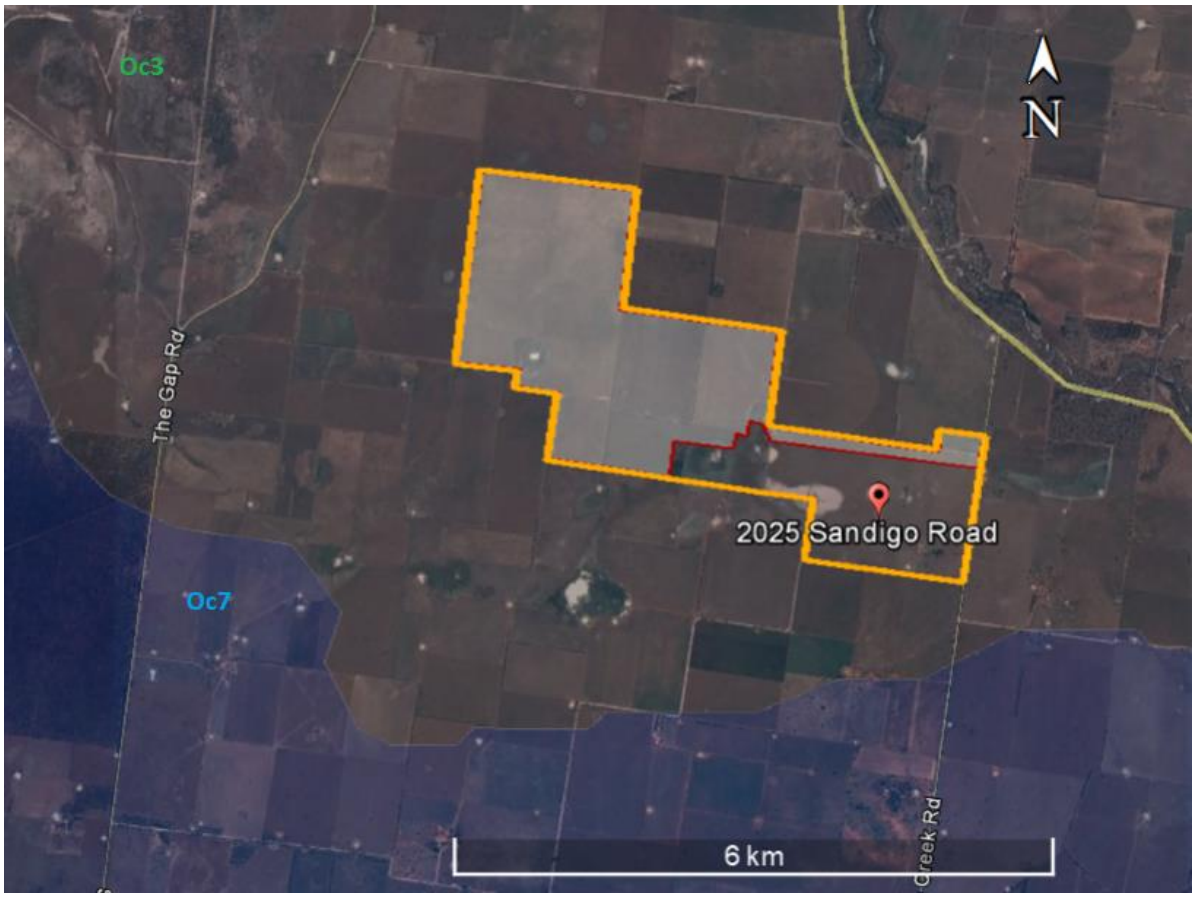

Figure 2: Mapping Units of the Digital Atlas of Australian Soils with Site Overlay.

6.2 Erosion Control

In order to mitigate the occurrence of erosion the following primary principles should be adhered to, particularly throughout the construction period of the project. Best Management Practices (BMP's) should be employed where applicable to further reduce the risk of potential erosion and sediment control.

- Integrate project design with any site constraints.
- Preserve and stabilise drainageways.
- Minimise the extent and duration of disturbance.
- Control stormwater flows onto, through and from the site in stable drainage structures.
- Install perimeter controls.
- Stabilise disturbed areas promptly.
- Protect steep slopes.
- Employ the use of sediment control measures to prevent off and on-site damage.
- Protect inlets, storm drain outlets and culverts.
- Provide access and general construction controls.
- Inspect and maintain sediment and erosion control measures regularly.

The risk of erosion on site due to construction activities is considered low due to the very low relief and generally low salinity and sodicity of topsoils and subsoils. Excavation of subsoils should be limited where possible, and excavated subsoils should be stockpiled and contained to avoid potential dispersion and sediment transfer. Ground cover around the structures should be maintained where possible. Maintenance of ground cover will also aid in the prevention of topsoil losses from wind erosion.

Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Volume 2A & 2C (DECC, 2008) should be consulted further in the development an Erosion and Sediment Control Plan (ESCP).

6.3 Acid Sulfate Soils

Acid sulphate soils is the common name given to naturally occurring soils containing iron sulphides. Exposure of the sulphides present in these soils to oxygen from drainage or excavation will lead to the generation of sulfuric acid. Field pH of these soils in their undisturbed state is generally pH 4 or less.

Landscape characteristics such as; the dominance of mangroves, reeds, rushes and other marine/estuarine or swamp-tolerant vegetation, low lying areas, back swamps or scalded areas of coastal estuaries and floodplains and sulphurous smell following rain after prolonged dry periods (Stone *et al*, 1998) after soil disturbance were not observed. There was no evidence of a jarositic horizon or jarosite precipitates or coatings on any root channels or cracks in the soil. From the soil survey conducted, it has been deduced that acid sulfate soils are not present on site.

6.4 Potential Impacts on Salinity, Groundwater Resources and Hydrology

Current operational procedures include irrigation via lateral movement irrigator. Associated water features include supply and drainage channels. The proposed development is likely to have a positive effect on the local groundwater table by reducing the amount of irrigation and water influx from sources other than precipitation.

Soils on site have a high ESP of >6% and these topsoils are classified as 'sodic'. Disturbance of these sites and associated areas should be kept to a minimum as a precaution due to the

potential risk of soil degradation where higher localised salinity or sodicity may be present. Direction of surface waters and any run-on should be avoided as local changes in the water regime are likely to mobilise salts stored in the soil, causing potential localised surface scalding and salinity related issues. Deep rooted vegetation should be maintained where present and ground clearing should be minimised.

6.5 Soil Characteristics and Management Responses

6.5.1 Chromosols

Table 5: Chromosol Characteristics and Management Responses.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Soil Surface		
These soils generally have weak structure in the surface with a firm to hard setting surface condition.	A firm to hard setting surface will generally have poor initial infiltration resulting in a large proportion of water running off causing erosion.	Surface infiltration rate can be increased through the incorporation of composted organic matter and by maintaining vegetative cover.
	A hard setting surface will also cause poor germination and seedling emergence.	Soil structure and moisture holding capacity can be improved through the incorporation of composted organic matter leading to better seedling establishment.
	A sandy to loamy surface with poor structure can have low soil strength causing trafficability issues.	Trafficability of these soils may be difficult when wet, however the use of gravel road surfaces may improve site access.
	If sandy to loamy surface soil with poor structure and low soil strength is overworked or excessively trafficked there is a high potential to generate dust.	Limit traffic and do not disturb unless necessary to avoid destruction of the limited soil structure. Construct gravel roads on the site and limit access off these roads. Consider the use of stabilisation products.
Expansive Clays		
These soils contain little to no expansive clays.		
Clay subsoils		
These soils contain non-sodic, slightly acidic to slightly alkaline clay subsoils that may be mottled.	These soils have imperfect drainage and lower landscape positions can stay wet for extended periods of time. Subsoil permeability is moderate.	Subsoil material is unsuitable for use on the soil surface and should be adequately covered with topsoil. Appropriate drainage design and materials (i.e. sand and gravel) can improve site access for construction. Depending on subsoil structure, plant roots are generally able to extend into the subsoil material without restriction. Gypsum additions can be used to assist structure improvement where required.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Dispersion		
These soils are generally non-dispersive; however, testing will be needed to confirm.	Although not generally dispersive, these soils are still susceptible to rill, sheet and stream bank erosion.	Maintain cover to reduce sheet and rill erosion. Stream bank erosion managed by maintaining vegetative cover and encouraging plants with fibrous root systems. Do not concentrate water flow unless using appropriate erosion and sediment control treatments. Erosion and sediment controls may need to be installed to manage drainage, erosion and prevent movement of sediment off-site.
Salinity		
These soils can have high salt levels (depending on parent material and landscape practices) particularly on lower slopes.	High salt levels will affect plant growth and will also impact water quality if leached or washed off.	If irrigating salty soils, maintain a leaching profile to reduce salt levels (salinity management handbook (DERM 2011) contains thresholds for different plants). Treat salty soils as dispersive soils, even if field testing results are negative, because salt can mask dispersion.
	Salt can cause scalding, erosion and damage to infrastructure.	Discharge salinity expressions can be managed by reducing water inputs and by increasing soil water use at the site or upslope if possible. Soil amelioration with gypsum and planting salt tolerant species may assist scald areas.
Fertility		
These soils generally have a low to moderate fertility.	The sandy surface and pale subsurface layers (where present) generally mean that nutrient content is low in these soils, as is their ability to hold onto nutrients.	Fertiliser additions may improve plant growth, particularly nitrogen, phosphorus, and potassium. To limit leaching/loss of nutrients, specific fertiliser rates should be divided up into regular smaller applications during the growing season, rather than one single application. Increasing organic matter content with composted organics will improve the fertility and assist nutrient retention in these soils.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Revegetation		
These soils are poorly to imperfectly drained with low to moderate fertility, highly alkaline subsoils and low plant available water holding capacity.	Plant species need be selected that are adapted to these conditions.	Addition of gypsum may be required to alleviate dispersion risk. Increasing organic matter content with composted organics will improve fertility, assist nutrient retention and improve moisture holding capacity of these soils. Relieve any compaction present and ensure adequate fertility for quick establishment. These soils will require frequent, low volume watering due to the dense subsoils. Protect surface with mulch material to reduce raindrop induced crusted or hard setting surface. Fertiliser additions should be divided up into regular smaller applications during the growing season to limit leaching of nutrients. Dense subsoil material significantly restricts plant root extension into the subsoil. Stabilisation and revegetation targets and timeframes should be in accordance with IECA (2008) guidelines
Soil Handling		
Some of these soils have very salty and/ or dispersive subsoils and potentially dusty topsoil.	The objective of soil handling is to minimise off site impacts and maximise the productive capacity of the soil on site consistent with the intended use.	Topsoil stripping should maximise available reserves and should avoid mixing with alkaline, salty and/or sodic subsoils – a simple survey of the site is recommended. Topsoil and subsoil stockpiles should be kept separate. Reinstate soil in the order they were removed (i.e. deeper subsoil below upper subsoil). Final placement of dispersive materials should be covered with adequate topsoil material to protect from erosion. Installation of erosion and sediment control structures may be required where soil is exposed. Trafficability of these soils may be difficult when wet, the use of gravel road surfaces may improve site access. Minimise the handling of topsoil material and ensure traffic is concentrated on constructed road surfaces.

6.5.2 Sodosols

Table 6: Sodosol Characteristics and Management Responses.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Soil Surface		
These soils generally have weak structure in the surface with a firm to hardsetting surface condition.	A sandy to loamy surface with poor structure can have low soil strength causing trafficability issues. If sandy to loamy surface soil with poor structure and low soil strength is overworked or excessively trafficked there is a high potential to generate dust.	Trafficability of these soils may be difficult when wet, however the use of gravel road surfaces may improve site access. Limit traffic and do not disturb unless necessary to avoid destruction of the soil structure. Construct gravel roads on the site and limit access off these roads. Consider the use of soil stabilisation products (i.e. polymer sprays).
Expansive Clays		
These soils contain little to no expansive clays.		
Clay subsoils		
These soils contain dense sodic, alkaline clay subsoils that are commonly mottled.	Depending on landscape position these soils can stay wet for long periods of time.	Appropriate drainage design and materials (e.g. sand and gravel) can improve site access for construction. Water diversion or vegetation may limit waterlogging at some locations.
Dispersion		
These soils are sometimes dispersive in the subsoil.	Dispersive soils have a high erosion risk and tunnel and gully erosion can occur.	Do not expose dispersive subsoil or at least minimise exposure (e.g. by staging construction disturbance, topsoil replacement and rehabilitation immediately following construction, installation of pipes and culverts for drains and other general earthworks). Gypsum can be used to ameliorate dispersive soils and assist with improving drainage and soil structure. Avoid ponding water on dispersive soils. To avoid an increased risk of tunnel erosion, ensure reinstated subsoil material is compacted similar to that of surrounding subsoil. Do not concentrate water flow unless using appropriate erosion and sediment control treatments. Erosion and sediment controls may need to be installed to manage drainage, erosion and prevent movement of sediment off-site.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Salinity		
These soils can have high salt levels (depending on parent material and landscape practices) particularly on lower slopes.	High salt levels will affect plant growth and will also impact water quality if leached or washed off.	If irrigating salty soils, maintain a leaching profile (i.e.. increase irrigation) to reduce salt levels (the salinity management handbook (DERM 2011) contains thresholds for different plants). Treat salty soils as dispersive soils, even if field testing results are negative, because salt can mask dispersion.
	Salt can cause scalding, erosion and damage to infrastructure.	Discharge salinity expressions can be managed by reducing water inputs (e.g. reducing irrigation, water diversions) and by increasing soil water use at the site or upslope if possible. Soil amelioration with gypsum and planting salt tolerant species may assist scald areas.
Fertility		
These soils generally have low to moderate fertility**.**	The sandy surface and pale subsurface layers generally mean that nutrient content is low in these soils as is their ability to retain nutrient.	Fertiliser additions will improve plant growth, particularly nitrogen, phosphorus, and potassium. To limit leaching/loss of nutrients, specific fertiliser rates should be divided up into regular smaller applications during the growing season, rather than one single application. Increasing organic matter content with composted organics will improve the fertility of these soils.
Revegetation		
These soils are poorly to imperfectly drained with low to moderate fertility, highly alkaline subsoils and low plant available water holding capacity.	Plant species need be selected that are adapted to these conditions.	Addition of gypsum may be required to alleviate dispersion risk. Increasing organic matter content with composted organics will improve fertility, assist nutrient retention and improve moisture holding capacity of these soils. Relieve any compaction present and ensure adequate fertility for quick establishment (testing required). These soils may require frequent, low volume watering due to the dense subsoils. Protect surface with mulch material to reduce raindrop induced crusted or hardsetting surface. Fertiliser additions should be divided up into regular smaller applications during the growing season to limit leaching of nutrients. Dense subsoil material significantly restricts plant root extension into the subsoil. Stabilisation and revegetation targets and timeframes should be in accordance with IECA (2008) guidelines.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Soil handling		
Some of these soils have very salty and/or dispersive subsoils and potentially dusty topsoil.	The objective of soil handling is to minimise off site impacts and maximise the productive capacity of the soil on site consistent with the intended use.	Topsoil stripping should maximise available reserves and should avoid mixing with alkaline, salty and/or sodic subsoils – a simple survey of the site is recommended. Topsoil and subsoil stockpiles should be kept separate. Reinstate soil in the order they were removed (i.e. deeper subsoil below upper subsoil). Final placement of dispersive materials should be covered with adequate topsoil material to protect from erosion (subsoil amelioration with gypsum may also be needed). Install erosion and sediment control structures where soil is exposed (i.e.. clean water diversions upslope, sediment fences around stockpiles, sediment control structures downslope). Trafficability of these soils may be difficult when wet, the use of gravel road surfaces may improve site access. Minimise the handling of topsoil material and ensure traffic is concentrated on constructed road surfaces (reduce soil degradation and dust generation).

7.0 Notes relating to results

Groundwater

No Free groundwater was encountered during the investigation. A groundwater table or seepage may be present at other times and fluctuations in groundwater levels and seepage could occur due to rainfall, changes in temperature and other factors.

Bore hole / test pit logging

The information supplied in the log sheets is based on visual and tactile assessment based on field conditions at the time of testing. The log sheets can include inferred data based on the experience of the geotechnician as well as factual data from in situ testing.

Samples

D	Disturbed sample
B	Bulk or composite sample
U	Undisturbed sample

Moisture Condition

D	Dry – runs freely through the fingers
M	Moist – does not run freely but is able to be formed
W	Wet – free water visible on the soil surface

Consistency (Cohesive Soils)

Description	Unconfined Compressive Strength (UCS)
Very soft	<25kPa
Soft	25-50kPa
Firm	50-100kPa
Stiff	100-200kPa
Very Stiff	200-400kPa
Hard	>400kPa

Relative Density (Cohesionless Soils)

Description	N Value blows per 300mm	Density Index Range%	Soil Friction Angle (degrees)
Very Loose	0-4	<15	<30
Loose	4-10	15-35	30-35
Medium	10-30	35-65	35-40
Dense	30-50	65-85	40-45
Very Dense	>50	>85	<45

8.0 Disclaimer

The information contained in this report has been extracted from field and laboratory sources believed to be reliable and accurate. DM McMahon Pty Ltd will not assume any responsibility for the misinterpretation of information supplied in this report. The accuracy and reliability of recommendations identified in this report need to be evaluated with due care according to individual circumstances. It should be noted that the recommendations and findings in this report are based solely upon the said site location and the ground level conditions at the time of testing. The results of the said investigations undertaken are an overall representation of the conditions encountered. The properties of the soil within the location may change due to variations in ground conditions outside of the tested area. The author has no control or liability over site variability that may warrant further investigation that may lead to significant design changes.

9.0 References

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10.0 Attachments

Field Soil logs

Laboratory results

McMahon EARTH SCIENCE

DOCUMENT ATTACHMENTS

REPORT 2018

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Attachment 01 : *Field Soil logs*

McMahon EARTH SCIENCE

SOIL SURVEY FIELD SHEET

Job No:	5034
Project:	Avonlie Solar Farm
Site:	2025 Sandigo Road

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
BH1	1	466306 E 6135057 N	1	0.0	0.3	A		RB		CL	T	3	N	-		Nil	-	-	
	2		2	0.3	0.5	B	D	RB		MC	M	4	N	-		Nil	-	-	
	3		2	0.5	1.5	B	D	RB		MC	T	5	N	-		Nil	-	-	
BH2	-	465953 E 6135117 N	1	0.0	0.1	A1		-RB		CL	D	4	N	-		Nil	-	-	Slight paling in colour w. depth.
	1		2	0.1	0.3	A	D	RB		CL	M	3	N	-		Nil	-	-	
	2		2	0.3	0.6	B	D	RB		MC	T	3	N	-		Nil	-	-	
			3	0.6	1.0	B	D	RY		MC	D	5	N	-		Nil	-	-	
BH3	-	465373 E 6135184 N	1	0.0	0.1	A		-RB		FSC	D	4	N	-		Nil	-	-	
	1		2	0.1	0.3	B	D	RY		FSC	D	4	N	-		Nil	-	-	
	2		2	0.3	1.0	B	D	-RY		LMC	D	5	N	-		Nil	-	-	
BH4	1	464745 E 6135273 N		0.0	0.2	A		-B		LSCL	D		N	-		Nil	-	-	
	2			0.2	1.0	B	D	RB		LC	T	4	N	-		Nil	-	-	
BH5	1	464354 E 6135689 N		0.0	0.3	A		YB		CL	D	2	N	-		Nil	-	-	
	2			0.3	1.5	B	D	YR		MC	T	4	N	-		Nil	-	-	
BH6	1	464425 E 6136299 N		0.0	0.3	A		YB		CL	D	2	N	-		Nil	-	-	Dry surface then moderately moist.
	2			0.3	1.0	B	D	YR		MC	T	4	N	-		Nil	-	-	
BH7		464083 E 6136385 N		0.0	0.1	A1		YB		CL	D	1	N	-		Nil	-	-	Dark brown moist layer approx 0.05-0.1m
	1			0.1	0.4	A	C	RB		LC	M	4	Y	Black		Nil	-	-	
	2			0.4	1	B	D	RB		MC	T	4	N	-		Nil	-	-	

McMahon EARTH SCIENCE

SOIL SURVEY FIELD SHEET

Job No:	5034
Project:	Avonlie Solar Farm
Site:	2025 Sandigo Road

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
BH8	1	463738 E 6136412 N		0.0	0.4	A		YB		CL	T	1	Y	R&Black		Nil	-	-	Dry top 5cm then moderately moist. -YB on the surface.
	2			0.4	1.0	B	D	RB		MC	T	2	N	-		Nil	-	-	
BH9	1	463716 E 6136852 N		0.0	0.3	A		+G		CL	D	5	N			Nil	-	-	Dry top 10cm.
	2			0.3	1.0	B	D	+G		MC	T	5	Y			Nil	-	-	
BH10	1	463761 E 6137091 N		0.0	0.3	A		YB		FSCL	D	2	N	-		Nil	-	-	
	2			0.3	1.0	B	D	RB		CL-LC	D	2	N	-		Nil	-	-	
BH11	1	463358 E 6137227 N		0.0	0.3	A		YB		CL	D	2	N	-		Nil	-	-	
	2			0.3	1.0	B	D	RB		LC	D	2	N	-		Nil	-	-	
BH12	1	463003 E 6137279 N		0.0	0.3	A		YB		CL	D	2	N	-		Nil	-	-	
	2			0.3	1.0	B	D	RB		LC	T	4	N	-		Nil	-	-	
BH13	1	462988 E 6137140 N		0.0	0.3	A		YB		CL	D	4	Y	Black		Nil	-	-	Red colour in hard clumps.
	2			0.3	1.0	B	D	RB		LC	T	4	N	-		Nil	-	-	
BH14	1	462932 E 6136898 N		0.0	0.3	A		YB		CL	D	3	N	-		Nil	-	-	
	2			0.3	1.0	B	D	RB		LC-MC	T	4	N	-		Nil	-	-	
BH15	1	462885 E 6136579 N		0.0	0.3	A		YB		CL	D	1	N	-		Nil	-	-	Bleaching from approx 0.8m.
	2			0.3	1.0	B	D	RB		LC	T	4	N	-		Nil	-	-	

SOIL SURVEY FIELD SHEET

Job No:	5034
Project:	Avonlie Solar Farm
Site:	2025 Sandigo Road

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
BH16	1	46295 E 6136435 E		0.0	0.3	A		YB		CL	D	1	N	-		Nil	-	-	
	2			0.0	1.0	B	D	RB		LC	T	4	Y	Black		Nil	-	-	
BH17	-	463458 E 6136058 N		0.0	0.1	A1		YB		CL	D	1	N	-		Nil	-	-	
	1			0.1	0.4	A	C	+RB		CL	T	2	Y	Black		Nil	-	-	
	2			0.4	1.0	B	D	YB		MC	M	4	N	-		Nil	-	-	
BH18	1	463546 E 6136058 N		0.0	0.3	A		YB		CL	D	3	N	-		Nil	-	-	
	2			0.3	1.0	B	D	YB		MC	M	3	N	-		Nil	-	-	
BH19	1	463527 E 6135722 N		0.0	0.3	A		YB-RB		LC	T	3	N	-		Nil	-	-	Lime present at approx 0.6m.
	2			0.3	1.0	B	D	RB		MC	M	3	N	-		Nil	-	-	
BH20	1	463689 E 6135489 N		0.0	0.3	A		YB-RB		CL	D-T	3	N	-		Nil	-	-	Dry top 0.1m. Lime present at approx 0.6m.
	2			0.3	1.0	B	D	RB		MC	T	4	N	-		Nil	-	-	
BH21	1	463725 E 6135092 N		0.0	0.3	A		YB		CL	D-T	3	N	-		Nil	-	-	Dry top 0.1m.
	2			0.3	1.0	B	D	RB		MC	T	4	N	-		Nil	-	-	
BH22	1	464078 E 6135630 N		0.0	0.3	A		YB-RB		CL	D-T	3	Y	Black					Dry top 0.1m. Lime present at approx 0.6m.
	2			0.0	1.0	B	D	RB		MC	T	4	N	-					
BH23	1	464174 E 6136043 N		0.0	0.3	A		YB		CL	D-T	2	N	-					Dry top 0.1m.
	2			0.3	1.0	B	D	RB		MC	T	4	N	-					

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SOIL SURVEY FIELD SHEET

Job No:	5034
Project:	Avonlie Solar Farm
Site:	2025 Sandigo Road

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
BH24	1	463852 E 6135989 N		0.0	0.3	A		YB		CL	D-T	3	N	-		Nil	-	-	Dry top 0.1m.
	2			0.3	1.0	B	D	RB		MC	T	4	Y	Black		Nil	-	-	
BH25	1	463670 E 6136148 N		0.0	0.3	A		YB		CL	D-T	2	N	-		Nil	-	-	Dry top 0.1m.
	2			0.3	1.0	B	D	RB		MC	T	5	N	-		Nil	-	-	
BH26		463251 E 6136360 N		0.0	0.1	A		YB		CL	D	1	N	-		Nil	-	-	
	1			0.1	0.3	B	D	RB		MC	M	3	Y	Black		Nil	-	-	
	2			0.3	1.0	B	D	RB		MC	M	3	Y	Black		Nil	-	-	
BH27	1	463059 E 6136803 N		0.0	0.3	A		YB		CL	D-T	2	N	-		Nil	-	-	
	2			0.3	1.0	B	D	RB		LC	T	4	N	-		Nil	-	-	
BH28	1	463217 E 613713 N		0.0	0.3	A		YB		CL	D	2	N	-		Nil	-	-	
	2			0.3	1.0	B	D	RB		LC	T	3	N	-		Nil	-	-	
BH29		463003 E 6136973 N		0.0	0.3	A		YB		CL	D	3	N	-		Nil	-	-	
				0.3	1.0	B	D	RB		LC	T	4	N	-		Nil	-	-	
BH30		463587 E 6137069 N		0.0	0.3	A		YB		LSC	D	2	N	-		Nil	-	-	
				0.3	1.0	B	D	RB		CL	D	2	N	-		Nil	-	-	

Attachment 02 : *Laboratory results*

ENVIRONMENTAL AND ANALYTICAL LABORATORIES

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PO Box 6118 4A Norton Street

Wagga Wagga NSW 2650

Attention: David McMahon

Friday, March 16, 2018

NATA Accredited Laboratory Number: 9597

Accredited for compliance with ISO/IEC 17025 - Testing

LABORATORY ANALYSIS REPORT

Report Number:1803-0042
Page 1 of 2

For all enquiries related to this report please quote document number: 1803-0042

Facility: **Order #**

Sample Type **Collected By** **Date Received**

Soil A. Debney 08-March-2018

EAL ID	Client ID. / Date/Time sample taken	Test	Result (units)		Method Reference	Limit of Reporting
18Mar-0157	**BH2/2** 08.03.18 10.00am					
		Conductivity (1:5 soil/water)	**102**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**5.5**	pH units	LTM-S-004	
18Mar-0158	**BH5/2** 08.03.18 10.00am					
		Conductivity (1:5 soil/water)	**206**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**5.8**	pH units	LTM-S-004	
18Mar-0159	**BH10/2** 08.03.18 10.00am					
		Conductivity (1:5 soil/water)	**156**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**6.2**	pH units	LTM-S-004	
18Mar-0160	**BH18/2** 08.03.18 10.00am					
		Conductivity (1:5 soil/water)	**362**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**6.1**	pH units	LTM-S-004	
18Mar-0161	**BH20/2** 08.03.18 10.00am					
		Conductivity (1:5 soil/water)	**545**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**6.6**	pH units	LTM-S-004	
18Mar-0162	**BH24/2** 08.03.18 10.00am					
		Conductivity (1:5 soil/water)	**330**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**6.7**	pH units	LTM-S-004	
18Mar-0163	**BH29/2** 08.03.18 10.00am					
		Conductivity (1:5 soil/water)	**204**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**6.8**	pH units	LTM-S-004	

ENVIRONMENTAL AND ANALYTICAL LABORATORIES

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DM McMahon Pty Ltd
PO Box 6118 4A Norton Street
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LABORATORY ANALYSIS REPORT

Report Number:1803-0042
Page 2 of 2
For all enquiries related to this report please quote document number: 1803-0042

Facility: **Order #**

Sample Type **Collected By** **Date Received**
Soil A. Debney 08-March-2018

EAL ID	Client ID. / Date/Time sample taken	Test	Result (units)		Method Reference	Limit of Reporting
18Mar-0164	**BH30/2** 08.03.18 10.00am					
		Conductivity (1:5 soil/water)	**142**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**7.3**	pH units	LTM-S-004	

Note:

**** NATA Accreditation does not cover the performance of this service.***

Signed ..... David Wade, Laboratory Manager.

All samples analysed as received.
All soil results are reported on a dry basis.
The EAL takes no responsibility for the end use of results within this report.
This report shall not be reproduced except in full.
This report replaces any previously issued report

Nutrient Advantage®

Nutrient Advantage Advice® Nutrient Report

D M MCMAHON PTY LTD ATF
PO BOX 6118

WAGGA WAGGA
NSW 2650

Report Print Date: 20/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: 5034 SANDIGO

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019490
Paddock Name: BH10/1
Sample Name: 5034 SANDIGO
Sample Depth (cm): 0 **To** 4

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 9/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		5.8
pH (1:5 CaCl2)		5.0
Elect. Conductivity (EC)	dS/m	0.11
Chloride	mg/kg	26
Nitrate Nitrogen	mg/kg	21
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	33
Phosphorus Buffer Index		63
Sulphur (KCl40)	mg/kg	7
Cation Exch. Cap. (CEC)	cmol(+)/kg	6.8
Calcium	cmol(+)/kg	3.9
Magnesium	cmol(+)/kg	1.4
Sodium	cmol(+)/kg	0.10
Potassium	cmol(+)/kg	1.40
Available Potassium	mg/kg	560
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	57.0
Magnesium % of Cations	%	20.0
Sodium % of Cations (ESP)	%	1.50
Potassium % of Cations	%	21.00
Calcium/Magnesium Ratio		2.8

ASPAC

Analyses conducted by **Nutrient Advantage Laboratory Services**
8 South Road, Werribee VIC 3030
NATA Accreditation No: 11958
Tel: 1800 803 453
Certificate of Analysis is available upon request.
Email: lab.feedback@incitecpivot.com.au

Incitec Pivot

Nutrient Advantage®

Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019490	**Test Code:**	E11
Paddock Name:	BH10/1	**Sample Type:**	Soil
Sample Name:	5034 SANDIGO	**Sampling Date:**	9/03/2018
Sample Depth (cm):	0 **To** 4		

The results reported pertain only to the sample submitted.
Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
* One or more components of this test are below their detection limit. The value used is indicative only.

Nutrient Advantage®

Nutrient Advantage Advice® Nutrient Report

D M MCMAHON PTY LTD ATF
PO BOX 6118

WAGGA WAGGA
NSW 2650

Report Print Date: 20/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: 5034 SANDIGO

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019491
Paddock Name: BH5/1
Sample Name: 5034 SANDIGO
Sample Depth (cm): 0 **To** 4

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 9/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		6.4
pH (1:5 CaCl2)		5.6
Elect. Conductivity (EC)	dS/m	0.06
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	11
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	25
Phosphorus Buffer Index		50
Sulphur (KCl40)	mg/kg	4
Cation Exch. Cap. (CEC)	cmol(+)/kg	8.2
Calcium	cmol(+)/kg	4.7
Magnesium	cmol(+)/kg	2.3
Sodium	cmol(+)/kg	0.12
Potassium	cmol(+)/kg	1.00
Available Potassium	mg/kg	400
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	58.0
Magnesium % of Cations	%	29.0
Sodium % of Cations (ESP)	%	1.40
Potassium % of Cations	%	12.00
Calcium/Magnesium Ratio		2.0

Analyses conducted by **Nutrient Advantage Laboratory Services**
8 South Road, Werribee VIC 3030
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Nutrient Advantage®

Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019491	**Test Code:**	E11
Paddock Name:	BH5/1	**Sample Type:**	Soil
Sample Name:	5034 SANDIGO	**Sampling Date:**	9/03/2018
Sample Depth (cm):	0 **To** 4		

The results reported pertain only to the sample submitted.
Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
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Nutrient Advantage®

Nutrient Advantage Advice® Nutrient Report

D M MCMAHON PTY LTD ATF
PO BOX 6118

WAGGA WAGGA
NSW 2650

Report Print Date: 20/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: 5034 SANDIGO

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019492
Paddock Name: BH2/1
Sample Name: 5034 SANDIGO
Sample Depth (cm): 0 **To** 4

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 9/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		5.7
pH (1:5 CaCl2)		4.8
Elect. Conductivity (EC)	dS/m	0.07
Chloride	mg/kg	25
Nitrate Nitrogen	mg/kg	17
Ammonium Nitrogen	mg/kg	6
Phosphorus (Colwell)	mg/kg	18
Phosphorus Buffer Index		66
Sulphur (KCl40)	mg/kg	9
Cation Exch. Cap. (CEC)	cmol(+)/kg	6.3
Calcium	cmol(+)/kg	3.9
Magnesium	cmol(+)/kg	1.1
Sodium	cmol(+)/kg	0.05
Potassium	cmol(+)/kg	1.10
Available Potassium	mg/kg	420
Aluminium	cmol(+)/kg	0.1
Aluminium % of Cations	%	1.8
Calcium % of Cations	%	63.0
Magnesium % of Cations	%	18.0
Sodium % of Cations (ESP)	%	0.75
Potassium % of Cations	%	17.00
Calcium/Magnesium Ratio		3.5

ASPAC

Analyses conducted by **Nutrient Advantage Laboratory Services**
8 South Road, Werribee VIC 3030
NATA Accreditation No: 11958
Tel: 1800 803 453
Certificate of Analysis is available upon request.
Email: lab.feedback@incitecpivot.com.au

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019492	**Test Code:**	E11
Paddock Name:	BH2/1	**Sample Type:**	Soil
Sample Name:	5034 SANDIGO	**Sampling Date:**	9/03/2018
Sample Depth (cm):	0 **To** 4		

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WAGGA WAGGA
NSW 2650

Report Print Date: 20/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: 5034 SANDIGO

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019493
Paddock Name: BH20/1
Sample Name: 5034 SANDIGO
Sample Depth (cm): 0 **To** 4

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 9/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		8.0
pH (1:5 CaCl2)		6.8
Elect. Conductivity (EC)	dS/m	0.16
Chloride	mg/kg	20
Nitrate Nitrogen	mg/kg	4
Ammonium Nitrogen	mg/kg	<1
Phosphorus (Colwell)	mg/kg	5
Phosphorus Buffer Index		99
Sulphur (KCl40)	mg/kg	11
Cation Exch. Cap. (CEC)	cmol(+)/kg	22.8
Calcium	cmol(+)/kg	8.0
Magnesium	cmol(+)/kg	11.0
Sodium	cmol(+)/kg	3.00
Potassium	cmol(+)/kg	0.92
Available Potassium	mg/kg	360
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	35.0
Magnesium % of Cations	%	48.0
Sodium % of Cations (ESP)	%	13.00
Potassium % of Cations	%	4.00
Calcium/Magnesium Ratio		0.7

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019493	**Test Code:**	E11
Paddock Name:	BH20/1	**Sample Type:**	Soil
Sample Name:	5034 SANDIGO	**Sampling Date:**	9/03/2018
Sample Depth (cm):	0 **To** 4		

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Report Print Date: 20/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: 5034 SANDIGO

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019494
Paddock Name: BH24/1
Sample Name: 5034 SANDIGO
Sample Depth (cm): 0 **To** 4

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 9/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		6.6
pH (1:5 CaCl2)		5.6
Elect. Conductivity (EC)	dS/m	0.06
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	8
Ammonium Nitrogen	mg/kg	1
Phosphorus (Colwell)	mg/kg	25
Phosphorus Buffer Index		84
Sulphur (KCl40)	mg/kg	3
Cation Exch. Cap. (CEC)	cmol(+)/kg	16.0
Calcium	cmol(+)/kg	9.4
Magnesium	cmol(+)/kg	5.0
Sodium	cmol(+)/kg	0.34
Potassium	cmol(+)/kg	1.30
Available Potassium	mg/kg	490
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	59.0
Magnesium % of Cations	%	31.0
Sodium % of Cations (ESP)	%	2.10
Potassium % of Cations	%	7.80
Calcium/Magnesium Ratio		1.9

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019494	**Test Code:**	E11
Paddock Name:	BH24/1	**Sample Type:**	Soil
Sample Name:	5034 SANDIGO	**Sampling Date:**	9/03/2018
Sample Depth (cm):	0 **To** 4		

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WAGGA WAGGA
NSW 2650

Report Print Date: 20/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: 5034 SANDIGO

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019495
Paddock Name: BH29/1
Sample Name: 5034 SANDIGO
Sample Depth (cm): 0 **To** 4

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 9/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		6.7
pH (1:5 CaCl2)		6.1
Elect. Conductivity (EC)	dS/m	0.09
Chloride	mg/kg	13
Nitrate Nitrogen	mg/kg	9
Ammonium Nitrogen	mg/kg	3
Phosphorus (Colwell)	mg/kg	32
Phosphorus Buffer Index		43
Sulphur (KCl40)	mg/kg	3
Cation Exch. Cap. (CEC)	cmol(+)/kg	8.0
Calcium	cmol(+)/kg	5.6
Magnesium	cmol(+)/kg	1.1
Sodium	cmol(+)/kg	0.03
Potassium	cmol(+)/kg	1.30
Available Potassium	mg/kg	500
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	70.0
Magnesium % of Cations	%	13.0
Sodium % of Cations (ESP)	%	0.33
Potassium % of Cations	%	16.00
Calcium/Magnesium Ratio		5.1

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019495	**Test Code:**	E11
Paddock Name:	BH29/1	**Sample Type:**	Soil
Sample Name:	5034 SANDIGO	**Sampling Date:**	9/03/2018
Sample Depth (cm):	0 **To** 4		

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