APPENDIX I SOIL SURVEYS

SOIL SURVEY REPORT

WELLINGTON NORTH SOLAR FARM

March 2018

DM McMahon Pty Ltd
6 Jones St (PO Box 6118)
East Wagga Wagga NSW 2650
t (02) **6931 0510** **www.dmmcmahon.com.au**

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Project brief

At the request of Jane Blomfield of NGH Environmental Pty Ltd, soil sampling, analysis and reporting was carried out to assess the site on 13 and 14 March 2018. The document provides information about the site and soil conditions from field observations and laboratory analysis.

Site identification

Address: Goolma Road, Wellington NSW 2820
Real property description: Lot 109 DP750760
Centre co-ordinate: 683829 6402941 MGA GDA z55
Property size: approx. 970ha
Owner: c/o NGH Environmental Pty Ltd
Local Council Area: Dubbo Regional
Present use: Agriculture
Development Application Reference: not known
Report identification: 5040

Certification

Name	Signed	Date	Revision Number
David McMahon BAppSc GradDip WRM		5/06/18	2

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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 Wellington North Solar Farm near Wellington, NSW.

The soil and land survey work was commissioned by Jane Blomfield of NGH Environmental Pty Ltd and was undertaken in general accordance with an email dated 7 August 2017 from Nick Graham-Higgs of NGH Environmental Pty Ltd. The survey was carried out utilising a backhoe to excavate soil pits for evaluation to a depth of approximately 1.2m. Alice Debney of DM McMahon Pty Ltd conducted a free soil survey on 13 and 14 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 (2008) where selection of a 'Moderately High (Detailed)' intensity level was deemed appropriate for satisfying the objectives for detailed project planning.

2.0 Site Characteristics

A brief 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 site is situated over two different Topographic map sheets: The Wellington 1:50,000 Topographic map sheet (8632-N) and the Geurie 1:50,000 Topographic map sheet (8633-S). The site is located at an elevation range of approximately 340m to 400m AHD. The site slope is classed as level to very gently inclined in the west and gently to moderately inclined to the east. The landform is generally a simple slope with a crest formation to the east and drainage plain associated with the first, second and fourth order streams which are tributaries of the Wuuluman Creek to the south west.

2.2 Vegetation

The site is used for agricultural production, predominantly livestock. The pastures consist of largely lucerne, with one paddock of sorghum. Cathead and paddy melon weeds are prevalent. A more detailed assessment of vegetation present can be seen in the NGH environmental scoping report.

2.3 Weather

The mean rainfall for Wellington is approximately 617.1mm per annum. The wettest months are November, December and January, however the rainfall is spread relatively evenly throughout the year. Mean maximum temperatures range from 15.2 ºC in July to 33.0 ºC in January and mean minimum temperatures range from 2.2 ºC in July to 15.2 ºC in January. Historical records obtained from Wellington (D&J Rural) AWS 065034 (www.bom.gov.au).

2.4 Hydrology

The site is located in the Macquarie River catchment area. Natural watercourses have been extensively modified since European settlement to improve channel efficiency. Run-off of

surface waters from precipitation flow into the drainage system of Wuuluman Creek and ultimately into the Macquarie River.

2.5 Soil & Landform

The site is on soil landscapes coded **bz** from the Soil and Land Resources of Central and Eastern NSW (OEH, 2017). A brief description of the soil landscapes are as follows, **Table 1.**

Table 1: Soil Landscapes

bz – Bodangora	
Topography	Low undulating hills ranging in elevation from 300 – 500 m. Local relief from 40 – 100m. Slopes are gently inclined (3 – 10%) with slopes from 1000 – 3000 m long. Drainage lines are 500 – 1000 m apart.
Soils:	**Euchrozems** *Topsoil* Dark reddish-brown clay loams to light clays, moderately well structured with sub-angular or angular blocky peds. Field pH increases from 5.5 to 7.0 in the A horizon; to 35cm depth. Gradual boundary to- *Subsoils* Moderate to strongly structured reddish-brown light to medium clays with smooth-faced, sub-angular or polyhedral peds. Gravel increases with depth and soft nodules of calcium carbonate begin to appear at about 90cm depth. Field pH 8.0 to 8.5. **Non-calcic Brown Soils** *Top Soils* Hardsetting, gravelly (50-90%) dark reddish-brown fine sandy loams to sandy clay loams with weak crumb or sub-angular blocky peds; pH 6 – 7; to 30cm depth. Clear boundary to – *Subsoils* Gravelly, dark reddish-brown, light medium clays with moderately structured fine sub-angular blocky peds; pH 8.0; weathered rock is encountered at about 80cm. **Terra Rossa Soils** *Topsoils* Friable dark reddish-brown fine sandy clay loams to clay loams with moderately structured, fine angular blocky, smooth-faced peds. pH 5.5; 12cm depth. Clear boundary to- *Subsoils* Dark reddish-brown, clay loams to medium clays; strongly structured, fine angular blocky peds with some limestone gravel at depth; pH 7.0 to 8.0, becoming 8.0 to 8.5 at depth.
Geology and Regolith:	Geological units are Ordovician undifferentiated, Silurian undifferentiated and Gowan Green Group. Parent rocks are Andesite, tuff, keratophyric lava and tuff, shale, limestone, conglomerate, agglomerate, siltstone and chert. *In situ* and colluvial-alluvial materials are derived from parent rock.

The site lies within the mapping unit **MO3** from the Digital Atlas of Australian Soils (CSIRO, 1991). The map unit **MO3** is described as:

"MO3"

"Gently undulating plains with occasional higher stony ridges: a complex array of soils is present but loamy nodular mottled yellow earths (Gn2.61), with lesser (Gn2.64) and (Gn2.74), are probably dominant. Closely associated are important areas of loamy or, less commonly, sandy red earths (Gn2.11, Gn2.14); these usually occur on well-defined stream levees. Smaller areas of friable earths (Gn3.71) and (Gn3.91) and deep loamy duplex soils (Dy3.81) also occur. The higher stony ridges have shallow gravelly duplex soils (Dy3.41) and shallow stony loams (Um2.12) and (Um4.1). Data are fairly limited. Occurs on sheet(s): 7"

2.6 Geology

The site geology is distributed over one unit: Ordovician sedimentary volcanics.

2.7 Hydrogeology

From the Geoscience Australia hydrogeology dataset, the groundwaters beneath the site are crossed over two units. They are described as porous extensive highly productive aquifers and fractured or fissured, extensive aquifers of low to moderate productivity.

2.8 Biophysical Strategic Agricultural Land

The site is located within a Biophysical Strategic Agricultural Land (BSAL) area, NSW DPE 2016. The dataset comes with an important note for users, that 'mapping was done at a regional scale, not at a property boundary level' therefore, a site-specific assessment is required to gauge the development against the BSAL mapping. A further investigation of the metadata which provides criteria for the BSAL mapping demonstrates that the site is within two classes being 'grazing - modified pasture' in the east and 'dryland cropping' in the west, OEH 2018. This is in conflict with the criteria for the BSAL mapping which suggests that land capability classes I or II under the Land and Soil Capability Mapping of NSW is BSAL land. Of note are the incorrect classes have been applied to the BSAL mapping with the old land classes I and II from the NSW Agriculture 2002 system being incorrectly applied to the Land and Soil Capability Classes of 1 and 2, OEH 2012. The classification systems are inverse which confuses the relevance of the BSAL dataset for use in land classification.

However, this assessment of the subject site categorises the land as Class 3 in the western lower slopes and plains and Class 4 on the eastern higher slopes and crests by reference to the Land and Soil Capability Classes, OEH 2012. Class 3 is defined as having moderate agricultural limitations with careful management required while Class 4 has moderate to high agricultural limitations with restricted management options. Based on the above, the land does not qualify as BSAL under the current classification system. More on the site-specific impacts of the proposal and the recommended management can be seen in section 6.6.

3.0 Investigation Scope of Works

The specifications for the site investigation and soil survey are as follows, **Table 2**:

Table 2: Scope of Works

Item	Description	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.	Carry out field investigations by reference to Guidelines for Surveying Soil and Land Resources (2008) & AS1726:1993 Geotechnical Site Investigations.	40 pits in total. Samples of topsoils, B, B/C and C horizons taken where present to adequately classify soils as per ASC 1996.
5.	Analyse soils in situ and at our NATA accredited laboratory to AS/RMS methods.	10 x Representative samples for topsoil analysis – pH, EC, nutrient and cation status. 10 x Representative samples for subsoil analysis – pH, EC, dispersion.
6.	Generate laboratory reports and review results.	-
7.	Compile results in report detailing methodology, desktop study, physical conditions, field work results, test locations, bore logs, in-situ test results, laboratory results and discussion.	-
8.	Recommendations for erosion control and prevention measures and management recommendations for earthworks.	-

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

Figure 1: Soil survey investigation pit locations.

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 at depth. Free groundwater was not encountered within the investigated depths.

4.2 Typical Soil Profiles

Soils can be classified into a typical soil profile across the site as per the Australian Soil Classification system (Isbell, 1996) and the Great Soil Groups (Stace *et al.,* 1968). Representative photographs from profiles examined on site can be seen below with a brief description of the profile characteristics. All soil pits investigated were located on managed agricultural lands. Field soil log sheets can be seen attached.

4.2.3 Ferrosols (Equivalent to Euchrozems).

Topsoil

Dark reddish-brown clay loams to light clays, moderately well-structured with sub-angular or angular blocky peds. Field pH increases from 5.5 to 7.0 in the A horizon; to 35cm depth. Gradual boundary to-

Subsoils

Moderately to strongly structured reddish-brown light to medium clays with smooth-faced, sub-angular or polyhedral peds. Gravel increases with depth and soft nodules of calcium carbonate begin to appear at about 90cm depth. Field pH 8.0 to 8.5.

Figures 2 and 3 represent typical soil profiles on site.

Figure 2: Typical soil profile with A and B horizons.

Figure 3: Typical soil profile with A, B and C horizons.

4.4 Laboratory Analysis

Ten 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 COA's can be found in the attachments and soil parameters can be seen summarised in **Table 3**. Ten subsoil samples were also analysed for pH and EC, and tested for dispersion, **Table 4**.

There was one outlier set of results in soil pit 34 that has been left out of the ranges provided below. There is the possibility of a sampling or laboratory error that has rendered inaccurate results. There was, however, considerably more moisture in the soil profile than any other soil pit, with the A Horizon classified as 'T' (moderately moist) and the B Horizon classified as 'T – M' (moderately moist to moist). Water and salt accumulates in open drainage depressions which is indicative of the landscape at this point. Salt from the colluvial water fluxes can accumulate in the soil after long periods of low rainfall, which may explain the high

Electrical Conductivity (EC), chloride and Exchangeable Sodium Percentage (ESP) readings.

4.4.1 Topsoil Analysis

4.4.1.1 pH & Electrical Conductivity

Topsoil pH (1:5 soil/water) ranged from 5.3 to 7.4 and can be classed as 'Strongly Acid' to 'Mildly Alkaline' (Bruce & Rayment, 1982). EC ranged from 0.03 to 0.27 dS/m and therefore the salinity rating was 'very low' (Agriculture Victoria, 2011).

4.4.1.2 Cation Exchange Capacity, Exchangeable Sodium Percentage & Dispersion

Cation Exchange Capacity (CEC) ranges from 5.3 to 19.3 cmol(+)/kg. CEC of the soils is rated by Hazelton and Murphy (2007), as 'very low' (<6) to 'moderate' (12 - 25). ESP ranges from 0.17% to 2.00%, which is given a sodicity rating of 'non-sodic' (0-6) (Hazelton & Murphy, 2007). Field determination of dispersion was Nil in all topsoil samples, with some slacking in 3 of the samples. It should be noted that one result (soil pit 34) had an ESP of 36%, however, field determination of dispersion was nil and therefore this is considered an outlier.

4.4.1.3 Colwell Phosphorus and Phosphorus Buffering Index

Colwell P (plant available phosphorus) ranges from 8 to 140mg/kg, which is classed as 'Extremely low' to 'Low' (AWI, 2008). Phosphorus Buffering Index (PBI) ranged from 22 to 110 and is classed from 'very, very low' (15 - 30) to 'low' (71 – 140) (Agriculture Victoria, 2011).

4.4.1.4 Calcium:Magnesium Ratio

Ca:Mg ratio should be at least 2:1. Higher calcium contents are acceptable however higher magnesium content may result in soil dispersion. Ca:Mg determined for topsoils returned results ranging from 0.5 to 4.7, indicating that there is low potential for dispersion of topsoils upon wetting.

4.4.2 Subsoil Analysis

4.4.2.1 pH & Electrical Conductivity

Subsoil pH (1:5 soil/water) ranged from 6.2 to 7.3 and can be classed as 'Slightly Acid' to 'Neutral' (Bruce & Rayment, 1982). EC ranged from 0.036 to 0.231 dS/m and therefore the salinity rating was 'very low' (Agriculture Victoria, 2011).

4.4.2.2 Dispersion

Field determination of dispersion indicated that all soils are unlikely to be sodic. (Hazelton & Murphy, 2007).

5.0 Summary of Test Results

Table 3: Topsoil - Results of laboratory testing.

Pit/Sample	Dispersion	pH (1:5 Water)	pH (1:5 CaCl2)	Electrical Conductivity	Chloride	Nitrate Nitrogen	Ammonium Nitrogen	Colwell P	PBI	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	%	%	%	%	%	-
2/1	N*	6.0	4.9	0.05	<10	3	3	33	88	4	12.1	8.5	1.8	0.04	1.80	690	<0.1	<1.0	70	15	0.33	15	4.7
5/1	N*	5.9	5.2	0.26	38	55	28	140	59	39	10.1	6.1	1.6	0.06	2.40	950	<0.1	<1.0	60	15	0.58	24	3.8
10/1	N	6.3	5.2	0.03	11	2	2	44	45	2	14.0	9.6	3.8	0.07	0.42	0.42	<0.1	<1.0	69	27	0.49	3	2.5
11/1	N	5.3	4.6	0.14	26	56	6	13	22	7	5.3	3.5	1.0	<0.02	0.79	310	0.1	2.1	65	18	<1.00	15	3.6
19/1	N	5.4	4.7	0.14	19	52	8	19	61	9	7.4	4.1	1.9	0.06	1.30	500	0.1	1.5	55	25	0.81	17	2.2
21/1	N*	7.1	6.1	0.04	11	2	1	8	110	3	13.4	9.6	2.5	0.02	1.30	520	<0.1	<1.0	72	18	0.17	9.9	3.8
30/1	N	5.7	5.2	0.26	39	79	16	130	69	22	14.1	9.1	2.4	0.08	2.50	970	<0.1	<1.0	65	17	0.60	18	3.8
34/1	N	7.4	7.3	5.90	11000	34	2	49	120	100	43.7	8.9	18.0	16.0	0.98	380	<0.1	<1.0	20	41	36.00	2.2	0.5
36/1	N	6.3	5.7	0.27	140	3	2	38	100	5	19.3	14.0	3.6	0.39	1.00	410	<0.1	<1.0	74	19	2.00	5.4	3.9
39/1	N	5.9	5.2	0.15	30	47	7	51	57	9	10.8	7.4	1.8	0.03	1.60	640	<0.1	<1.0	68	16	0.29	15	4.1

Table 4: Subsoil - Results of laboratory testing.

Pit/Sample	Horizon	pH (1:5 soil/water)	Electrical Conductivity	Dispersion*
Units		-	µS/cm	-
2/2	B	6.3	36	N
5/2	B	6.2	156	N
10/2	B	6.4	131	N
11/2	B	-	-	N
19/2	B	7.3	38	N
21/2	B/C	6.4	231	N
30/2	B	6.8	97	N
30/3	C	6.8	230	-
34/2	B	7.0	764	P
36/2	B	-	-	N
36/3	C	7.2	128	-
39/2	B	7.0	41	N

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

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 below, **Table 5**.

Table 5: Potential landscape limitation assessment

Soil Type	Erosion Hazard	Salinity Risk	Acid Soil	Waterlogging Risk	Acid Sulfate Soils	Infrastructure
Ferrosol	LOW	LOW	YES	MODERATE	NO	MODERATE

As follows is the soil landscape map (eSpade, 2017) that has been generally validated by the soil survey through laboratory and field techniques, **Figure 4**. As such, management practices can be grouped into management classes of either soil landscape units or Australian Soil Classification units. This report identifies management practices for ASC units in section 6.5 below.

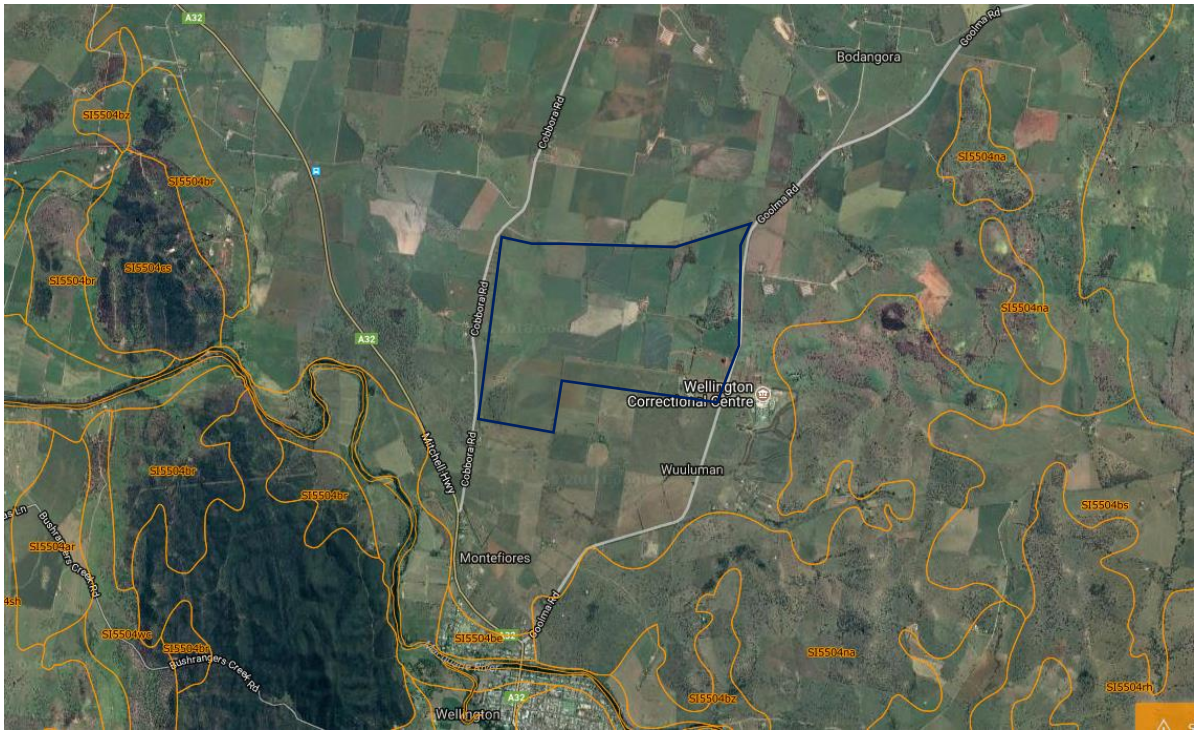

Figure 4: Bodangora soil landscape with site overlay.

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 (BMPs) 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.
- Protect inlets, storm drain outlets and culverts.
- Provide access and general construction controls.
- Inspect and maintain sediment and erosion control measures regularly.

- Employ the use of sediment control measures to prevent off and on-site damage.

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 of 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 dryland farming and grazing. Associated water features are drainage plains and lines, and two groundwater bores (GWO14993 and GWO16640). At the time of investigation, the pasture condition appeared to be poor with minimal ground cover in the majority of paddocks which would increase the flux of rainwater into the subsoil through recharge. Given the soils on site are classified as ‘non-sodic’ and are of low salinity the risk of salt build-up in discharge areas is thought to be low. However, changing direction of surface waters and any run-on should be avoided as local changes in the water regime are likely to mobilise any salts stores, however low, in the soil. Deep rooted vegetation should be maintained where present, especially large individual trees along fence lines and in paddocks, and the three small areas of bush on the eastern side of the property. The majority of pastures consist of lucerne, a pasture with a deep root system, with the exception of one paddock which contains sorghum, an annual species which would ideally

be replaced with lucerne. Ground clearing of pastures and trees should be minimised, and where removal is necessary, minimise disturbance of surrounding vegetation.

There are four groundwater bores found within and around the subject site as can be seen in **Figure 5** below.

Figure 5: Registered groundwater bores on and near the site.

The details of the bore construction for the bores located above are shown as follows in **Table 6** (DPI, 2018).

Table 6: Registered groundwater bores in the locale (DPI, 2018).

Bore ID	Drilled depth (m)	Water bearing zone (m)	Standing water level (m)	AHD (m)	Purpose
GW043218	18.80	No data	No data	380	Stock, Domestic
GW014993	18.30	12.20 - 14.30 17.10 - 17.40	No data	370	Not known
GW026447	33.50	19.8 – 21.3	No data	350	Stock
GW016640	7.3	No data	No data	310	Stock

As can be seen above the groundwater bores onsite or down gradient of the site are for stock and/or domestic use. The groundwater is likely to be in alluvial layers and be responsive to rainfall events in terms of standing water level and salinity. From a review of the current and proposed site operations the potential impacts on salinity, groundwater and hydrology are thought to be low.

6.5 Potential Impacts on Agricultural Resources

The proposal is to install solar panels for a short to medium term period with a view to restore the land to the original land use setting upon decommissioning. The proposal is to build limited infrastructure in the form of boundary roads and substations while the solar panels will be installed on pile driven posts or on small pad footings. Upon decommissioning of the solar farm, the pile driven posts or small pad footings will be removed causing minimal soil and landscape disturbance and the land will be fit for purpose for continued primary industry use dependent upon the soil management responses outlined as follows being implemented. During operation of the solar farm ground cover will be maintained and managed with the option for slashing, crash grazing, reseeding and amelioration with fertiliser and/or lime dependent upon the results of the monitoring and reporting carried out. Therefore, based on the findings of this report from the site-specific assessment, the proposal will have limited impact on agricultural resources, and the land upon decommissioning of the solar farm will be suitable for alternative land uses such as forestry and mining in addition to agriculture.

6.6 Potential for the project to improve erosion characteristics of the land

The project has the ability to potentially improve erosion characteristics of the land owing to the minimisation of grazing and cessation of cultivation. Agricultural practices, which will be limited throughout the commissioning and operation of the solar farm are the main cause of uncontrolled erosion on site and by limiting this erosion characteristics will be improved. The landscape will be stabilised by maintaining groundcover through, allowing vegetation to become better established, which will abate structural breakdown and increase organic matter content in soil and subsequent aggregate stability. Proposed conservation earthworks on the eroded gully on the property will also enhance erosion control and improve water quality downstream.

6.5 Soil Characteristics and Management Responses

6.5.1 Ferrosols

Table 7: Characteristics and Management Responses.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Soil Surface		
These soils generally have moderate structure in the surface and subsoil and are non-sodic.	Surface structure can deteriorate following prolonged cultivation/ handling to produce a hardsetting surface.	Excessive cultivation or handling of these soils should be avoided. Soil structure and surface infiltration rate can be maintained through the incorporation of composted organic matter and by maintaining vegetative cover. During construction limit traffic to designated paths to minimise destruction of the soil structure. Following construction do not disturb unless necessary (routine maintenance of infrastructure should be kept to the designated paths). Construct gravel roads on the site and limit access off these roads.
Expansive Clays		
These soils contain little to no shrink swell clays.	Some of these soils may contain layers of shrink swell clays at depth.	Reinstate soils in the order they are removed (ie. topsoil above subsoil) to reduce possible effect on infrastructure.
Clay subsoils		
These soils contain clay loam to medium clay subsoils that may be grouped into red and brown sub groups.	Subsoils have moderate to strong structure with texture ranging from clay loam to medium clay. Where these soils are formed on weathered rock profiles may be shallow (some rocky), while those developed on alluvium are deep. The subsoil of this soil type is generally suitable for most earthwork purposes. However both the topsoil and subsoil are prone to structural decline and compaction.	Relieve compaction of subsoil material where revegetation required, amelioration may assist. Excessive handling of these soils should be avoided.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Dispersion		
These soils are usually non-dispersive.	These soils generally have low sodium content (ie. non-sodic) and as a result are likely to be nondispersive. However, these soils may be susceptible to rill and sheet erosion when left exposed to heavy rainfall and/or stream bank erosion when located adjacent to watercourses.	Maintain cover to reduce sheet and rill erosion. Final shaping of sloping land should avoid the concentration of water flows (ie. maintain sheet flow). If possible, during construction the existing gullies are to be remediated to minimise further erosion. Stream bank erosion managed by maintaining vegetative cover and encouraging plants with fibrous root systems. Riparian zones should be maintained and improved where possible.
Salinity		
Due to their free drainage characteristics, these soils generally have low salt levels (depending on parent material and landscape practices).	Soil parent material often contains minimal salt, this in combination with elevated landscape position with good runoff and/ or permeable soil characteristics are such that these soils do not generally contain high salt concentration within the soil profile.	Maintain site drainage. Avoid applying poor quality water (ie. salty) water to these soils to maintain low salinity status.
Fertility		
These soils are often fertile with clay textured soils generally the best.	Moderate clay content and moderate fertility. The site is within two classes of the BSAL area, being 'grazing – modified pasture' in the east and 'dryland cropping' in the west.	May require limited fertiliser additions to stimulate plant growth, particularly nitrogen and phosphorus (depending on plants). Topsoil conservation should be maximised through appropriate soil handling practices. Addition of organic matter in the form of composted organics will maintain fertility, nutrient retention assist to and improve moisture holding capacity of these soils.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Revegetation		
These soils have strong to slight acid pH, they are well drained with good fertility and plant available water holding capacity (depending on profile depth).	Plant species need be selected that are adapted to these conditions.	Relieve any compaction present and ensure adequate fertility for quick establishment (testing required). Shallow profiles will require frequent, low volume watering. Deep profiles can be watered for longer periods and less frequently (monitor moisture conditions). Protect surface with mulch material to reduce raindrop induced crusted or hardsetting surface. Stabilisation and revegetation targets and timeframes should be in accordance with IECA (2008) guidelines.
Soil Handling		
These soils have very few limitations for agronomic and engineering uses.	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 salty and/or sodic subsoils – testing is recommended. Topsoil or subsoil stockpiles should be kept separate. Reinstate soil in the order they were removed (ie. lower subsoil below upper subsoil). To maintain soil structure, limit the handling of soil material and ensure traffic is concentrated on constructed road surfaces and utilise water trucks (reduce dust generation). Installation of erosion and sediment control structures may be required where soil is exposed (eg. clean water diversions upslope, sediment fences around stockpiles). Trafficability of these soils should be avoided when wet (structural decline), the use of gravel road surfaces may improve site access.

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
T	Moderately moist – does not run freely and is difficult to form
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	Density Index	Soil Friction
	blows per 300mm	Range%	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

SOIL SURVEY FIELD SHEET

Job No:	5040
Project:	Wellington Solar Farm
Site:	Goolma Road, Wellington NSW 2650

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
1	1	0685615 E 6402770 N		0.0	0.2	A1		RB		SCL	D	5	N	-	s.d. SAB	Nil	-	-	Lots of roots present. Slight colour change from A1 to A2. Hit bluestone.
	-			0.2	0.5	A2	D	RB		SCL	D	5	N	-	s.d. SAB	Nil	-	-	
	2			0.5	0.9	B	C	BR		LC	D-T	5	Y	Black	w.d. SAB	Nil	-	-	
2	1	0685008 E 6402891 N		0.0	0.4	A		RB		SCL	D	3	N	-	s.d. SAB	Nil	-	-	Roots to approx 0.8m. Slightly darker brown BR.
	2			0.4	1.2	B	D	BR/RB		LC	D	3	N	-	w.d. SAB	Nil	-	-	
3	1	0684816 E 6402596 N		0.0	0.4	A		RB		SL	D	1	N	-	w.d. SAB	Y	0-5	5	Roots to 0.6m. V. hard at 1.0m.
	2			0.4	1.0	B	C	BR		CL	D	4	Y	Black	Massive	Y	5-10	10	
4	1	0685018 E 6402265 N		0.0	0.4	A		RB		SCL	D	1	N	-	s.d. SAB	Y	0-20	10	Red clay w. soft silty rock & bluestone.
	2			0.4	1.2	B	C	BR		LC	D-T	4	N	-	Massive	Y	0-20	20	
5	1	0684677 E 6402709 N		0.0	2.0	A		RB		SCL	D	SCL	N	-	w.d. SAB	Nil	-	-	Lots of tap roots. Catheads. Sorghum crop.
	2			0.2	1.2	B	C	BR		LC	D-T	LC	N	-	Massive	Y	0-5	5	
6	1	0684649 E 6402300 N		0.0	0.2	A		RB		SCL	D	1	N	-	w.d. SAB	Nil	-	-	Bluestone from 1.0m.
	2			0.2	1.2	B	C	BR		LC	D-T	5	N	-	Massive	Y	0-5	5	
7	1	0684215 E 6402292 N		0.0	0.2	A		RB		SCL	D	1	N	-	w.d. SAB	Nil	-	-	
	2			0.2	1.0	B	C	BR		LC	D-T	4	N	-	Massive	Nil	-	-	
8	-	0684125 E 6402719 N		0.0	0.2	A		RB		SCL	D	1	N	-	w.d. SAB	Nil	-	-	Redening with depth. Small bluestone fragements.
	-			0.2	1.2	B	D	BR-R		LC	D-T	7	Y	Black	SAB	Y	0-5	5	

SOIL SURVEY FIELD SHEET

Job No:	5040
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Site:	Goolma Road, Wellington NSW 2650

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
9	-	0683834 E 6402354 N		0.0	0.2	A		RB		SCL	D	1	N	-	s.d. SAB	Nil	-	-	Bluestone fragments.
	-			0.2	1.2	B	C	BR-R		CL	T	5	N	-	w.d. SAB	Y	0-10	5	
10	1	0683033 E 6402406 N		0.0	0.4	A		RB		SCL	D	1	N	-	s.d. SAB	Nil	-	-	Hit bluestone at 0.9m.
	2			0.4	0.9	B	D	-RB-BR		LC	T	5	N	-	w.d. SAB	Y	0-10	5	
11	1	0683164 E 6402740 N		0.0	0.3	A		YB		SCL	D	3	N	-	s.d. SAB	Nil	-	-	Bluestone (soft).
	-			0.3	0.8	B1	C	RB		LC	T	5	N	-	w.d. SAB	Nil	-	-	
	2			0.8	1.2	B1	D	R		LC	T	6	N	-	Massive	Y	0-10	5	
12	-	0682789 E 6401946 N		0.0	0.3	A		RB		SCL	D	3	N	-	s.d. SAB	Nil	-	-	Bluestone from 0.6m.
	-			0.3	0.6	A1	C	BR		LC	D	4	N	-	s.d. SAB	Nil	-	-	
	-			0.6	1.1	B	C	BR		LC	T	4	N	-	w.d. SAB	Y	0-30	10	
13	1	0682015 E 6401388 N		0.0	0.3	A		RB		SCL	D	2	N	-	w.d. SAB	Nil	-	-	
	-			0.3	0.8	B1	C	BR		CL	T	4	N	-	w.d. SAB	Nil	-	-	
	2			0.8	1.2	B2	C	R		LC	T	6	N	-	Massive	Nil	-	-	
14	-	0682224 E 6401374 N		0.0	0.3	A		RB		SCL	D	2	N	-	w.d. SAB	Nil	-	-	
	-			0.3	0.8	B1	C	BR		CL	D	5	N	-	Massive	Nil	-	-	
	-			0.8	1.2	B2	D	R		LC	T	4	Y	Black	Massive	Nil	-	-	
15	-	0682642 E 6401305 N		0.0	0.2	A		RB		SCL	D	4	N	-	s.d. SAB	Nil	-	-	
	-			0.2	0.8	B1	C	BR		CL	D	5	N	-	Massive	Nil	-	-	
	-			0.8	1.2	B2	D	R		LC	T	3	N	-	Massive	Nil	-	-	

SOIL SURVEY FIELD SHEET

Job No:	5040
Project:	Wellington Solar Farm
Site:	Goolma Road, Wellington NSW 2650

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
16	-	0682642 E 6401305 N		0.0	0.15	A		RB		SCL	D	4	N	-	s.d. SAB	Nil	-	-	Small bluestone fragments.
	-			0.15	0.6	B1	C	BR		CL	D	5	N	-	Massive	Nil	-	-	
	-			0.6	1.2	B2	D	RB		LC	T	3	N	-	Massive	Y	0-5	10	
17	1	0681974 E 6402581 N		0.0	0.1	A		YB		SCL	D	4	N	-	s.d. SAB	Nil	-	-	Small peds in B Horizon. Bluestone rock.
	2			0.1	0.4	B	C	RB		CL	T	6	N	-	s.d. SAB	Nil	-	-	
	3			0.4	0.9	C	D	GR		Rock	D	7	N	-	Rock fragments	Y	5-50	95	
18	-	0682037 E 6403307 N		0.0	0.2	A		YB		SCL	D	3	N	-	s.d. SAB	Nil	-	-	Small peds in B Horizon. Bluestone rock.
	-			0.2	0.5	B	C	RB		CL	T	6	N	-	s.d. SAB	Nil	-	-	
	-			0.5	0.8	C	D	GR		Rock	D	7	N	-	Rock fragments	Y	5-50	95	
19	-	0682611 E 6402858 N		0.0	0.5	A		RB		SCL	D	3	N	-	s.d. SAB	Nil	-	-	Reddening with depth.
	-			0.5	1.2	B	D	BR		CL-LC	T	5	N	-	Massive	Nil	-	-	
20	-	0682727 E 6403498 N		0.0	0.4	A		RB		SCL	D	3	N	-	Platey/SAB	Nil	-	-	Reddening with depth.
	-			0.4	1.2	B	D	BR		CL-LC	T	5	Y	Black	Massive	Y	5-15	20	
21	1	682798 E 6403705 N		0.0	0.4	A		RB		SCL	D	1	N	-	s.d. SAB	Nil	-	-	
	2			0.4	0.7	B	C	BR		CL	T	5	N	-	w.d. SAB	Nil	-	-	
	-			0.7	1.3	C	C	G		LC	D	7	N	-	Massive	Y	5-40	80	
22	-	0682543 E 6403705 N		0.0	0.4	A		YB		SCL	D	5	N	-	s.d. SAB	N	-	-	
	-			0.4	0.8	B	C	RB		CL	T	6	N	-	s.d. SAB	N	-	-	
	-			0.8	1.2	C	C	R+G		LC	T	7	N	-	Massive	Y	5-40	80	

SOIL SURVEY FIELD SHEET

Job No:	5040
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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
23	-	682226 E 6404132 N		0.0	0.20	A		RB		SCL	D	2	N	-	s.d. SAB	Nil	-	-	
	-			0.20	0.6	B1	C	BR		CL	D	3	N	-	s.d. SAB	Nil	-	-	
	-			0.6	1.1	B2	D	BR		CL	D	2	N	-	Massive	y	5-40	80	
24	1	682530 E 6404182 N		0.0	0.10	A		RB		SCL	D	2	N	-	s.d. SAB	Nil	-	-	
	2			0.10	0.5	B	C	BR/R		CL	D	6	N	-	s.d. SAB	Y	5-10	10	
	3			0.5	0.7	C	D	BR/R		CL	D	7	N	-	Massive	Y	20-50	80	
25	-	0682918 E 6404066 N		0.0	0.30	A		YB		SCL	D	1	N	-	s.d. SAB	Nil	-	-	
	-			0.30	0.6	B	C	RB		CL	D	5	N	-	w.d. SAB	Nil	-	-	
	-			0.6	1.0	C	D	BG		LC/rock	D	7	N	-	Massive	Y	10-5	80	
26	-	0683507 E 6403742 N		0.0	0.35	A		YB		SCL	D	4	N	-	w.d. SAB	Nil	-	-	
	-			0.35	0.6	B1	C	BR		LC	D	5	N	-	w.d. SAB	Nil	-	-	Bluestone fragments.
	-			0.6	1.2	B2	C	R		LC	T	2	N	-	Massive	Y	5-40	5	
27	1	0684060 E 6403927 N		0.0	0.20	A		YB		SCL	D	3	N	-	w.d. SAB	Nil	-	-	
	2			0.20	0.8	B1	D	+RB		LC	T	5	N	-	Massive	Nil	-	-	
	3			0.8	1.2	B2	C	BR		LC	T	4	N	-	Massive	Nil	-	-	
															w.d. SAB				
28	-	0684111 E 6403522 N		0.0	0.40	A		YB		SCL	D	2	N	-	s.d. SAB	Nil	-	-	
	-			0.40	1.2	B	C	RB		LC	T	3	N	-	w.d. SAB	Nil	-	-	

SOIL SURVEY FIELD SHEET

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Site:	Goolma Road, Wellington NSW 2650

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
29	-	683608 E 6403522 N		0.0	0.20	A		YB		SCL	D	5	N	-	s.d. SAB	Nil	-	-	
	-			0.20	0.8	B1	C	RB		LC	T	4	N	-	w.d. SAB	Nil	-	-	
	-			0.8	1.1	B2	C	BR		LC	T		N	-	Massive	Nil	-	-	
30	1	683969 E 6403050 N		0.0	0.20	A		YB		SCL	D	1	N	-	w.d. SAB	Nil	-	-	
	2			0.20	0.8	B	D	RB		LC	T	4	N	-	w.d. SAB	Nil	-	-	
	3			0.8	1.1	C	C	BG		W. rock	T	2	N	-	Massive	Y	-	-	
31	-	683526 E 6402913 N		0.0	0.30	A		YB		SCL	D	1	N	-	w.d. SAB	Nil	-	-	
	-			0.30	1.2	B	D	RB		LC	T	4	Y	B	Massive	Nil	-	-	
32	1	68443 E 6403354 N		0.0	0.30	A		RB		SCL	D	2	N	-	SAB	Nil	-	-	
	2			0.30	0.7	B	C	BR		CL	OT	3	N	-	Massive	Y	5 to 10	5	Bluestone fragments.
	3			0.7	1.1	C	C	BG		Rocky	D	R	N	-	Decomp. Rock	Y	5 to 30	80-90	
33	-	684737 E 6403828 N		0.0	0.40	A		RB		SCL	D	2	N	-	SAB	Nil	-	-	
	-			0.40	1.3	B	D	BR		LC	T	4	N	-	Massive	Y	5 to 20	30	
34	1	684828 E 6403992 N		0.0	0.20	A		+RB		SCL	T	3	N	-	SAB	Nil	-	-	
	2			0.20	1.3	B		+BR		LC	M	4	N	-	Massive	Nil	-	-	
35	-	684262 E 6403895N		0	0.3	A		YB		SCL	D	4	N	-	s.d. SAB	Nil	-	-	
	-			0.3	0.9	B1	D	BR		CL	D	4	N	-	w.d. SAB	Nil	-	-	
	-			0.9	1.2	B2	C	R		LC	T	2	N	-	Massive	Nil	-	-	

SOIL SURVEY FIELD SHEET

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36	1	684844 E 6403237 N		0.0	0.2	A		+RB		SCL	D	2	N		s.d. SAB	Nil	-	-	Small peds. Bluestone fragments.
	2			0.2	0.7	B	D	RB		CL	D/T	5	N		w.d. SAB	Nil	-	-	
	3			0.7	0.9	C	D	RBG		W. rock	D/T	3	Y	G&B	Decomp. Rock	Y	5 to 10	20	
37	-	685741 E 6403237 N		0.0	0.3	A		RB		SCL	D	2	N		w.d. SAB	Nil	-	-	Hit bluestone 0.9m.
	-			0.3	0.9	B	D	BR		CL	D/T	4	N		Massive	Y	5 to 20	5	
38	-	685520 E 6403513 N		0.0	0.2	A		RB		SCL	D	2	N		w.d. SAB	Nil	-	-	Hit rock 0.9m.
	-			0.2	0.7	B	C	BR		CL	D/T	5	N		Massive	Nil	-	-	
	-			0.7	0.9	C	D	YB		W. rock	D/T	4	N		Decomp. Rock	Y	5 to 20	50	
39	1	685490 E 6403929 N		0.0	0.3	A		YB		SCL	D	3	N		w.d. SAB	Nil	-	-	
	2			0.3	0.8	B1	C	RB		LC	T	5	N		Massive	Nil	-	-	
	-			0.8	1.3	B2	D	BR		LC	T	4	N		Massive	Nil	-	-	
40	-	685653 E 6403714 N		0.0	0.3	A		YB		SCL	D	4	N		w.d. SAB	Nil	-	-	
	-			0.3	0.8	B1	D	RB		CL	D	5	N		w.d. SAB	Nil	-	-	
	-			0.8	1.2	B2	D	BR		LC	D/T	5	N		Massive	Nil	-	-	

Charles Sturt University

ENVIRONMENTAL AND ANALYTICAL LABORATORIES

Locked Bag 588
Wagga Wagga NSW 2678

Tel: +61 2 6933 2849
Fax: +61 2 6933 2477
Email: eal@csu.edu.au
www.csu.edu.au/faculty/science/eal

DM McMahon Pty Ltd

PO Box 6118 4A Norton Street

Wagga Wagga NSW 2650

Attention: David McMahon

Monday, March 19, 2018

NATA Accredited Laboratory Number: 9597

Accredited for compliance with ISO/IEC 17025 - Testing

LABORATORY ANALYSIS REPORT

Report Number:1803-0079
Page 1 of 2
For all enquiries related to this report please quote document number: 1803-0079

Facility:

Order #

Sample Type
Soil

Collected By
Alice Debney

Date Received
16-March-2018

EAL ID	Client ID. / Date/Time sample taken	Test	Result (units)		Method Reference	Limit of Reporting
18Mar-0258	**5040 2/2** 16.03.18					
		Conductivity (1:5 soil/water)	**36**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**6.3**	pH units	LTM-S-004	
18Mar-0259	**5040 5/2** 16.03.18					
		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-0260	**5040 10/2** 16.03.18					
		Conductivity (1:5 soil/water)	**131**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**6.4**	pH units	LTM-S-004	
18Mar-0261	**5040 19/2** 16.03.18					
		Conductivity (1:5 soil/water)	**38**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**7.3**	pH units	LTM-S-004	
18Mar-0262	**5040 21/2** 16.03.18					
		Conductivity (1:5 soil/water)	**231**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**6.4**	pH units	LTM-S-004	
18Mar-0263	**5040 30/2** 16.03.18					
		Conductivity (1:5 soil/water)	**97**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**6.8**	pH units	LTM-S-004	
18Mar-0264	**5040 30/3** 16.03.18					
		Conductivity (1:5 soil/water)	**230**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**6.8**	pH units	LTM-S-004	

Charles Sturt University

ENVIRONMENTAL AND ANALYTICAL LABORATORIES

Locked Bag 588
Wagga Wagga NSW 2678

Tel: +61 2 6933 2849
Fax: +61 2 6933 2477
Email: eal@csu.edu.au
www.csu.edu.au/faculty/science/eal

DM McMahon Pty Ltd

PO Box 6118 4A Norton Street

Wagga Wagga NSW 2650

Attention: David McMahon

Monday, March 19, 2018

NATA Accredited Laboratory Number: 9597

Accredited for compliance with ISO/IEC 17025 - Testing

LABORATORY ANALYSIS REPORT

Report Number:1803-0079
Page 2 of 2
For all enquiries related to this report please quote document number: 1803-0079

Facility: **Order #**

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

Soil Alice Debney 16-March-2018

EAL ID	Client ID. / Date/Time sample taken	Test	Result (units)		Method Reference	Limit of Reporting
18Mar-0265	**5040 34/2** 16.03.18					
		Conductivity (1:5 soil/water)	**764**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**7.0**	pH units	LTM-S-004	
18Mar-0266	**5040 39/2** 16.03.18					
		Conductivity (1:5 soil/water)	**41**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**7.0**	pH units	LTM-S-004	
18Mar-0267	**5040 36/3** 16.03.18					
		Conductivity (1:5 soil/water)	**128**	µS/cm	LTM-S-003	1
		pH (1:5 soil/water)	**7.2**	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: 26/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: DM MCMAHON

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019480
Paddock Name: 2/1
Sample Name: 5040
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 16/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		6.0
pH (1:5 CaCl2)		4.9
Elect. Conductivity (EC)	dS/m	0.05
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	3
Ammonium Nitrogen	mg/kg	3
Phosphorus (Colwell)	mg/kg	33
Phosphorus Buffer Index		88
Sulphur (KCl40)	mg/kg	4
Cation Exch. Cap. (CEC)	cmol(+)/kg	12.1
Calcium	cmol(+)/kg	8.5
Magnesium	cmol(+)/kg	1.8
Sodium	cmol(+)/kg	0.04
Potassium	cmol(+)/kg	1.80
Available Potassium	mg/kg	690
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	70.0
Magnesium % of Cations	%	15.0
Sodium % of Cations (ESP)	%	0.33
Potassium % of Cations	%	15.00
Calcium/Magnesium Ratio		4.7

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:	022019480	**Test Code:**	E11
Paddock Name:	2/1	**Sample Type:**	Soil
Sample Name:	5040	**Sampling Date:**	16/03/2018
Sample Depth (cm):	0 **To** 10		

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.

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Nutrient Advantage Advice® Nutrient Report

D M MCMAHON PTY LTD ATF
PO BOX 6118

WAGGA WAGGA
NSW 2650

Report Print Date: 26/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: DM MCMAHON

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019481
Paddock Name: 5/1
Sample Name: 5040
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 16/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		5.9
pH (1:5 CaCl2)		5.2
Elect. Conductivity (EC)	dS/m	0.26
Chloride	mg/kg	38
Nitrate Nitrogen	mg/kg	55
Ammonium Nitrogen	mg/kg	28
Phosphorus (Colwell)	mg/kg	140
Phosphorus Buffer Index		59
Sulphur (KCl40)	mg/kg	39
Cation Exch. Cap. (CEC)	cmol(+)/kg	10.1
Calcium	cmol(+)/kg	6.1
Magnesium	cmol(+)/kg	1.6
Sodium	cmol(+)/kg	0.06
Potassium	cmol(+)/kg	2.40
Available Potassium	mg/kg	950
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	60.0
Magnesium % of Cations	%	15.0
Sodium % of Cations (ESP)	%	0.58
Potassium % of Cations	%	24.00
Calcium/Magnesium Ratio		3.8

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019481	**Test Code:**	E11
Paddock Name:	5/1	**Sample Type:**	Soil
Sample Name:	5040	**Sampling Date:**	16/03/2018
Sample Depth (cm):	0 **To** 10		

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D M MCMAHON PTY LTD ATF
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WAGGA WAGGA
NSW 2650

Report Print Date: 26/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: DM MCMAHON

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019482
Paddock Name: 10/1
Sample Name: 5040
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 16/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		6.3
pH (1:5 CaCl2)		5.2
Elect. Conductivity (EC)	dS/m	0.03
Chloride	mg/kg	11
Nitrate Nitrogen	mg/kg	2
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	44
Phosphorus Buffer Index		45
Sulphur (KCl40)	mg/kg	2
Cation Exch. Cap. (CEC)	cmol(+)/kg	14.0
Calcium	cmol(+)/kg	9.6
Magnesium	cmol(+)/kg	3.8
Sodium	cmol(+)/kg	0.07
Potassium	cmol(+)/kg	0.42
Available Potassium	mg/kg	160
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	69.0
Magnesium % of Cations	%	27.0
Sodium % of Cations (ESP)	%	0.49
Potassium % of Cations	%	3.00
Calcium/Magnesium Ratio		2.5

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019482	**Test Code:**	E11
Paddock Name:	10/1	**Sample Type:**	Soil
Sample Name:	5040	**Sampling Date:**	16/03/2018
Sample Depth (cm):	0 **To** 10		

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D M MCMAHON PTY LTD ATF
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WAGGA WAGGA
NSW 2650

Report Print Date: 26/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: DM MCMAHON

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019483
Paddock Name: 11/1
Sample Name: 5040
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 16/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		5.3
pH (1:5 CaCl2)		4.6
Elect. Conductivity (EC)	dS/m	0.14
Chloride	mg/kg	26
Nitrate Nitrogen	mg/kg	56
Ammonium Nitrogen	mg/kg	6
Phosphorus (Colwell)	mg/kg	13
Phosphorus Buffer Index		22
Sulphur (KCl40)	mg/kg	7
Cation Exch. Cap. (CEC)	cmol(+)/kg	5.3
Calcium	cmol(+)/kg	3.5
Magnesium	cmol(+)/kg	1.0
Sodium	cmol(+)/kg	<0.02
Potassium	cmol(+)/kg	0.79
Available Potassium	mg/kg	310
Aluminium	cmol(+)/kg	0.1
Aluminium % of Cations	%	2.1
Calcium % of Cations	%	65.0
Magnesium % of Cations	%	18.0
Sodium % of Cations (ESP)	%	<1.00
Potassium % of Cations	%	15.00
Calcium/Magnesium Ratio		3.6

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019483	**Test Code:**	E11
Paddock Name:	11/1	**Sample Type:**	Soil
Sample Name:	5040	**Sampling Date:**	16/03/2018
Sample Depth (cm):	0 **To** 10		

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D M MCMAHON PTY LTD ATF
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NSW 2650

Report Print Date: 26/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: DM MCMAHON

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019484
Paddock Name: 19/1
Sample Name: 5040
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 16/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		5.4
pH (1:5 CaCl2)		4.7
Elect. Conductivity (EC)	dS/m	0.14
Chloride	mg/kg	19
Nitrate Nitrogen	mg/kg	52
Ammonium Nitrogen	mg/kg	8
Phosphorus (Colwell)	mg/kg	19
Phosphorus Buffer Index		61
Sulphur (KCl40)	mg/kg	9
Cation Exch. Cap. (CEC)	cmol(+)/kg	7.4
Calcium	cmol(+)/kg	4.1
Magnesium	cmol(+)/kg	1.9
Sodium	cmol(+)/kg	0.06
Potassium	cmol(+)/kg	1.30
Available Potassium	mg/kg	500
Aluminium	cmol(+)/kg	0.1
Aluminium % of Cations	%	1.5
Calcium % of Cations	%	55.0
Magnesium % of Cations	%	25.0
Sodium % of Cations (ESP)	%	0.81
Potassium % of Cations	%	17.00
Calcium/Magnesium Ratio		2.2

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019484	**Test Code:**	E11
Paddock Name:	19/1	**Sample Type:**	Soil
Sample Name:	5040	**Sampling Date:**	16/03/2018
Sample Depth (cm):	0 **To** 10		

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Nutrient Advantage Advice® Nutrient Report

D M MCMAHON PTY LTD ATF
PO BOX 6118

WAGGA WAGGA
NSW 2650

Report Print Date: 26/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: DM MCMAHON

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019485
Paddock Name: 21/1
Sample Name: 5040
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 16/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		7.1
pH (1:5 CaCl2)		6.1
Elect. Conductivity (EC)	dS/m	0.04
Chloride	mg/kg	11
Nitrate Nitrogen	mg/kg	2
Ammonium Nitrogen	mg/kg	1
Phosphorus (Colwell)	mg/kg	8
Phosphorus Buffer Index		110
Sulphur (KCl40)	mg/kg	3
Cation Exch. Cap. (CEC)	cmol(+)/kg	13.4
Calcium	cmol(+)/kg	9.6
Magnesium	cmol(+)/kg	2.5
Sodium	cmol(+)/kg	0.02
Potassium	cmol(+)/kg	1.30
Available Potassium	mg/kg	520
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	72.0
Magnesium % of Cations	%	18.0
Sodium % of Cations (ESP)	%	0.17
Potassium % of Cations	%	9.90
Calcium/Magnesium Ratio		3.8

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019485	**Test Code:**	E11
Paddock Name:	21/1	**Sample Type:**	Soil
Sample Name:	5040	**Sampling Date:**	16/03/2018
Sample Depth (cm):	0 **To** 10		

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Nutrient Advantage Advice® Nutrient Report

D M MCMAHON PTY LTD ATF
PO BOX 6118

WAGGA WAGGA
NSW 2650

Report Print Date: 26/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: DM MCMAHON

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019486
Paddock Name: 30/1
Sample Name: 5040
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 16/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		5.7
pH (1:5 CaCl2)		5.2
Elect. Conductivity (EC)	dS/m	0.26
Chloride	mg/kg	39
Nitrate Nitrogen	mg/kg	79
Ammonium Nitrogen	mg/kg	16
Phosphorus (Colwell)	mg/kg	130
Phosphorus Buffer Index		69
Sulphur (KCl40)	mg/kg	22
Cation Exch. Cap. (CEC)	cmol(+)/kg	14.1
Calcium	cmol(+)/kg	9.1
Magnesium	cmol(+)/kg	2.4
Sodium	cmol(+)/kg	0.08
Potassium	cmol(+)/kg	2.50
Available Potassium	mg/kg	970
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	65.0
Magnesium % of Cations	%	17.0
Sodium % of Cations (ESP)	%	0.60
Potassium % of Cations	%	18.00
Calcium/Magnesium Ratio		3.8

Analyses conducted by **Nutrient Advantage Laboratory Services**
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Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019486	**Test Code:**	E11
Paddock Name:	30/1	**Sample Type:**	Soil
Sample Name:	5040	**Sampling Date:**	16/03/2018
Sample Depth (cm):	0 **To** 10		

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Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
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Nutrient Advantage Advice® Nutrient Report

D M MCMAHON PTY LTD ATF
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WAGGA WAGGA
NSW 2650

Report Print Date: 26/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: DM MCMAHON

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019487
Paddock Name: 34/1
Sample Name: 5040
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 16/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		7.4
pH (1:5 CaCl2)		7.3
Elect. Conductivity (EC)	dS/m	5.90
Chloride	mg/kg	11000
Nitrate Nitrogen	mg/kg	34
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	49
Phosphorus Buffer Index		120
Sulphur (KCl40)	mg/kg	100
Cation Exch. Cap. (CEC)	cmol(+)/kg	43.7
Calcium	cmol(+)/kg	8.9
Magnesium	cmol(+)/kg	18.0
Sodium	cmol(+)/kg	16.00
Potassium	cmol(+)/kg	0.98
Available Potassium	mg/kg	380
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	20.0
Magnesium % of Cations	%	41.0
Sodium % of Cations (ESP)	%	36.00
Potassium % of Cations	%	2.20
Calcium/Magnesium Ratio		0.5

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019487	**Test Code:**	E11
Paddock Name:	34/1	**Sample Type:**	Soil
Sample Name:	5040	**Sampling Date:**	16/03/2018
Sample Depth (cm):	0 **To** 10		

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D M MCMAHON PTY LTD ATF
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WAGGA WAGGA
NSW 2650

Report Print Date: 26/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: DM MCMAHON

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019488
Paddock Name: 36/1
Sample Name: 5040
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 16/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		6.3
pH (1:5 CaCl2)		5.7
Elect. Conductivity (EC)	dS/m	0.27
Chloride	mg/kg	140
Nitrate Nitrogen	mg/kg	3
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	38
Phosphorus Buffer Index		100
Sulphur (KCl40)	mg/kg	5
Cation Exch. Cap. (CEC)	cmol(+)/kg	19.3
Calcium	cmol(+)/kg	14.0
Magnesium	cmol(+)/kg	3.6
Sodium	cmol(+)/kg	0.39
Potassium	cmol(+)/kg	1.00
Available Potassium	mg/kg	410
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	74.0
Magnesium % of Cations	%	19.0
Sodium % of Cations (ESP)	%	2.00
Potassium % of Cations	%	5.40
Calcium/Magnesium Ratio		3.9

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

Nutrient Advantage®

Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019488	**Test Code:**	E11
Paddock Name:	36/1	**Sample Type:**	Soil
Sample Name:	5040	**Sampling Date:**	16/03/2018
Sample Depth (cm):	0 **To** 10		

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: 26/03/2018
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: DM MCMAHON

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019489
Paddock Name: 39/1
Sample Name: 5040
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 16/03/2018

Analyte / Assay	Units	Value
pH (1:5 Water)		5.9
pH (1:5 CaCl2)		5.2
Elect. Conductivity (EC)	dS/m	0.15
Chloride	mg/kg	30
Nitrate Nitrogen	mg/kg	47
Ammonium Nitrogen	mg/kg	7
Phosphorus (Colwell)	mg/kg	51
Phosphorus Buffer Index		57
Sulphur (KCl40)	mg/kg	9
Cation Exch. Cap. (CEC)	cmol(+)/kg	10.8
Calcium	cmol(+)/kg	7.4
Magnesium	cmol(+)/kg	1.8
Sodium	cmol(+)/kg	0.03
Potassium	cmol(+)/kg	1.60
Available Potassium	mg/kg	640
Aluminium	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	68.0
Magnesium % of Cations	%	16.0
Sodium % of Cations (ESP)	%	0.29
Potassium % of Cations	%	15.00
Calcium/Magnesium Ratio		4.1

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019489	**Test Code:**	E11
Paddock Name:	39/1	**Sample Type:**	Soil
Sample Name:	5040	**Sampling Date:**	16/03/2018
Sample Depth (cm):	0 **To** 10		

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