APPENDIX L

LAND AND SOILS ASSESSMENT REPORT

Proposed Segment Factory

Land and Soils Assessment Report

Prepared for Snowy Hydro Limited
September 2019

EMM
creating opportunities

Proposed Segment Factory

Land and Soils Assessment Report

Report Number

J17188 RP100

Client

Snowy Hydro Limited

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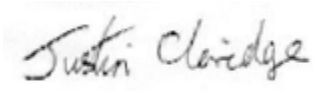
Prepared by



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24 September 2019

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24 September 2019

Executive Summary

Snowy Hydro Limited (Snowy Hydro) proposes to develop Snowy 2.0, a large-scale pumped hydro-electric storage and generation project which would increase hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme). This would be achieved by establishing a new underground hydro-electric power station that would increase the generation capacity of the Snowy Scheme by almost 50%. Snowy 2.0 would link the existing Tantangara and Talbingo reservoirs within the Snowy Scheme through a series of underground tunnels and hydro-electric power station. The tunnels for Snowy 2.0, including the exploratory tunnel for Exploratory Works and underground tunnels linking Tantangara and Talbingo reservoirs for the Main Works, would be excavated, for the most part, using tunnel boring machines (TBMs) and would be lined using precast concrete segments.

Snowy Hydro is seeking approval for the construction and operation of a precast concrete tunnel segment factory at Polo Flat (the proposed segment factory), near Cooma in the Snowy Monaro Regional local government area (LGA).

The proposed segment factory will involve surface disturbance works with the preparation of hardstand surfaces suitable for undertaking the proposed activity. Earthworks of cut and fill and/or the importation of suitable subgrade material will be used to achieve the desired levels.

The location of the proposed segment factory is on land owned by Snowy Hydro Limited (Snowy Hydro) in Polo Flat, an industrial area located to the north-east of Cooma.

This Land and Soils Assessment Report supports the environmental impact statement (EIS) for the proposed segment factory.

A soil survey and laboratory analysis of representative soil profiles for the site were undertaken in accordance with relevant NSW and Australian soil survey guidelines and standards. As a result, the soils of the site have been mapped into six soil types.

The site has mostly residual soils formed on lower slopes of basalt (Tv) and dacite (Src). There is also an unnamed water course, with some minor alluvium, that flows through the site entering in the south-east corner and flowing in a north-westerly direction.

Existing soil disturbance from previous land use activities is evident at the site. The site is devoid of all trees apart from a couple of shrubs on the southern fence line and around the old house on the southern boundary. Livestock grazing has likely occurred in the past as well as currently.

Soils formed from the Quarternary/Tertiary sediments and volcanics (basalt)

The majority of the site consists of long gently to very gently sloping residual basalt soils on lower slopes. The more elevated basalt soils are very shallow (~0.1 metre (m) deep) Tenosols (Ba-TE), before grading into shallow (0.1-0.5 m deep) Brown and Red Dermosols and Vertosols (BA-DE) and an area of moderately deep (0.5-1.0 m deep) Black Vertosols (Ba-VE) with areas of weak gilgai. Small pebbles of quartz and basalt and larger basalt cobbles occur in some areas. These basalt soils are non-saline and non-sodic. They generally have a moderate to high fertility.

Soils formed from the Silurian Colinton Volcanics (Bredbo Group)

The northern side of the drainage line and eastern hills consists of residual dacite soils on lower slopes. The soils in the south of this location appear to be on a lithology that are more resistant to weathering resulting in shallower (<0.5 m deep) and rockier Red Kandosols and Dermosols of the Da-KA map unit. The northern section of this geology transitions into a flatter colluvial slope with deeper (>0.5 m) Red Kandosols and Ferrosols.

The soils generally have a gradational profile with topsoils of clay loam fine sandy to light clay grading into light medium clay subsoils. The brown to reddish brown topsoils are weakly structured before grading into red subsoils sometimes with polyhedral structure. The surface condition is often firm to hardsetting and there is evidence of sheet erosion over much of the unit. The pH is neutral to alkaline (ie pH of 7 to 14). These soils have very low salt contents and are non-sodic. Test results for Emerson were class 6 to 8, indicating the soil does not tend to disperse.

Soils formed from alluvial and colluvial deposits

The soils are generally deep >1.0 m and the upper (southern) areas of the unit appear to be dominated by basaltic source material with black cracking clays and minor gilgai. Further north on the alluvium there is a greater influence of dacite weathered material with lighter clays and less vertic properties. The soils have a uniform clay texture with dark greyish brown light medium clay surface over dark brown to black medium to medium heavy clay subsoils. In the southern section of the unit soils are heavier with vertic properties (eg slickensides and lenticular peds) and grade into browner slightly lighter soils further north. There are few to very few surface coarse fragments which also occur throughout the soil profile. The surface condition is self-mulching, cracking and crusting.

The potential impacts to the soil and land resources can be managed through the development and implementation of an environmental management plan (EMP) incorporating:

- soil and water management measures for the construction and operational phases of the proposed segment factory; and

- site-based erosion and sediment control plans detailing staging of works and implementation of measures to control drainage and erosion and sedimentation during the construction phase of the project until the site is stable.

Where required, contaminated soils (eg asbestos containing material) may need to be removed and disposed of off-site. Also topsoils under heavy infestations of African lovegrass will have a high soil seed bank that are a liability for the colonisation and spread of this grass. Soil seed banks of these areas should be either be disposed of off-site or buried where they do not pose a risk of germination.

The key risks to the soil and land resources associated with the construction and operation of the proposed segment factory are soil erosion and water quality related, impacts to land and soil capability (ie returning/maintaining the soil in a condition to achieve future land use and stability objectives).

The development and implementation of the management measures identified above, using site specific soils information, and the adoption of the recommended management measures in this report will mitigate potential project impacts on the soil and land resources.

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1 Introduction

1.1 Snowy 2.0

Snowy Hydro Limited (Snowy Hydro) proposes to develop Snowy 2.0, a large-scale pumped hydro-electric storage and generation project which would increase hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme). Snowy 2.0 is the largest committed renewable energy project in Australia and is critical to underpinning system security and reliability as Australia transitions to a decarbonised economy. Snowy 2.0 will link the existing Tantangara and Talbingo reservoirs within the Snowy Scheme through a series of underground tunnels and a new hydro-electric power station will be built underground.

Snowy Hydro Limited (Snowy Hydro) proposes to develop Snowy 2.0, a large-scale pumped hydro-electric storage and generation project which would increase hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme). This would be achieved by establishing a new underground hydro-electric power station that would increase the generation capacity of the Snowy Scheme by almost 50%. Snowy 2.0 would link the existing Tantangara and Talbingo reservoirs within the Snowy Scheme through a series of underground tunnels and hydro-electric power station.

Snowy 2.0 has been declared to be State significant infrastructure (SSI) and critical State significant infrastructure (CSSI) by the NSW Minister for Planning under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). CSSI is infrastructure that is deemed by the NSW Minister for Planning and Public Spaces to be essential for the State for economic, environmental or social reasons. An application for CSSI must be accompanied by an environmental impact statement (EIS).

Separate applications are being submitted by Snowy Hydro for different phases of Snowy 2.0, including Exploratory Works for Snowy 2.0 (the Exploratory Works) and Snowy 2.0 Main Works (the Main Works).

The first phase of Snowy 2.0, the Exploratory Works (Application Number SSI 9208), includes an exploratory tunnel and portal and other exploratory and construction activities primarily in the Lobs Hole area of the Kosciuszko National Park (KNP). Exploratory Works has been assessed in a separate EIS and is subject to an approval issued by the former NSW Minister for Planning on 7 February 2019. Construction for Exploratory Works has already commenced.

The second phase of Snowy 2.0, the Snowy 2.0 Main Works (Application Number SSI 9687), covers the major construction elements of Snowy 2.0, including permanent infrastructure (such as the underground power station, power waterways, access tunnels, chambers and shafts), temporary construction infrastructure (such as construction adits, construction compounds and accommodation), management and storage of extracted rock material and establishing supporting infrastructure (such as road upgrades and extensions, water and sewage treatment infrastructure, and the provision of construction power). Snowy 2.0 Main Works also includes the operation of Snowy 2.0. The EIS for Snowy 2.0 Main Works was submitted to the NSW Department of Planning, Industry and Environment (DPIE) in September 2019.

A separate application has also been submitted for a proposed factory that would manufacture precast concrete segments that would line the tunnels being excavated for Snowy 2.0 (Application Number SSI 10034). This Land and Soils Assessment Report (LSAR) supports the EIS for the proposed segment factory.

On 26 June 2019, Snowy Hydro referred the proposed segment factory (Reference Number 2019/8481) to the Commonwealth Minister for the Environment under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). On 13 August 2019, the proposed segment factory was determined by the Acting Assistant Secretary Assessments and Waste Branch of the Commonwealth Department of the Environment and Energy (DEE), as delegate to the Minister, to be 'not a controlled action' and therefore does not require further assessment or approval under the EPBC Act.

1.2 The proposed segment factory

The tunnels for Snowy 2.0, including the exploratory tunnel for Exploratory Works and underground tunnels linking Tantangara and Talbingo reservoirs for the Main Works, would be excavated, for the most part, using tunnel boring machines (TBMs) and would be lined using precast concrete segments. These segments are proposed to be manufactured at the proposed segment factory to be located on the south-eastern side of Polo Flat (the site), which is an industrial area located to the east of Cooma.

The proposed segment factory would contain a building for the casting and curing of the segments, uncovered storage areas for raw materials and segments, vehicle parking areas and associated offices and workshops.

Main inputs for the segments include aggregate, sand, cement and rebar steel. Primary outputs include the segments which would be transported to the TBM launch sites for Exploratory Works and Main Works within KNP.

The construction phase of the proposed segment factory would last about five months utilising a workforce of about 30 people. Construction would take place six days a week (from Monday to Saturday) and for 10 hours per day.

The factory would operate over a period of about 3.5 years utilising a workforce of about 125 people. It would be operational 24 hours a day, seven days a week.

The proposed segment factory would be constructed and operated by Future Generation Joint Venture (FGJV) which has been contracted by Snowy Hydro to construct Snowy 2.0.

At the completion of the construction of Snowy 2.0, the proposed segment factory would be decommissioned.

Further details of the proposed segment factory are provided in Chapter 2 of this report.

1.3 Location of the site

The site of the proposed segment factory is located on the south-eastern side of Polo Flat, predominantly on the southern part of the land owned by Snowy Hydro. The site is located to the east of Polo Flat Road and to the north of Carlaminda Road.

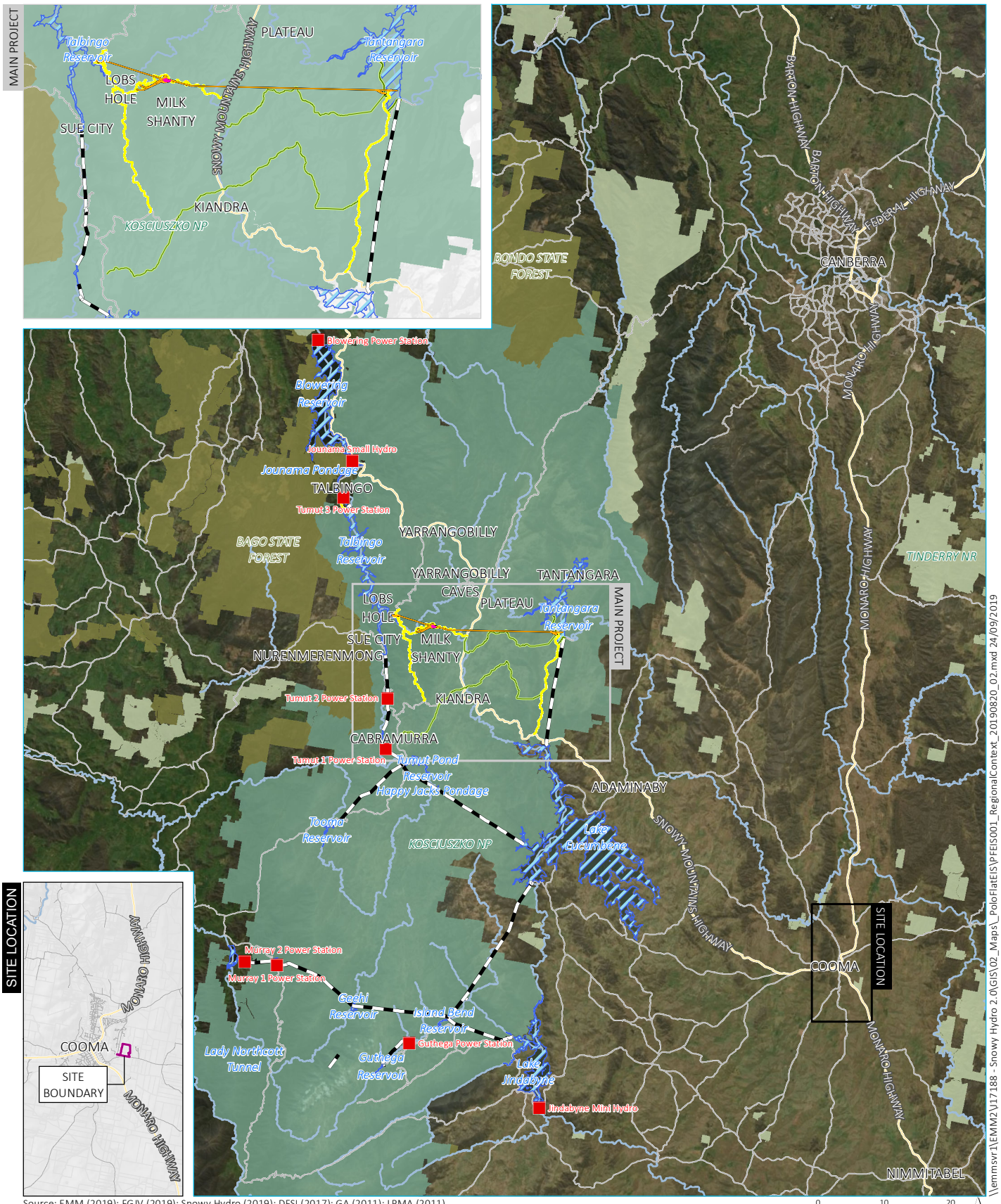
Figure 1.1 shows the location of the site in a regional context and Figure 1.2 shows the site in its local context.

The site contains the following land parcels:

- southern part of Lot 14 in Deposited Plan (DP) 250029 – also known as 9 Polo Flat Road, Polo Flat;
- Lot 3 in DP 238762 – also known as 33 Carlaminda Road, Polo Flat; and
- an unmade road corridor, directly south of the aforementioned lots.

Except for a few buildings located on the southern part of Lot 3 in DP 238762, the site is vacant and dominated by grassland. A third order watercourse flows in a north-westerly direction through the middle of the site.

Lot 14 in DP 250029 is a large parcel of land which contains a private airfield predominantly located in the middle and northern part of the land. This airfield was originally established in 1921 and further developed in the late 1950s and 1960s to service the Snowy Scheme. It became the base for the Snowy Mountains Hydro-electric Authority's (the predecessor to Snowy Hydro) flying unit and aircraft. The land was sold by Snowy Hydro in 1998 where it continued use as a private airfield. Snowy Hydro purchased the land again in early 2019.



Source: EMM (2019); FGJV (2019); Snowy Hydro (2019); DFSI (2017); GA (2011); LPMA (2011)

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KEY

Site boundary

Snowy 2.0 project elements
- Utilities
- Tunnels, portals, intakes
- Power station
- Permanent roads and surface infrastructure

Existing Snowy Scheme
- Existing power station
- Existing pipeline tunnel
- Scheme storage

- Main road
- Local road or track
- Watercourse
- Kosciuszko National Park
- NPWS reserve
- State forest

Location of the project area

Snowy 2.0
Soils Assessment
Proposed Segment Factory
Figure 1.1

snowy 2.0

EMM creating opportunities

Source: EMM (2019); FGJV (2019); Snowy Hydro (2019); DFSI (2017); GA (2011); LPMA (2011)

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KEY

- Site boundary
- Rail line
- Main road
- Local road or track
- Watercourse
- Cadastral boundary
- NPWS reserve

Location of site in local context

Snowy 2.0
Soils Assessment
Proposed Segment Factory
Figure 1.2

snowy2.0

EMM creating opportunities

The site is surrounded by industrial development to the west and predominantly rural land to the south and east. To the north of the site is the remainder of Lot 14 in DP 250029 which contains the private airfield, and other industrial development. Snowy Hydro's private airfield contains a main north-south aligned runway, hangers and offices. It also contains an above ground fuel tank for the refuelling of planes and helicopters.

Lot 3 in DP 238762 contains a communications tower which ceased use (ie transmission) in August 2019.

There is an isolated industrial operation containing a residence located about 150 metres (m) to the south-east of the site, and an abattoir located about 350 m to the east.

The nearest residence is a rural residence located about 450 m to the south-south-east of the site. The nearest residences within Cooma are located about 1 km to the west of the site.

1.4 Proponent

Snowy Hydro is the proponent for the proposed segment factory. Snowy Hydro is an integrated energy business – generating energy, providing price risk management products for wholesale customers and delivering energy to homes and businesses. Snowy Hydro is the fourth largest energy retailer in the NEM and is Australia's leading provider of peak, renewable energy.

As previously stated, the proposed segment factory would be constructed and operated by FGJV which has been contracted by Snowy Hydro to construct Snowy 2.0.

1.5 Purpose of this report

This LSAR supports the EIS for the proposed segment factory. The objectives of this LSAR are to:

- describe, classify and map the soils within the site;
- identify soil attributes of the soil map units that will inform appropriate management measures;
- identify appropriate soil management measures;
- identify any potentially problematic soil, such as acid sulfate soils, highly sodic, acidic or saline soil, that may require special management if disturbed during project activities; and
- assess the impacts of the project on the soil resources and land and soil capability.

1.6 Assessment guidelines and requirements

This LSAR has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs), issued by the NSW DPIE on 31 July 2019. These state, inter alia, that the EIS must include:

> … an assessment of impacts of the project on the soils and land capability of the site, including potential impacts associated with the use of hydrocarbons and chemicals and dealing with any contaminated soil on site;

This LSAR addresses the potential impacts of the proposed segment factory on the soils and land capability of the site. A separate Contamination Assessment has been prepared to address potentially contaminated soils on the site.

2 Project description

2.1 Overview

It is proposed to construct and operate a factory on the site to supply precast concrete segments that would line the tunnels for Snowy 2.0.

The construction phase of the proposed segment factory would last about five months utilising a workforce of about 30 people. The operational phase would last about 3.5 years utilising a workforce of about 125 people.

The proposed segment factory would be decommissioned at the completion of operations.

2.2 Construction

2.2.1 Main activities

The following main activities would be undertaken for the construction of the proposed segment factory:

- demolition and removal of buildings and decommissioned telecommunications tower on the southern part of site;
- clearing, removal of topsoil and vegetation (topsoil excavated would be stockpiled on site for later use if deemed suitable);
- undertaking earthworks to establish level surfaces;
- establishment of primary access road;
- installation of site services (power, water and communications);
- establishment of site surfaces (ie concrete, asphalt and cement soil); and
- construction of site facilities and buildings, including precast building, concrete batching plant (CBP), workshops, offices, parking areas, storage areas and associated facilities.

2.2.2 Earthworks

Excavation will be carried out at the site to provide level surfaces, establish the access road and create the required trenches for drainage.

Where possible excavated material would be reused on site for filling and compaction (including benching areas of the site where required). Where there is a deficit of excavated material, additional material would be sourced from locations in proximity to site and/or from quarries near Canberra.

2.2.3 Traffic movements

Construction vehicle movements will comprise construction worker's light vehicles and heavy vehicles transporting equipment, building and construction materials, waste, and fill material if required.

2.2.4 Construction timeframe and hours

The construction phase of the proposed segment factory would last about five months (estimated to commence in March 2020 subject to obtaining the required approvals). Construction would be undertaken from Monday to Saturday for 10 hours per day. Access to the site would generally start at 6 am for pre-starts and toolbox talks, and construction would commence at 7 am.

2.2.5 Workforce

A workforce of about 30 people would be required to construct the proposed segment factory.

2.3 Operations

2.3.1 General

The segments would be produced by casting concrete (made in the concrete batching plant (CBP)) in reusable steel moulds which would then be cured in a chamber. Following curing, the segments would be temporarily stored onsite before being transported to the TBM launch sites within KNP.

The casting and curing would be undertaken in the precast building. Storage of the segments would predominantly be undertaken in uncovered storage areas.

Main inputs for the segments include aggregate, sand, cement, water and steel rebar.

Approximately 130,500 segments would be manufactured over the operational period.

2.3.2 Site layout

The layout of the proposed segment factory is shown in Figure 2.1. Details of the site layout are provided below.

i General layout

The CBP and precast building (which contains a casting room and curing chamber) would be located at the southern end of the site. Open storage areas would be located predominantly to the north of the building on the northern part of the site.

Site offices and workshops would be located in the south-western corner of the site.

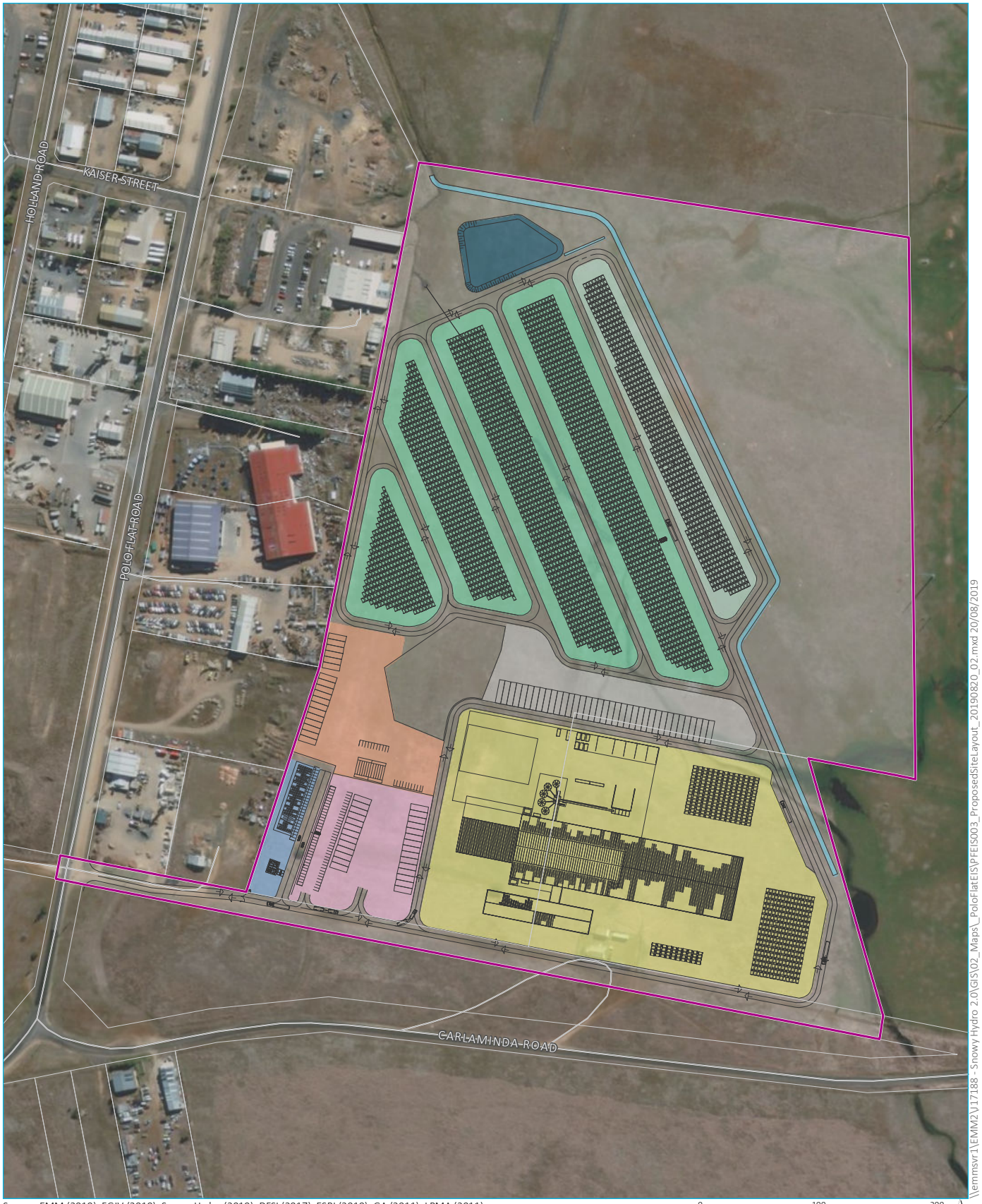
ii Ingress and egress

Vehicle ingress and egress to the site would be provided on a new access road which would connect to Polo Flat Road. The access road would be constructed on an existing informal service road located in the unmade road corridor immediately north of Carlaminda Road.

iii Raw materials storage

Cement silos, and aggregate and sand storage areas for the CBP would be located adjacent to the CBP. Storage would be sized to hold approximately three days production.

Other raw materials include steel rebar and concrete admixtures which would be stored in, or adjacent to, the precast building.



Source: EMM (2019); FGJV (2019); Snowy Hydro (2019); DFSI (2017); ESRI (2019); GA (2011); LPMA (2011)

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KEY

- Site boundary
- Indicative site layout
- Local road or track
- Cadastral boundary
- Precast yard, concrete plant, aggregates area, precast warehouse, segment storage
- Bus stop and parking
- Offices, guard house and first aid
- Mechanical and plant workshop with parking
- Trailer parking
- Storage area
- Emergency storage area
- Detention basin
- Drainage

Proposed layout

Snowy 2.0
Soils Assessment
Proposed Segment Factory
Figure 2.1

snowy2.0

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iv Parking

Two large parking areas are proposed in the south-western corner of the site, and to the north of the precast building. Parking in the south western area would be used for light vehicles, trucks and buses. Parking to the north of the precast building would be used for trucks.

v Drainage

A diversion drain would be constructed around the eastern perimeter of the site to divert water from the third order watercourse. The drain diversion would be constructed to match the general width and depth of the existing watercourse.

A detention basin would be provided to the north of the site to collect surface flows. Overflows from the detention basin would be directed into the diversion drain.

vi Site surfaces

Most of the site would be utilised for the proposed segment factory. The base of the site offices and workshop area, parking areas and segment storage areas would be constructed using cement soil where the soils are mixed with cement, watered and compacted to provide a stabilised base.

The site of the precast building and aggregate and sand storage bins would be constructed using concrete, and the circulation area to the west of the precast building would be constructed using a mix of cement soil and concrete. The access road and internal circulation roads would be constructed using asphalt or concrete.

2.3.3 Utility connections

The proposed segment factory would be connected to utility mains, including communications, electricity, water, wastewater and gas.

2.3.4 Segment inputs

As previously stated, main inputs for the precast concrete segments include aggregate, sand, cement and steel rebar. These main inputs would likely be sourced from locations in proximity to site and/or from quarries near Canberra.

In addition to these main inputs, several accessories are also required to produce the segments, such as reinforcement cages, steel fibres, gaskets and inserts. These inputs would likely be sourced locally or from Canberra.

2.3.5 Segment transport

Following casting, curing and storage, the segments would be transported to the TBM launch sites within KNP.

2.3.6 Traffic movements

Operational vehicle movements will comprise light vehicles (worker's vehicles and service vehicles) and heavy vehicles required for the transportation of the main inputs for the segments and for the transportation of the segments from the site to the TBM launch sites within KNP.

2.3.7 Staff and manpower

A workforce of about 125 people would be required to operate the proposed precast segment factory. As many local workers as possible would be sourced from the Snowy Mountains Regional LGA and surrounding localities.

2.3.8 Hours of operation

It is proposed to operate the proposed segment factory 24 hours a day, seven days a week. It is estimated that the factory would operate for a period of about 3.5 years.

2.4 Decommissioning

As previously stated, the proposed segment factory would be decommissioned at the completion of construction of Snowy 2.0 which would include removal of all plant and equipment. Snowy Hydro would retain the main structures such as the precast building, workshops and offices and seek to use these for an alternative industrial use.

It is envisaged that Snowy Hydro would submit a separate application for approval for an alternative use of the site prior to the decommissioning phase of the project.

3 Soil assessment

3.1 Overview of the assessment process

This LSAR comprised the following steps:

- a desktop review of existing information;
- a soil survey with laboratory analysis on representative profiles to identify soil types and their characteristics; and
- an assessment of potential impacts on soil resources and proposed management and mitigation methods.

Within this report, the soils assessment area is defined as the broader area surrounding the site. As discussed in Chapter 1, the site contains the following land parcels:

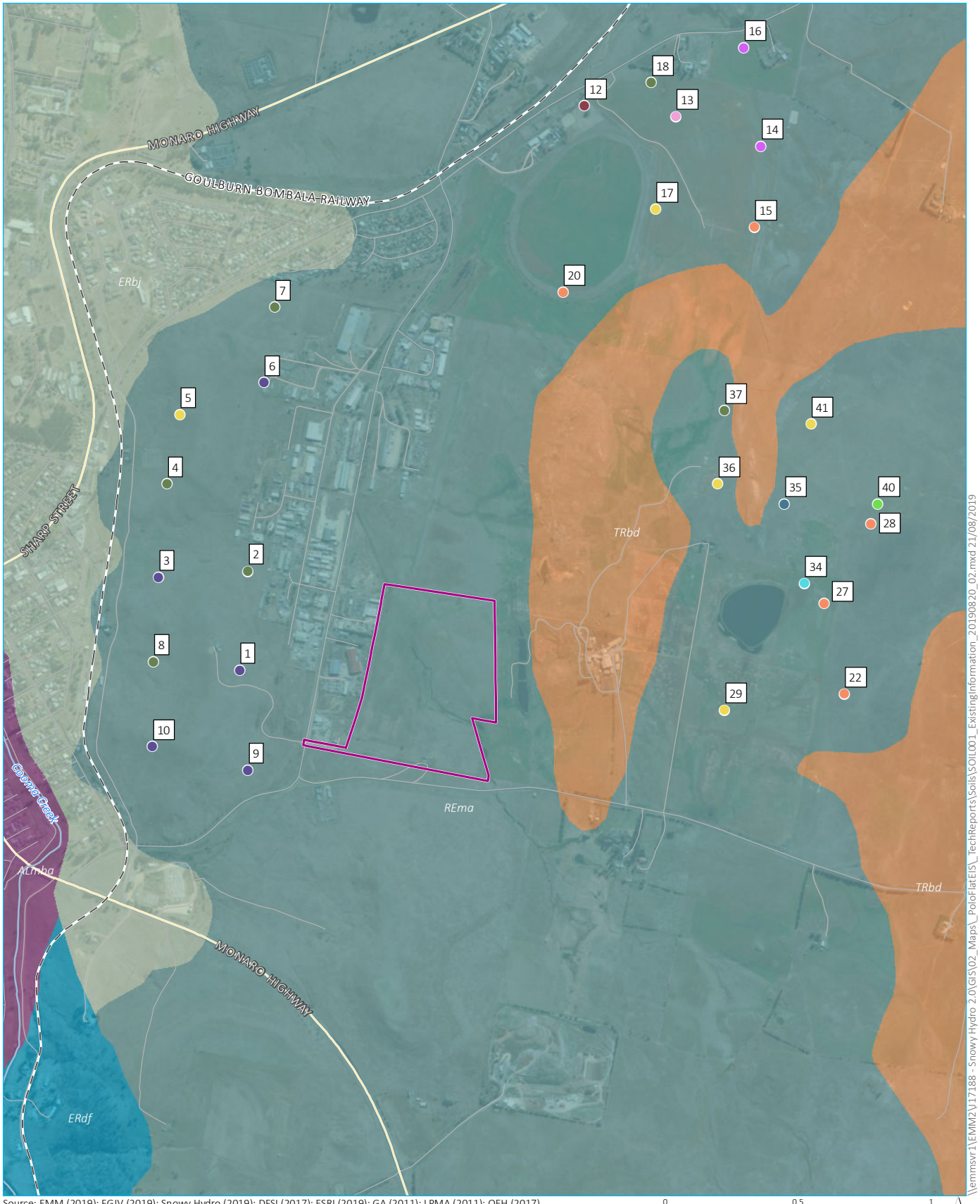
- Southern part of Lot 14 in DP 250029;
- Lot 3 in DP 238762; and
- an unmade road corridor, directly south of the aforementioned lots.

3.2 Desktop review

To determine baseline soil conditions within the assessment area, including soil management data, the following was undertaken prior to the soil survey:

- review of available and potentially relevant soils and land resource information from published reports:
  - Soil Landscapes of the Cooma 1:100,000 Sheet map and report (Tulau 1994);
  - soil profile attribute data environment (eSPADE) online database (OEH 2019a). There are 28 eSPADE soil profile sites that occur in proximity to the asssessment area (shown on Figure 3.1) with similar pedogenic conditions. Annexure A details these historic eSPADE soil profiles, which are described in detail but no laboratory data is available;
- review of regional geological mapping generated by the Bureau of Mineral Resources, Geology and Geophysics: Bega - Mallacoota 1:250,000 geological sheet (Lewis and Glen 1995); and
- interpretation of aerial photography to identify sites for field assessment that are representative of soil/landscape units throughout the site.

A map of the eSPADE soil profile sites and the soil landscape mapping is presented in Figure 3.1.



Source: EMM (2019); FGJV (2019); Snowy Hydro (2019); DFSI (2017); ESRI (2019); GA (2011); LPMA (2011); OEH (2017)

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KEY

- Site boundary
- Rail line
- Main road
- Local road or track
- Watercourse

eSPADE profile (Great Soil Group)

- Black Earth
- Chromosol
- Euchrozem
- Grey Clay
- Lithosol
- Non-calcic Brown Soil
- Prairie Soil
- Red Earth
- Rendzina
- Yellow Earth

Cooma soil landscapes

- Binjura (ERbj)
- Bredbo (TRbd)
- Dry Farm (ERdf)
- Maneroo (REma)
- Murrumbidgee variant a (ALmba)

Existing soil desktop information for the project area

Snowy 2.0
Soils Assessment
Proposed Segment Factory
Figure 3.1

snowy2.0

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Other broad scale studies and mapping reviewed include:

- Australian soil classification (ASC) soil type map of NSW (OEH 2019b);
- great soil group soil type mapping of NSW (OEH 2019c);
- hydrological soil group mapping (OEH 2019d);
- inherent soil fertility mapping (OEH 2019e);
- land and soil capability classes mapping (OEH 2019f);
- Atlas of Australian Acid Sulfate Soils (Fitzpatrick *et al.* 2011);
- *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) - Strategic Agricultural Land Map of NSW (DP&I 2013); and
- NSW soil and land information system (SALIS) (OEH 2018g).

3.3 Soil survey

A soil survey of the site was undertaken between 23 and 24 May 2019. At the time of the survey, the extent of area needed for the design of the proposed segment factory was not confirmed and as such a broader area was considered. A total of 20 survey sites we completed, with 15 of these survey sites located within the current site boundary and 5 survey sites located beyond the site boundary. These survey sites are shown on Figure 3.2.

3.3.1 Sampling intensity

The site is approximately 31.6 hectares (ha). The nominal mapping scale of the survey is 1:5,000 which has a recommended ground observation range from 2 sites/1 ha to 4 sites/1 ha, with a minimum acceptable of 1 site/2 ha (*Guidelines for surveying soil and land resources* (McKenzie *et al.* 2008)).

Based on an area of 31.6 ha and 15 sites the sampling intensity is more than 1 site per 2 ha which is consistent with a scale of 1:5,000. Soil sampling sites are shown in Figure 4.2.

3.3.2 Site descriptions

Soil site descriptions were undertaken in accordance with the *Australian Soil Survey and Land Survey Field Handbook 3rd edition* (The National Committee on Soil and Terrain, 2009) and classified using *The Australian Soil Classification* (Isbell, 2016). Soil site descriptions include a soil profile description, site observation and photographs taken of the soil profile and landscape at each location.

Site observations include descriptions of:

- landform (including slope);
- geology;
- surface characteristics (eg gilgai[1] and rockiness); and
- vegetation.

[1] Gilgai is surface microrelief associated with soils containing shrink-swell clays (NCST 2009).

Soil profile descriptions include (where applicable) details of:

- horizon depths and designation;
- boundary distinctness;
- field texture;
- colour;
- mottles;
- coarse fragments;
- structure;
- segregations; and
- field tests (eg pH, electrical conductivity (EC)).

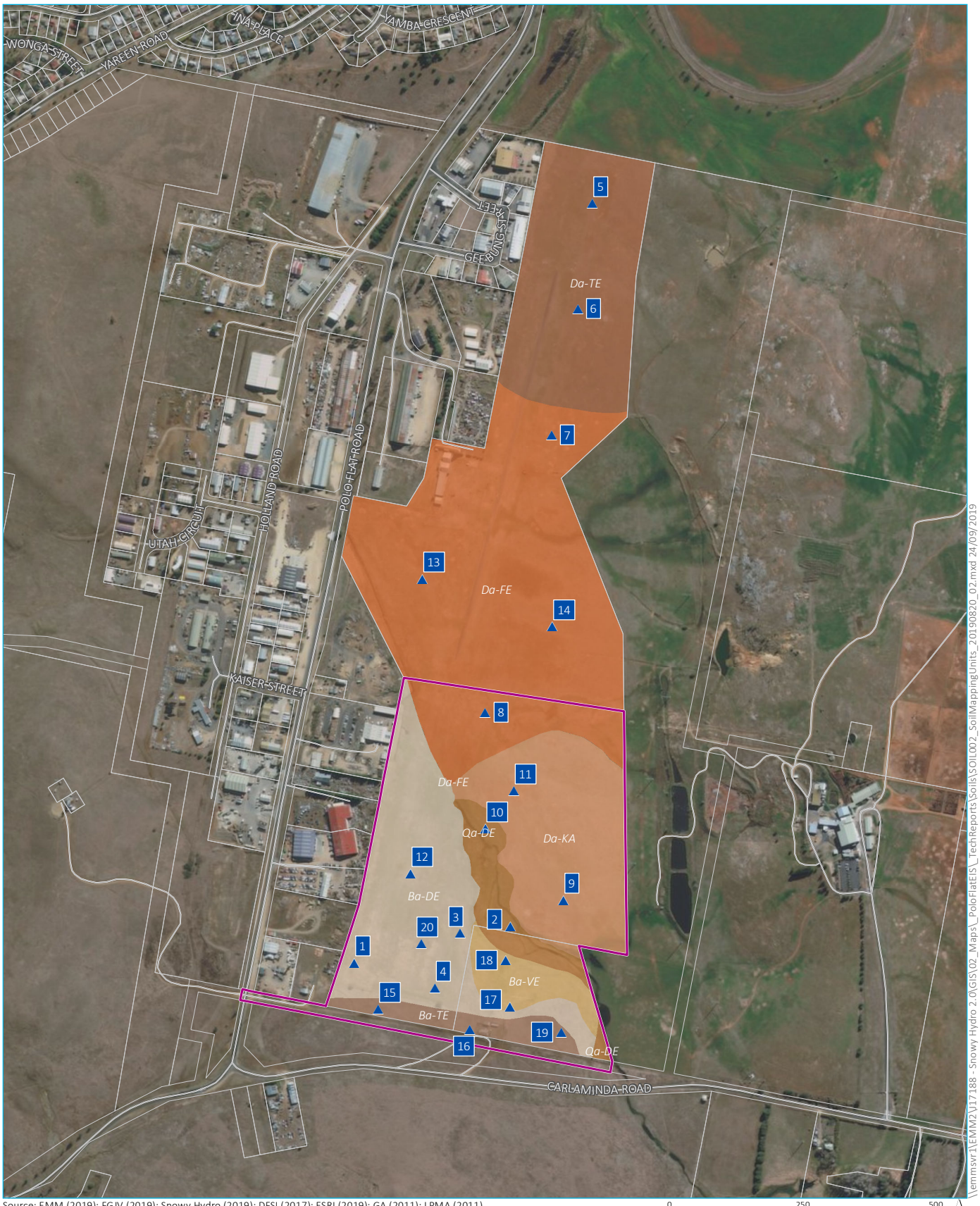
A total of 20 observations were recorded and seven sites were sampled for laboratory analysis. Soil site descriptions with laboratory data are presented in Annexure B.

3.3.3 Laboratory analysis

From the 20 sites surveyed, seven sites were selected for soil sample analysis, a total of 12 soil samples were analysed.

Analyses undertaken by Nutrient Advantage Laboratory Services, Incitec Pivot (ASPAC and NATA accredited laboratory in Werribee, Victoria) included:

- Sample depth 0.0–0.1 m – pH; EC; chloride (Cl^-) (1:5); exchangeable cations (calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), aluminium (Al)) and cation exchange capacity (CEC) (Ammonium chloride (NH_4Cl) or Ammonium Acetate); organic carbon (OC) (Walkley and Black) and organic matter (OM) (calculation); particle size distribution (PSD) (< 2 µm, 2–20 µm, 20–50 µm, 0.05–2 mm); Colwell Phosphorous; Sulfate Sulfur; Total Phosphorus (P), Total nitrogen (N), nitrate N, Ammonium N, micro nutrients (Boron (B), Copper (Cu), Iron (Fe), Manganese (Mn) and Zinc (Zn)); Exchangeable Sodium Percentage (ESP), and Emerson dispersion.
- Sample depths 0.1–0.2 m, 0.2–0.3 m, 0.5–0.6 m, 0.8–0.9 m, 1.1–1.2 m – pH, EC, Cl^- (1:5); exchangeable cations (Ca, Mg, Na, K, Al) and CEC (NH_4Cl or Ammonium Acetate); PSD (<2µm, 2–20 µm, 20–50 µm, 0.05–2.0 mm); ESP and Emerson dispersion.



Source: EMM (2019); FGJV (2019); Snowy Hydro (2019); DFSI (2017); ESRI (2019); GA (2011); LPMA (2011)

0 250 500 m

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KEY

- Site boundary
- Local road or track
- Cadastral boundary
- Soil survey site

Soil type

- Qa-DE
- Ba-DE
- Ba-TE
- Ba-VE
- Da-FE
- Da-KA
- Da-TE

Soil survey sites

Snowy 2.0
Soils Assessment
Proposed Segment Factory
Figure 3.2

snowy 2.0

EMM creating opportunities

4 Existing environment

4.1 Geology

The *Bega - Mallacoota 1:250,000 geological sheet* (Lewis and Glen 1995) outlines surface geological units found within the soil assessment area. Surficial geology and its contribution as the parent material is usually the dominant factor in soil formation in Australia.

The geology of the site is mapped as Quaternary alluvium with small areas of Tertiary basalt on the western and southern edges. At a local scale and from a soils perspective, the Quaternary alluvium is only present in relatively minor amounts with the majority of the assessment area consisting of residual soils on the Colinton Volcanics (Src); part of the Silurian period Bredbo Group from the Silurian Period and the Monaro Volcanic (Tv) form the Tertiary Period as discussed in Section 3.

The geology is shown in Figure 4.1 and a description of the mapped geological units is presented in Table 4.1. The dominant lithology of the Colinton Volcanics, part of the Bredbo Group, is dacite which is a felsic extrusive rock, intermediate in composition between andesite and rhyolite. The dominant lithology of the Monaro Volcanics is basalt, a basic igneous rock.

Table 4.1 Geology of the site and surrounding area

Symbol	Group	Unit name	Description
Qa	Quaternary		Alluvial and colluvial deposits
Tv	Undifferentiated - Cainozoic/Tertiary volcanics	Monaro Volcanics and Bondo Dolerite Member	Basalt, olivine basalt
Srca, Srcb	Bredbo Group (Silurian)	Colinton Volcanics	Sheared, medium-grained crystal-rich dacitic volcanics (dacite, andesite, rhyolite, tuff, limestone)

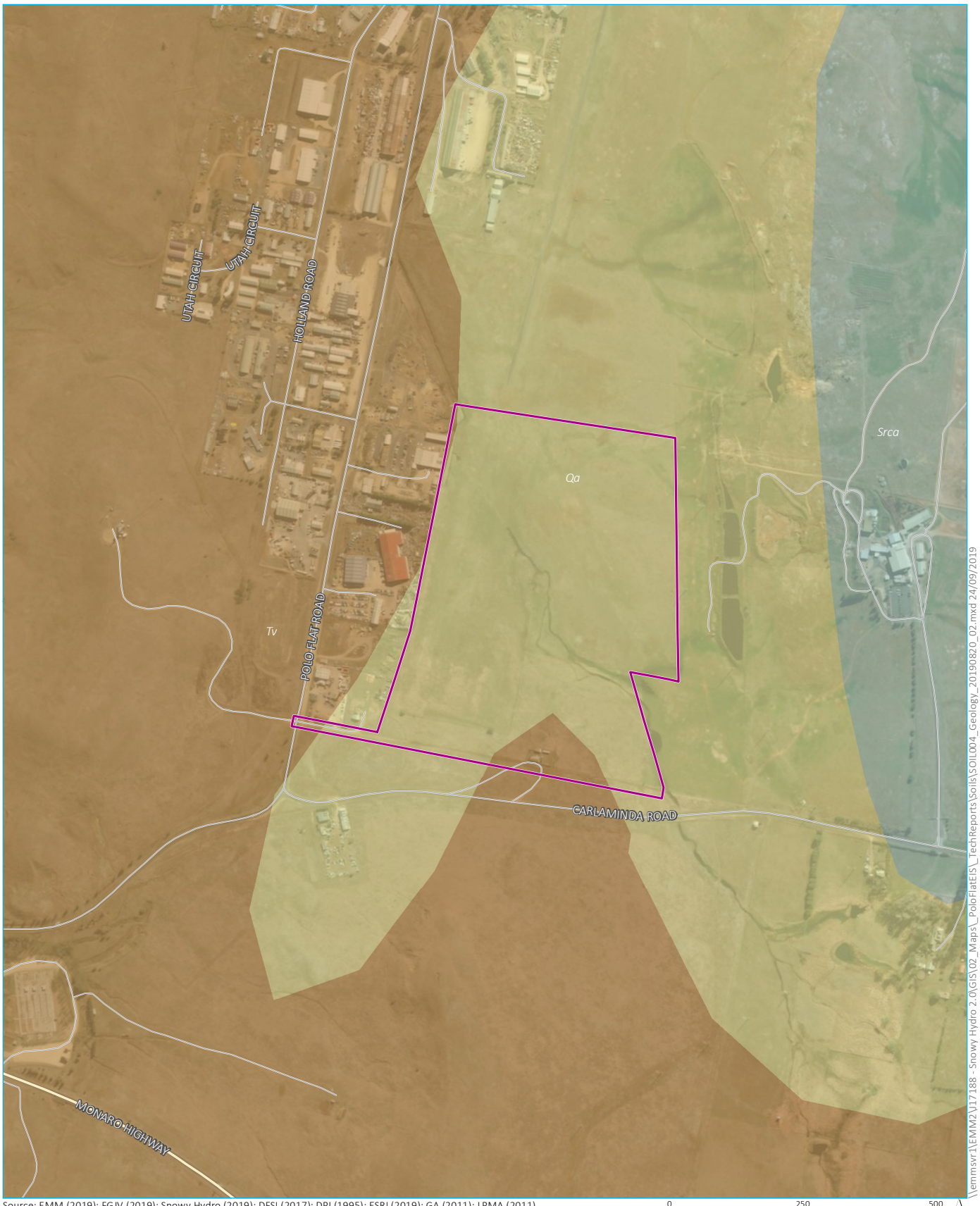
4.2 Soils

The soils of the site have been mapped into five soil mapping units. Figure 4.2 presents the Australian Soil Classification (ASC) and a basic soil description of these soil mapping units.

The soils within the site have formed mainly on residual lower slopes of rises to low hills. There is also an unnamed watercourse, with some minor alluvium, that flows through the assessment area entering in the south-east corner and flowing in a north-westerly direction. Smaller drainage features can also be observed from the low hills in the east.

The western side of the site is mapped as Monaro Volcanic (Tv) from the Tertiary Period and the eastern side is mapped as Colinton Volcanics (Src) part of the Silurian period Bredbo Group from the Silurian Period. The Monaro Volcanics are predominantly basalt and the Colinton Volcanics are mostly dacite.

Residual basalt occurs mainly on the southern side of the unnamed watercourse, but also appears to extend under colluvial wash of the adjacent geological unit on the northern side of the drainage line in the south eastern section of the assessment area. Mixed source alluvium occurs to a limited extent along the main channel. The central portion of the site consists of colluvial slopes and deeper soils on Colinton Volcanics with the northern portion of the lot on shallow soils with frequent rock outcrops in the steeper slopes/higher landscape positions.



Source: EMM (2019); FGJV (2019); Snowy Hydro (2019); DFSI (2017); DPI (1995); ESRI (2019); GA (2011); LPMA (2011)

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KEY

- Site boundary
- Main road
- Local road or track

Bega - Mallacoota 1:250,000 geological map

- Qa - Undifferentiated - Alluvium, fluvial deposits: gravel, sand, silt and clay (Quaternary)
- Tv - Undifferentiated - Basalt, olivine basalt (Tertiary)
- Srca - Colinton Volcanics - Sheared, medium-grained crystal-rich dacitic volcanics (Silurian)

Geology of the assessment area

Snowy 2.0
Soils Assessment
Proposed Segment Factory
Figure 4.1

snowy 2.0

EMM creating opportunities

Existing soil disturbance from previous land use activities is evident. The site is devoid of all trees apart from a couple of shrubs on the southern fence line and around the old house on the southern boundary. Livestock grazing has likely occurred in the past as well as currently. At the time of the survey there was no active grazing.

There appears to have been levelling and filling works associated with the development of the airport. Some minor levelling works would have been undertaken as part of the bitumen airstrip construction. There also appears to be evidence of levelling around site 11 (refer to Figure 4.2) with possible subsoil exposure and soil observations of a shallower rockier profile compared to surrounding sites. The main drainage line through the site has been partially filled to accommodate the runway with a buried pipe to maintain flow. There is also evidence of other drainage works having been undertaken with diversion banks installed to manage surface flows.

The soils mapped in the site are largely related to geological units and have also been mapped on morphological similarities (eg soil depth, topsoil and subsoil textures, structure, colour and topsoil depths) of the different lithologies. All soils in the sections below are described by their site conditions of runoff, permeability and drainage in accordance with the Australian Soil and Land Survey Field Handbook (NCST 2009) definitions.

The soils and the geological units are described in more detail in the following sections and are shown in Figure 4.2.

Table 4.2 Soil mapping units

Soil unit	ASC	Geology	Soil types (Tulau 1994)	Soil description
Ba-TE	Tenosols	Tv	Ma1	Very shallow (approximately 10 cm) dark brown light clay topsoil overlying weathered basalt rock. There are few basalt cobbles and large pebbles of quartz on the surface and throughout the soil. The soil surface condition is generally soft with a weak crust. Soils are neutral to mildly alkaline.
Ba- DE	Dermosols, Vertosols	Tv	Ma4	Shallow (15-50 cm) gradational soil with clay loam fine sandy to light clay topsoil grading to well-structured medium to medium heavy clays overlying decomposing basalt. Vertic properties such as lenticular peds generally occur in the subsoil. Surface condition ranges from firm to self-mulching and often has a weak surface crust. Soils are neutral to mildly alkaline.
Ba- VE	Vertosols	Tv	Ma3, Ma5	Moderately deep uniform textured clay soil with cracking and self-mulching surface. Well-structured, black to brown, light medium clay topsoil over black to red, medium clay subsoil. Alkaline soil reaction trend. Incipient gilgai may or may not be present.
Da-FE	Ferrosols	Srca	Bd3, bd4, bd5	Moderately deep (>0.75 m) to deep gradational soils. Apedal brown to reddish brown clay loam fine sandy to light clay topsoils grading into red polyhedral moderate structured light medium clay subsoils. A B1 horizon may or may not be present in the profile. The surface condition is firm to hard setting. The soil has a neutral to alkaline soil reaction trend.
Da-KA	Kandosols, Ferrosols	Srca	Bd3, bd4, bd5	Shallow (<50 cm) gradational textured soil with weakly structured brown topsoils of clay loam sandy over reddish brown moderately structured light medium clay subsoils. Some polyhedral structure in the subsoil. Surface coarse fragments range from very few to abundant small pebbles to cobbles. The surface condition ranges from soft to hard setting and some have a weak crust.
Qa-DE	Vertosols, Dermosols	Qa	Ma5	Deep (>1.0 m) uniform textured clay soil with cracking and self-mulching surface. Possible weak gilgai. Well-structured, black light medium clay topsoil over black, medium heavy clay subsoil. Neutral soil reaction trend, formed from Quaternary mixed source alluvium.

4.2.1 Soils formed from the Quarternary/Tertiary sediments and volcanics (basalt)

The Monaro Volcanics (Tv) is dominated by basalt. Three mapped units have been identified in this geological unit that tend to grade into each other based on landscape position, and boundaries are approximate. There are very shallow rocky soils (Ba-TE) occupying gently inclined slopes upslope of shallow clay soils (Ba-DE) on very gently inclined slopes and a limited area of deeper cracking clay soils (Ba-VE) with weak gilgai.

i Ba-TE

The Ba-TE soil was identified along the southern boundary of the site with slightly steeper slopes than the adjacent lower unit (Plate 4.1). There are a few basalt cobbles and large pebbles of quartz on the surface and throughout the soil. The topsoil is a dark brown, light clay with a mostly soft and weakly crusting surface condition (Plate 4.2). The pH is neutral to alkaline (ie pH of 7 to 14).

These soils have low salt contents and are non-sodic. However, the salt content (EC 0.33 dS/m and Chloride 330 mg/kg) of this analysed site is still greater than the other analysed soils possibly being located in a discharge zone below a rock outcrop at a minor break of slope.

Test results for Emerson were class 6 for the topsoil, so it does not tend to disperse. Surface fertility is generally low apart from total nitrogen and potassium levels which are high. Topsoil pH is 8.2 which is moderately alkaline.

The soils are generally moderately permeable and moderately well drained with moderately rapid runoff.

Plate 4.1 Landscape at site #15 lower slope of gently undulating low hills landform

Plate 4.2 Soil profile at site #15, surface top right, A1 to 8 cm and bottom at 10 cm Leptic Tenosol

ii Ba-DE

The Ba-DE soil was identified downslope of the Ba-TE soil in the southern part of the site above the drainage line. This soil occurs on long very gentle slopes (pediplain) at the bottom of rises to low hills (Plate 4.3 and Plate 4.4). There are surface coarse fragments ranging from very few to common basalt cobbles and large quartz pebbles. These coarse fragments also occur throughout the soil profile. Soil textures are clay loam, fine sandy to light clay in the topsoil grading to medium to medium heavy clays in the subsoil (Plate 4.5). Soils are 0.25 to 0.5 m deep overlying decomposing basaltic rock. The surface condition ranges from firm to weakly crusting and self-mulching (Plate 4.6). There is evidence of sheet erosion in parts of this unit.

These soils have very low salt contents and are non-sodic. Topsoils and subsoils were found to have an Emerson's class 3 rating, so they have a moderate erosion risk. Surface fertility is low for most nutrients apart from potassium and trace elements copper and manganese. Soil pH is neutral to mildly alkaline.

Plate 4.3 Landscape at site #3 lower slope of very gently undulating rises to low hills landform

Plate 4.4 Landscape at site #3 lower slope of very gently undulating rises to low hills landform

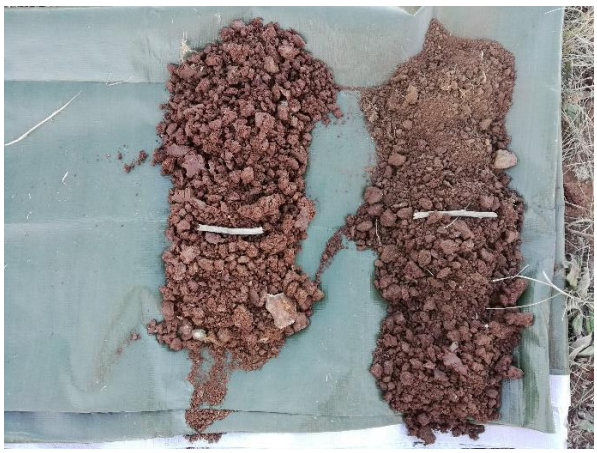


Plate 4.5 Soil profile at site #3, surface top right, bottom at 50 cm, Brown Dermosol

Plate 4.6 Soil surface at site #3, quartz and basalt surface coarse fragments with a crusting and weakly self-mulching surface condition

iii Ba-VE

The Ba-VE soil was identified downslope of the Ba-DE soil in the southern part of the site above the drainage line. This soil is similar to the Ba-DE soil with a slightly heavier surface texture and a deeper soil depth. It occurs on very gentle slopes and some parts appear to have weak gilgai (Plate 4.7 and Plate 4.8). There are the same surface coarse fragments and throughout the soil profile as the other basalt soil types. Soil textures are light-medium clay in the topsoil grading to medium clay in the subsoil (Plate 4.9).

Surface condition ranges from cracking and self-mulching to firm. Soils are > 0.5 m deep overlying decomposing basaltic rock. Very few manganese nodules may occur in the lower B horizon. These soils are generally slowly permeable and imperfectly drained with slow runoff.

These soils have very low salt contents and are non-sodic. Test results for Emerson were class 6 and 7, so the soil does not tend to disperse. Surface fertility is generally high to very high for most macro nutrients, with sulfate sulfur the only low rating. Soil pH is neutral to moderately alkaline. Macro nutrients include N, P, K, Ca, sulfur (S) and Mg.

Plate 4.7 Landscape at site #18 weak gilgai possible alluvial influence

Plate 4.8 Landscape at site #18 lower slope of very gently undulating rises to low hills landform

Plate 4.9 Soil profile at site #18, surface top right, bottom at 70cm, Black Vertosol

4.2.2 Soils formed from the Silurian Colinton Volcanics (Bredbo Group)

The Colinton Volcanics occur on the northern side of the drainage line and rise to the eastern hills. The dominant lithology of the Colinton Volcanics is dacite which is a felsic extrusive rock, intermediate in composition between andesite and rhyolite.

There are three soil types mapped in the Colinton Volcanics. They range from very shallow rocky soils in the north, to deep red well-structured soils through the central area, and reddish moderately deep soils in the south of this geological unit.

i Da-FE

The Da-FE soil was identified in the northern portion of the site and occurs on very gently to gently undulating residual and colluvial slopes of the eastern hills (Plate 4.10 and Plate 4.12). Soils are moderately deep (>0.75 m) to deep, particularly in lower and flatter slope positions. These areas appear to be a more easily weathered lithology with the Colinton Volcanics (possibly more andesitic in composition).

The soils have a gradational profile with topsoils of clay loam fine sandy to light clay grading into light medium clay subsoils. The brown to reddish brown topsoils are weakly structured before grading into red polyhedral moderate structure subsoils (Plate 4.11 and Plate 4.13). A B1 horizon may or may not be present in the profile.

There are none to very few surface coarse fragments which may or may not also occur in the subsoils. The surface condition is firm to hardsetting and there is evidence of sheet erosion over much of the unit. The pH is either neutral or alkaline soil reaction trend (pH of 7 to 14). The soils are generally moderately permeable and imperfectly to moderately well to well drained (depending on position) with slow to moderately rapid runoff.

These soils have very low salt contents and are non-sodic. Test results for Emerson were class 6 to 8, so the soil does not tend to disperse. Surface fertility is generally moderate with high to very high potassium and low boron.

The soils have been classified primarily as Red Ferrosols, but the classification and iron oxide content has not been confirmed by laboratory analysis. Red and Yellow Kandosols occur as minor variants.

Plate 4.10 Landscape at site #14 mid-slope of gently undulling rises on pediment colluvial slope

Plate 4.11 Soil profile at site #14, surface top right in 30 cm rows to 90+ cm, Red Ferrosol

Plate 4.12 Site #14 looking back into hills (east)

Plate 4.13 Soil profile at site #7, surface top right in 30 cm rows to 80 cm, Red Ferrosol

ii Da-KA

The Da-KA soil was identified in the eastern portion of the site and occurs on gently undulating residual and colluvial slopes of the eastern hills (Plate 4.14). Soils are generally shallow (<0.5 m) and rocky. These areas appear to have more rhyolitic coarse fragments, but also basalt suggesting some areas may have a mix of lithologies possibly with a basalt substrate mixed with colluvial dacite/rhyolite material or a mix of lithologies from within the Colinton Volcanics (Plate 4.20). The Colinton Volcanics are not mapped as being present within the site, but are within the broader assessment area. Soil derived from the Colinton Volcanics has likely migrated down slope from the east.

The soils have a gradational profile with topsoils of clay loam sandy grading into light medium clay subsoils. The brown topsoils are weakly structured before grading into reddish brown moderate subangular blocky structure subsoils, some with polyhedral structure (Plate 4.15 and Plate 4.17).

There are very few to abundant surface coarse fragments from small pebbles to cobbles and lithologies of quartz, rhyolite and andesite/basalt. The surface condition ranges from soft to hardsetting and some have a weak crust. The pH is either neutral or alkaline soil reaction trend.

There is evidence at site 11 that the upper portion of the soil has possibly been stripped off to level the airstrip. The soil has common rhyolite gravel, is quite shallow compared to adjacent sites and has a heavy surface texture of light medium clay more common in the subsoil of similar profiles. The soils are generally moderately permeable and moderately well drained with moderately rapid runoff.

These soils have very low salt contents and are non-sodic. Test results were Emerson class 7 for the topsoil, so it does not tend to disperse. Surface fertility has macro nutrients ranging from very low (sulfur) to high (phosphorus and potassium). Topsoil pH of site 11 is 8.6 which is strongly alkaline.

Plate 4.14 Landscape at site #11 mid-slope of gently undulating low hills

Plate 4.15 Soil profile at site #11, surface top right to 35 cm.

Plate 4.16 Site #11 rhyolite gravel and more intermediate igneous rocks

Plate 4.17 Soil profile at site #9, surface top right in 30 cm rows to 45 cm, Red Kandosol

4.2.3 Soils formed from alluvial and colluvial deposits

There is an unnamed drainage feature that flows through the site and it has some alluvium along parts of its flow length. The source of the alluvium is a varied mix of the two surrounding geological units in the catchment area. Colluvial processes from adjacent hillslopes also contribute source material to these soils. Colluvial wash of the Bredbo Group appears to overlie basalt at site 9.

i Qa-DE

The Qa-DE soil was identified along the central drainage feature until the channel disappears north-west of site 10, possibly due to filling and levelling works undertaken for the construction of the airstrip. The extent of the alluvium appears to be bound fairly closely to the main channel. Alluvial and colluvial process both operate at the margins of this unit. The soils are generally deep >1.0 m and the upper (southern) areas of the unit appear to be dominated by basaltic source material with black cracking clays (Plate 4.18) and minor gilgai. The further north on the alluvium and there is a greater influence of the Colinton Volcanics with lighter clays and less vertic properties (Plate 4.20 and Plate 4.21).

The soils have a uniform clay texture with dark greyish brown light medium clay surface over dark brown to black medium to medium heavy clay subsoils (Plate 4.19). In the southern section of the unit soils are heavier with vertic properties (eg slickensides and lenticular peds) and grade into browner slightly lighter soils further north.

There are few to very few surface coarse fragments which also occur throughout the soil profile. The surface condition is self-mulching, cracking and crusting.

These soils have very low salt contents and are non-sodic. Emerson class of 6 and 7 indicate that the soils do not tend to disperse. Surface fertility is moderate to very high apart from sulfur which is low. Soil pH is 8.6 which is neutral to moderately alkaline.

The soils are generally slowly permeable and imperfectly drained with slow runoff.

Plate 4.18 Landscape at site #2 main drainage feature

Plate 4.19 Soil profile at site #2, surface top right in 30 cm rows to 70+ cm, Back Vertosol

Plate 4.20 Channel of main drainage line near Site #10

Plate 4.21 Soil profile at site #10, surface top right in 30 cm rows to 60+ cm, Black Dermosol

4.2.4 Laboratory results

The laboratory reports from Nutrient Advantage Laboratory Services are included in Annexure C. The relevant chemical and physical data is summarised in the soil site data decodes presented in Annexure B and a number of ratings for key soil parameters by soil map unit are presented in Table 4.6 for the topsoil and Table 4.7 for the subsoil. The ratings for the interpretation of soil chemical analyses are based around general plant requirements for optimal growth. A rating of very low or low would limit plant growth for required nutrients and a rating of moderate or higher would have less impact. Where there are higher ratings for toxic elements or conditions, such as salinity, these conditions would limit plant growth. Relative significance of the individual ratings will depend on whether they are macro or micronutrients or a constraint (e.g. salinity) and the relative requirements / sensitivities of different plant species.

The analysed samples generally have moderate to high fertility, but low levels of sulfur and boron. They also do not have any significant subsoil constraints such as salinity, sodicity, acidity or magnesic layers. The Emersons tests results were also mostly 6 to 8 indicating a low potential to disperse.

Inherent soil erodibility can be assessed using the K-factor from the Universal Soil Loss Equation (USLE) and clay dispersion hazard. These measures of erodibility should be used in the development of site based Erosion and Sediment Control Plans (ESCPs) which would form part of an overall Environmental Management Plan (EMP). Soil erosion hazard is the combination of slope, soil erodibility, and runoff/runon factors. The map unit soil erosion hazard assessed against the degrees of erosion hazard in Hazelton and Murphy (2007).

The topsoil K-factors for each of the soil types has been calculated using the soil erodibility nomograph in Appendix A of the Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2006) and these are presented in Table 4.3. The nomograph uses the following soil parameters to determine the K-factor; percent silt and very fine sand, percent sand, percent organic matter, soil structure and permeability.

Table 4.3 Map unit soil erodibility

Map unit	Topsoil K-factor	K-factor rating[1]	Emerson class	Class of erosion hazard
Ba-TE	0.032	Moderate	7	Moderate
Ba- DE	0.032	Moderate	3	Slight – High
Ba- VE	0.02-0.03	Low - Moderate	7	Moderate
Da-FE	0.022-0.044	Moderate to High	8	Moderate – High
Da-KA	0.018	Low	7	High
Qa-DE	0.02-0.03	Low to Moderate	7	Moderate – High

Notes: 1. Soil erodibility classes based on USLE (Hazelton and Murphy 2007).

A dispersion hazard rating as an indicator of dispersion potential is presented in Table 4.4 and includes a number of soil parameters analysed by the laboratory. The most commonly used parameters are ESP and Emerson class number. The results of the laboratory analysis did not identify any sodic soils (i.e. ESP >6) and Emerson class[2] numbers were 3 or higher on all samples. The Ca:Mg ratio was also greater than 0.5 on all samples. Based on the Emerson class number, ESP and the Ca:Mg ratio all of the analysed samples have a low potential to disperse except for site 1 (Ba-DE) topsoil and subsoil samples, which have a moderate potential to disperse (Emerson 1967).

Table 4.5 presents three factors, including the clay dispersion hazard calculated above, that can be used to assess the erosion risk rating of a site.

Table 4.4 Clay dispersion hazard (IECA 2008)

Dispersion hazard rating	Emerson class	ESP (%)	Ca:Mg ratio	Typical clay content (%)
Low	4-8	<6	>0.5	<10
Moderate	3	6-15	0.5	10-30
High	1-2	>15	<0.5	>30

Table 4.5 Erosion risk parameters and recommended ratings (IECA 2008)

Site conditions during soil disturbance	Erosion risk rating				
	Very low	Low	Moderate	High	Extreme
Average slope of disturbed area (%)	<3	>3 & ≤5	>5 & ≤10	>10 & ≤15	>15
Clay dispersion hazard[1]	Low	Low	Moderate	Moderate	High
Average monthly rainfall depth (mm)	0-30	31-45	46-100	101-225	>225

Notes: 1. The clay dispersion hazard rating is based on Table 4.4.
2. The average monthly rainfall depth (mm) should be determined as an average of the months during which soil disturbance is occurring, or scheduled to occur, whenever this time period is known; otherwise the annual average value shall be adopted.

[2] Soils are divided into classes on the basis of their coherence in water (Emerson 1967) – Severe to moderate dispersion Class 1 and Class 2 soils. Soils that slake but do not disperse (Classes 3-6) and soils that neither slake nor disperse (Classes 7 & 8) have no limitation based on modified Emerson's test.

Table 4.6 Ratings of topsoil attributes in soil mapping units

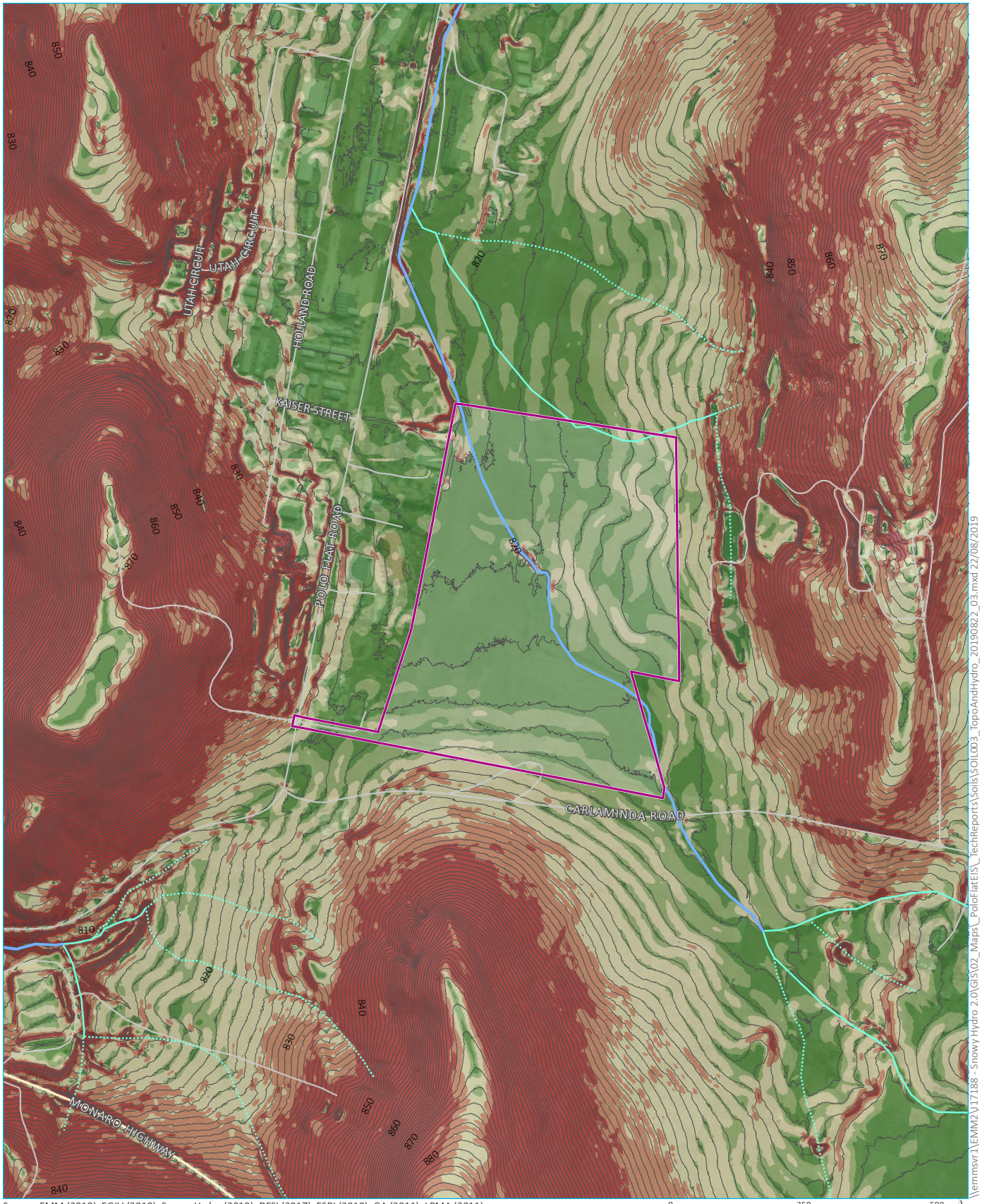
Mapped soil unit	Topsoil Fertility (~100 mm bgl)										
	Total Nitrogen	Available Nitrogen	Phosphorus	Exchangeable Potassium	Sulfate Sulfur	Organic Carbon	Boron	Zinc	Manganese	Copper	Erodibility
Ba-TE	Moderate	Medium	High	Very High	Low	High	Low	Moderate	Moderate	Moderate	Low
Ba- DE	Low	Very low	Low	Moderate	Very low	Low	Very low	Low	Moderate	Moderate	Moderate
Ba- VE	High	Moderate	High	Very High	Low	High	Moderate	Moderate	Moderate	Moderate	Low
Da-FE	Moderate - High	Very low - Moderate	Very low	High - Very High	Low - Moderate	Moderate - High	Low	Moderate	Moderate	Moderate	Moderate
Da-KA	Moderate	Very low	High	High	Very low	Moderate	Low	Low	Moderate	Moderate	Moderate
Qa-DE	High	Moderate	High	Very High	Low	High	Moderate	Moderate	Moderate	Moderate	Moderate

Note: After Bruce and Rayment (1982) and Hazelton and Murphy (2007).

Table 4.7 Ratings of subsoil attributes in soil mapping units

Mapped soil unit	Subsoil parameters (~250 mm bgl)					Deeper subsoil parameters (~500 mm bgl)				
	Sodicity	CEC	Salinity	Dispersion potential	Erosion potential	Sodicity	CEC	Salinity	Dispersion potential	Erodibility
Ba-TE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ba- DE	Non-sodic	High	Low	Moderate	Low	NA	NA	NA	NA	NA
Ba-VE	Non-sodic	High	Very Low	Low	Low - Moderate	Non-Sodic	Very High	Very Low	Low	Moderate
Da-FE	Non-Sodic	Moderate	Very Low	Low	Moderate	Non-Sodic	Moderate	Very Low	Low	Moderate
Da-KA	Non-Sodic	Moderate	Very Low	Low	Moderate	Non-Sodic	Moderate	Very Low	Low	Moderate
Qa-DE	Non-sodic	High	Very Low	Low	Low - Moderate	Non-Sodic	High	Very Low	Low	Moderate

Note: After Bruce and Rayment (1982) and Hazelton and Murphy (2007).



Source: EMM (2019); FGJV (2019); Snowy Hydro (2019); DFSI (2017); ESRI (2019); GA (2011); LPMA (2011)

0 250 500 m

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KEY

- Site boundary
- Main road
- Local road or track
- Contour (1 m)

Slope

- 0 - 3%
- 3-5%
- 5-10%
- 10-15%
- >15%

Strahler stream order

- 1st order
- 2nd order
- 3rd order

Topography and hydrology of the project area

Snowy 2.0
Soils Assessment
Proposed Segment Factory
Figure 4.2

snowy2.0

EMM creating opportunities

4.3 Erosion

The site appears relatively stable and has good grass cover protecting the soils from erosion. There was no evidence of any rill or gully erosion during the field survey, however minor sheet erosion appeared widespread and most noticeable in the soils with sandy clay loam topsoils. None of the analysed soil samples were sodic or magnesic and the Emerson dispersion tests were not dispersive. Notwithstanding this, there is still a moderate to high risk of water erosion particularly in the weakly structured soils, where there are long slope lengths and steeper slopes. Section 4.2.4 discusses the inherent soil erodibility of the soils and the degree of erosion hazard. Soils with weak to massive structure and high silt contents are the most at risk of wind erosion, due to increased likelihood of forming dust sized soil particles when disturbed.

The seasonal conditions will also influence the risk of erosion with the site experiencing summer dominant rainfall and the strongest average wind speeds in August to October.

4.4 Salinity

There is no evidence to suggest that salinity is an issue within the site. Soil salinity levels were found to be very low to low across the site.

The groundwater investigation as part of Water Assessment (EMM 2019) found shallow groundwater standing water levels (SWL) from 5.0 m to 9.8 m below ground level across 7 bores. The EC ranged from approximately 300 µS/cm to 1,000 µS/cm.

Any reduction in recharge associated with site development is negligible compared with total groundwater source recharge (EMM 2019). No significant hydraulic constrictions or other discharge sites were identified during the soil survey and the risk of surface expressions of salinity is low unless there was significant hydrologic change upslope.

4.5 Acid sulfate soils

There are no acid sulfate soils mapped for the site. The national Atlas of Australian Acid Sulfate Soils (Fitzpatrick et al. 2011) maps the area as extremely low probability of occurrence. Although usually associated with coastal environments, acid sulfate soils can also occur at higher elevations inland, associated with anaerobic conditions along river and lake beds and in saline seepage areas where there are organic-rich deposits.

The combination of the acid sulfate soils mapping and the geomorphic features suggest that there is a very low potential for the occurrence of acid sulfate soils at the site.

4.6 Land capability

4.6.1 Land and soil capability classes

The Land and Soil Capability (LSC) assessment scheme is a broad-scale scheme for low intensity agricultural land use. The LSC classes distinguish between the inherent physical capacity of the land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources. It emphasises risks and hazards rather than productivity.

DPIE has produced LSC mapping for most of NSW at a very broad scale in the compilation of *The land and soil capability assessment scheme – second approximation* (OEH 2012). The LSC assessment scheme uses soil and landscape attributes that describe the biophysical features of the land including landform position, slope gradient, drainage, climate, soil type and soil characteristics to derive detailed rating tables for a range of land and soil hazards. These hazards include water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils and mass movement (OEH 2012).

The site is currently mapped as Class 4 meaning that there are moderate limitations to cropping. The relevant LSC class is detailed in Table 4.8.

Table 4.8 Relevant land and soil capability classes

LSC class	Associated ASC classes	Description	Area (Ha)	%
4	**Ferrosols**	**Moderate capability land:** Moderate to high limitations for high-impact land uses. It will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture; and the limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.	30	100%

5 Impact assessment

5.1 Introduction

The impact of the proposed segment factory on the soils and land resources is related to the nature of the disturbance activity, the environmental values and their sensitivity to change. Potential impacts on the soils and land resources in the site may result in land degradation and off-site impacts unless there is implementation of appropriate and effective management and mitigation measures.

The potential impacts may result in direct impacts to the soil resource or indirect/offsite impacts. Direct impacts could include erosion (water and wind) and sedimentation, soil compaction, reduced soil quality (eg through the mixing of the soil profile) and fertility decline (eg loss of topsoil and organic carbon). Indirect impacts could include soil and land conditions resulting from direct impacts, which may limit future land uses and thereby result in an inability to support significant ecological communities and the provision of ecosystem services such as water quality.

As stated in Section 2.3.2, most of the site would be utilised for the proposed segment factory. Earthworks are required to level the site and the following ground treatments are proposed:

- cement soil – applied to the base of the site offices and workshop area, parking areas and segment storage areas;
- concrete – applied to the base of the precast building and aggregate and sand storage bins;
- cement soil and concrete – applied to the base of the circulation area to the west of the precast building; and
- asphalt or concrete – applied to the main access road and internal circulation roads.

In addition to the above, a diversion drain would be constructed around the eastern part of the site and a water management basin constructed to the north of the storage areas.

Soils on the site not disturbed as a result of the construction of the proposed segment factory include soils to the east of the diversion drains, and patches of soils where native grasslands would be retained around the water management basin and immediately to the north east of the precast building.

Notwithstanding the above, some soils would need to be retained onsite for use in landscaping and/or rehabilitation works where appropriate to do so.

5.2 Landform and hydrology

Minor and localised changes to the landform of the majority of the site would be required during construction as a result of earthworks required to achieve load bearing surfaces at the required grade. As a result, in most areas after construction, the final landform will differ from the original landform.

There would be minor changes to drainage, including groundwater infiltration, sheet flow and drainage features as a result of the proposed segment factory. If not managed correctly, this may result in impacts on downstream aquatic ecosystems due to changes in runoff, water quality and potential sedimentation. Mitigation measures would be undertaken during the construction phase to avoid these impacts. These measures are described in Chapter 6.

5.3 Salinity

The project is likely to have negligible impact on salinity from alterations to the surface hydrology due to minimal changes in flow and the low salinity levels in hillslope and drainage depression soils.

No mitigation measures are required in relation to salinity.

5.4 Soil resource and land capability

Any soil disturbance during construction works has the potential to result in the loss of the soil resource and therefore the site's land capability. The soil resource includes topsoil and subsoil reserves that supply water and nutrients for plant growth. Soil loss can be both physical loss and loss through contamination with unsuitable materials (eg rock, subsoils mixed in topsoil). In addition, some soil is always lost during handling (ie stripping, stockpiling and spreading), and poor site selection for stockpiles may further decrease the available soil, particularly if the stockpile has to be relocated.

Notwithstanding the above, the topsoil resource at the site is contaminated with a seed bank of weeds and asbestos containing material (ACM).

The Biodiversity Development and Assessment Report (BDAR) (EMM 2019) indicates that part of the site suffers from heavy infestations of African Lovegrass and that the high soil seed bank presents a liability for the colonisation and spread of this grass. To reduce the risk of spread of this grass through the soil bank, the BDRA recommends that clearing of African Lovegrass should include appropriate disposal of this vegetation, including disposal of the soil seed bank. This includes disposal of the soil seed bank off-site or buried so that it does not pose a risk of germination.

The Contamination Assessment (EMM 2019) indicates that while asbestos was not reported in soil or groundwater at concentrations that exceed screening levels, various fragments of ACM was found on the surface of the site at various locations. It also noted that the potential for fragments of ACM to weather and cause asbestos contamination of soils cannot be precluded and management measures will be required for construction of the proposed segment factory. These measures include:

- Surface clearance (emu bob or similar) should be undertaken to remove fragments of ACM observed at the site surface.
- Due to the identification of ACM at the site surface, topsoil or other materials excavated from the site will require further testing to confirm suitability for re-use on-site or appropriate classification for off-site disposal.

Accordingly, while soil disturbance during construction has the potential to result in the loss of the soil resource on the site, the resource itself is contaminated as a result of the African Lovegrass infestation and scattered ACM.

Mitigation measures would be undertaken during the construction phase to manage the soil resource as much as practical during construction. Chapter 6 describes mitigation measures, including measures required to ensure soil contamination issues are adequately addressed.

5.5 Soil erosion and sediment transport

Construction will require removal of pasture grasses and soil disturbance within the site boundary which destabilises soils and leaves them exposed to erosion processes. Soil erosion would result in the loss of soil from the site which could lead to sedimentation of land and waterways downstream, as well as a decrease in water quality of these surface water features.

Mitigation measures would be undertaken during the construction phase to avoid these impacts. These measures are described in Chapter 6.

5.6 Acid sulfate soils

Acid sulfate soils, when undisturbed, do not present a risk to the environment. When disturbed, the iron sulfides they contain react with oxygen in the air to create sulfuric acid. In turn, the sulfuric acid can release metals in the soil and damage waterways, aquatic and terrestrial flora and fauna and infrastructure.

The desktop review and field survey revealed that the assessment area is unlikely to contain acid sulfate soils.

No mitigation measures are required for acid sulfate soils.

6 Mitigation measures

6.1 Introduction

An Environmental Management Plan (EMP) would be prepared and implemented for both the construction and operational phases of the proposed segment factory. The EMP would provide details on mitigation and management measures for soils during both phases of the project.

6.2 Landform and hydrology

The EMP would provide details on mitigation and management measures for surface water flows during both the construction and operational phases to minimise impacts to water quality.

6.3 Soil resource

Consistent with the BDAR and Contamination Assessment, the following mitigation and management measures are proposed to address soil contamination:

- The clearing of the weed species African Lovegrass should include appropriate disposal of this vegetation. This includes disposal of the soil seed bank off-site or buried so it does not pose a risk of germination.
- Surface clearance (emu bob or similar) should be undertaken to remove fragments of ACM observed at the site surface.
- Due to the identification of ACM at the site surface, topsoil or other materials excavated from the site will require further testing to confirm suitability for re-use on-site or appropriate classification for off-site disposal.

To allow for soils to be made available for use in landscaping and/or rehabilitation works, the following mitigation and management measures are proposed:

- Soil requirements will be accurately determined before construction works begin. The volume of soil required for landscaping can be calculated using the area estimated for rehabilitation multiplied by the depth of soil required. If any alterations to the plans are made, or if site conditions are different than expected (eg shallow soil in places) the required volume of soil for landscaping should be re-calculated.
- An inventory of soil stripped should be prepared, so that contaminated material is identified for removal and if any significant deficit is identified, additional material can be sourced prior to landscaping and/or rehabilitation.

6.3.1 Soil capability class and rehabilitation

The following mitigation and management measures are proposed for soils that are stockpiled on the site for use in landscaping and/or rehabilitation:

- Topsoil management would include the following measures:
  - stripped topsoil would be stockpiled separately from subsoil stockpiles where possible and practical;
  - topsoils would be stockpiled using methods and machinery that limit the amount of compaction so as to avoid structural decline;
  - stockpiles would be placed away from water discharge zones where they are not disturbed by other activities, where possible;
  - topsoils to be maintained for an extended period of time (eg greater than 20 days) may be sprayed with a bonding agent or seeded with appropriate species and monitored for weed management; and
  - Stockpiles would be clearly signposted.
- The following measures are designed to minimise the loss of soil during respreading on landscaped and/or rehabilitated areas and promote successful vegetation establishment:
  - soil would be respread in even layers at a thickness appropriate for the intended use;
  - topsoil would be compacted firmly but not excessively and left slightly rough (light cultivation after reinstatement may be required) to provide a suitable seed bed for revegetation;
  - as soon as practicable after respreading, a sterile cover crop (or other form of cover if a cover crop is unsuitable) should be established to limit erosion and soil loss;
  - if fertiliser is applied to aid in the reestablishment of cover it should contain as a minimum nitrogen, phosphorous, potassium and sulfur (based on the soil laboratory analysis); and
  - where vegetative cover has not been established the use of other cover may include mulching (organics or rocks), geofabrics (eg jute matting) or soil binding agent until suitable cover is achieved.

6.4 Soil erosion and sediment transport

Erosion and Sediment Control Plans (ESCPs) would be prepared for the construction phase of the project. Erosion and sediment control measures will be designed, constructed and implemented in accordance with the following guidelines:

- Managing Urban Stormwater, Volume 1 (Blue Book) (Landcom 2004); and
- Managing Urban Stormwater, Volume 2A Installation of Services (DECC 2007).

7 Conclusion

The location of the proposed segment factory is on land owned by Snowy Hydro Limited (Snowy Hydro) in Polo Flat, an industrial area located to the north-east of Cooma.

The site is zoned IN1 General Industrial under the CMLEP which permits a range of industrial uses. The development of the site for the proposed segment factory is consistent with the uses permitted within this zone. It is surrounded by industrial development to the north and west and predominantly vacant land to the south and east.

A soil survey and laboratory analysis of representative soil profiles for the site was undertaken in accordance with relevant NSW and Australian soil survey guidelines and standards. The survey and assessment of the site considered a broader area (assessment area). The soils of the assessment area have been mapped into six soil types that are mostly soils formed on lower slopes of basalt (Tv) and dacite (Src). There is also an unnamed drainage feature, with some minor alluvium, that flows through the assessment area entering in the south east corner and flowing in a north-westerly direction.

The basalt soils include Leptic Tenosols, shallow Brown and Red Demosols and Vertosols and moderately deep Black Vertosols with areas of weak gilgai. The dacite soils include shallow rocky Red Kandosols and Dermosols in the southern section and transition into deeper (>0.5 m) Red Kandosols and Ferrosols. The alluvial soils along the drainage line are mapped as deep Black Vertosols and Dermosols.

Laboratory analysis of the soils found that they have a moderate to high fertility, neutral to alkaline pH and do not have any significant subsoil constraints such as salinity, acidity/alkalinity, sodicity or magnesic horizons. The Emerson class results also indicates that they do not have a tendency to disperse.

The inherent soil erodibility of most soils across the assessment area is moderate (based on their K-factor and dispersive potential), however the soil erosion hazard, the combination of slope, soil erodibility, and runoff/runon factors, rates the soil map unit from slight to high soil erosion hazard.

Where required, contaminated soils (eg ACM) may need to be removed and disposed of off-site. Also topsoils under heavy infestations of African lovegrass will have a high soil seed bank that are a liability for the colonisation and spread of this grass. Soil seed banks of these areas should either be disposed of off-site or buried where they do not pose a risk of germination.

The key risks to the soil and land resources associated with the construction and operation of the proposed segment factory will be managed by proposed mitigation measures, and are soil erosion and water quality related, impacts to land and soil capability.

The potential impacts to the soil and land resources can be managed through the development and implementation of an EMP incorporating soil and water mitigation and management measures for the construction and operational phases of the project.

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Annexure A

Soil sites from the NSW SALIS database

Profile	easting	northing	GSG	Surface texture	Subsoil texture	Soil depth (cm)
Profile 22	694738	5987694	Euchrozem	LMC	C	
Profile 20	693681	5989204	Euchrozem	CLS	LMC	
Profile 10	692137	5987496	Black Earth	LC	MC	
Profile 16	694361	5990122	Non-calcic Brown Soil	FSCL	SC	60
Profile 18	694013	5989992	Lithosol	SCL		30
Profile 12	693761	5989904	Prairie Soil	ZCL	ZC	50
Profile 13	694105	5989864	Rendzina	SFSCL	LC	
Profile 14	694425	5989752	Non-calcic Brown Soil	FSCL	LC	
Profile 17	694029	5989516	Red Earth	FSCL	LMC	
Profile 15	694401	5989448	Euchrozem	FSCL	LC	50
Profile 7	692597	5989148	Lithosol	CL		9
Profile 6	692557	5988864	Black Earth	ZC	MC	
Profile 5	692241	5988744	Red Earth	FSCL		10
Profile 4	692193	5988484	Lithosol	LC		16
Profile 3	692161	5988132	Black Earth	LC	LMC	
Profile 2	692497	5988156	Lithosol	CL		27
Profile 1	692465	5987784	Black Earth	LC	MC	
Profile 8	692141	5987816	Lithosol	ZCL		12
Profile 9	692497	5987408	Black Earth	MHC	HC	
Profile 37	694288	5988759	Lithosol	FSCL		15
Profile 41	694613	5988709	Red Earth	FSC	LMC	
Profile 36	694263	5988484	Red Earth	FSCL	LC	55
Profile 35	694513	5988409	Yellow Earth	FSCL	FSC	
Profile 40	694863	5988409	Chromosol	CLFS	MC	60
Profile 28	694838	5988334	Euchrozem	FSCL	MHC	
Profile 34	694588	5988109	Grey Clay	ZCL	MHC	
Profile 27	694663	5988034	Euchrozem	FSCL	MC	90
Profile 29	694288	5987634	Red Earth	SCL	LC	80

Annexure B

Soil site data

SITE DESCRIPTION **Soil Unit: Ba-DE** **Site: PF-1**

Co-ordinates: **Easting:** 692917.3 **Northing:** 5987571 **Zone:** 55 **Datum:** GDA94

ASC Soil Order: Brown Dermosol **Sampler:** J Claridge

LANDFORM

Slope:	2%	**Runoff:**	Moderately rapid
Morphological type:	Lower-slope	**Permeability:**	Moderately permeable
Landform element:	Hillslope	**Drainage:**	Moderately well drained
Landform pattern:	Rises to Low Hills	**Surface condition:**	Firm to Hardsetting
Relief modal class:	Gently Undulating Rises	**Disturbance:**	Complete clearing
Coarse fragments:	Few medium quartz pebbles and very few basalt cobbles	**Rock outcrop:**	Nil
Geology:	Monaro Volcanics and Bondo Dolerite Member - basalt		
Vegetation:	Thick grass cover		

Site PF-1 landscape

Site PF-1 soil profile, surface at top right, total depth 25 cm

SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1	0.00-0.10	Very dark greyish brow (10YR 3/2); clay loam fine sandy texture; moderate subangular blocky structure; very few small quartz pebbles; dry weak consistence; pH 7.0; clear change to -
B21	0.10-0.25	Dark brown (7.5YR 3/3); light medium clay texture; moderate subangular blocky 5-10 mm structure; very few large pebbles of basalt; pH 6.5; clear change to -
BC	0.25+	Dark greyish brown (7.5YR 4/2); decomposed basalt rock.

Site: PF1

Surface (0–10 cm) Chemistry Data

pH (H_2O)	Bicarbonate extr. P (Colwell) (mg/kg)	Nitrate nitrogen (mg/kg)	Total nitrogen (%)	Boron (mg/kg)	Sulfate sulfur (mg/kg)	Organic matter (%)	Total organic carbon (%)	Trace Elements			
								Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
7.2	17	2.5	0.1	0.35	1.4	2	1.19	1.7	35	15	0.76

Soil Profile Chemistry Data

Depth (m)	Particle size (%)*				pH (H_2O)	EC (dS/m)	EC rating (VL, L, M, H, VH, E)	Cl^- (mg/kg)	Exchangeable cations (meq/100 g)						ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Fine sand	Coarse sand					Al	Ca	Mg	K	Na	CEC				
0-0.1	17	14	31	39	7.2	0.03	VL	<10.0	<0.10	7	3.5	0.27	0.05	11	0.5	NS	3	2.0
0.1-0.2	32	15	34	18	7.6	0.04	VL	<10.0	<0.10	17	9.9	0.31	0.23	28	0.8	NS	3	1.7

Notes:* Coarse sand (>2 mm), Fine sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm), ID (Indeterminable).

SITE DESCRIPTION	**Soil Unit: Da-FE**		**Site: PF-7**	
Co-ordinates:	**Easting:** 693288	**Northing:** 5988562	**Zone:** 55	**Datum:** GDA94
ASC Soil Order:	Red Ferrosol	**Sampler:**	J Claridge	

LANDFORM

Slope:	4%	**Runoff:**	Moderately rapid
Morphological type:	Mid-slope	**Permeability:**	Moderately permeable
Landform element:	Hillslope	**Drainage:**	Moderately well drained
Landform pattern:	Rises to Low Hills	**Surface condition:**	Firm to Hardsetting
Relief modal class:	Undulating Rises to Low Hills	**Disturbance:**	Complete clearing
Coarse fragments:	Very few medium quartz pebbles	**Rock outcrop:**	Nil
Geology:	Colinton Volcanics		
Vegetation:	Grass cover		

Site PF-7 landscape

Site PF-7 soil profile, surface at top right, 30 cm rows, total depth 80c m

SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1	0.00-0.10	Brown (7.5YR 4/3); clay loam fine sandy texture; weak subangular blocky structure; dry firm consistence; pH 6.0; gradual change to -
B1	0.10-0.35	Dark reddish brown (5YR 3/3); light clay texture; weak subangular blocky 10-20mm structure; pH 6.5; diffuse change to -
B2	0.35-0.75	Dark reddish brown (2.5YR 3/4); light medium clay texture; weak to moderate polyhedral structure; gradual change to -
BC	075-0.8	

Site: PF7

Surface (0–10 cm) Chemistry Data

pH (H_2O)	Bicarbonate extr. P (Colwell) (mg/kg)	Nitrate nitrogen (mg/kg)	Total nitrogen (%)	Boron (mg/kg)	Sulfate sulfur (mg/kg)	Organic matter (%)	Total organic carbon (%)	Trace Elements			
								Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
6.6	<5	17	0.17	0.66	7.4	3	1.74	2	59	30	0.65

Soil Profile Chemistry Data

Depth (m)	Particle size (%)*				pH (H_2O)	EC (dS/m)	EC rating (VL, L, M, H, VH, E)	Cl^- (mg/kg)	Exchangeable cations (meq/100 g)						ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Fine sand	Coarse sand					Al	Ca	Mg	K	Na	CEC				
0-0.1	15	13	46	26	6.6	0.07	VL	11	<0.10	4	1.9	0.9	0.03	6.9	0.4	NS	7	2.1
0.5-0.6	50	9	31	10	7.3	0.03	VL	<10.0	<0.10	10	11	0.75	0.23	22	1.0	NS	6	0.9

Notes:* Coarse sand (>2 mm), Fine sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm), ID (Indeterminable).

SITE DESCRIPTION	**Soil Unit: Da-FE**		**Site: PF-8**	
Co-ordinates:	**Easting:** 6931623	**Northing:** 5988041	**Zone:** 55	**Datum:** GDA94
ASC Soil Order:	Red Kandosol	**Sampler:**	J Claridge	

LANDFORM

Slope:	2%	**Runoff:**	Moderately rapid
Morphological type:	Lower-slope	**Permeability:**	Moderately permeable
Landform element:	Hillslope	**Drainage:**	Moderately well drained
Landform pattern:	Rises	**Surface condition:**	Firm
Relief modal class:	Very gently undulating rises	**Disturbance:**	Complete clearing
Coarse fragments:	None	**Rock outcrop:**	Nil
Geology:	Colinton Volcanics		
Vegetation:	Thick grass cover		

Site PF-8 landscape

Site PF-8 soil profile, surface at top right, total depth 90 cm

SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1	0.00-0.15	Dark brown (7.5YR 3/2); clay loam fine sandy texture; weak structure; pH 6.5; gradual change to -
B1	0.15-0.50	Reddish brown (5YR 4/4); sandy light clay texture; weak subangular blocky 10-20 mm structure; pH 7.5; diffuse change to -
B2	0.5-0.9	Dark reddish brown (5YR /3); light medium clay texture; weak polyhedral 10-20 mm structure; very few medium quartz pebbles; pH 7.5; clear change to -
C	0.9+	

Site: PF8

Surface (0–10 cm) Chemistry Data

pH (H_2O)	Bicarbonate extr. P (Colwell) (mg/kg)	Nitrate nitrogen (mg/kg)	Total nitrogen (%)	Boron (mg/kg)	Sulfate sulfur (mg/kg)	Organic matter (%)	Total organic carbon (%)	Trace Elements			
								Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
6.5	260	4.7	0.38	0.68	10	5.9	3.43	3.9	220	31	2.7

Soil Profile Chemistry Data

Depth (m)	Particle size (%)*				pH (H_2O)	EC (dS/m)	EC rating (VL, L, M, H, VH, E)	Cl^- (mg/kg)	Exchangeable cations (meq/100 g)						ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Fine sand	Coarse sand					Al	Ca	Mg	K	Na	CEC				
0-0.1	27	9	33	30	6.5	0.08	VL	<10.0	<0.10	9.5	7.2	2.2	0.38	19	2.0	NS	8	1.3

Notes:* Coarse sand (>2 mm), Fine sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm), ID (Indeterminable).

SITE DESCRIPTION **Soil Unit: Da-KA** **Site: PF-11**

Co-ordinates: **Easting:** 693217 **Northing:** 5987894 **Zone:** 55 **Datum:** GDA94

ASC Soil Order: Red Dermosol **Sampler:** J Claridge

LANDFORM

Slope:	3%	**Runoff:**	Moderately rapid
Morphological type:	Lower-slope	**Permeability:**	Moderately permeable
Landform element:	Hillslope	**Drainage:**	Moderately well drained
Landform pattern:	Rises	**Surface condition:**	Soft with weak crust
Relief modal class:	Very gently undulating rises	**Disturbance:**	Complete clearing
Coarse fragments:	Abundant medium rhyolite pebbles and few andesite cobbles	**Rock outcrop:**	Nil
Geology:	Colinton Volcanics		
Vegetation:	Grass cover		

Site PF-11 landscape

Site PF-11 soil profile, surface at top right, total depth 35 cm

SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1	0.00-0.05	Brown (7.5YR 4/4); light medium clay texture; moderate subangular blocky structure; many medium rhyolite pebbles; pH 7.0; clear change to -
B2	0.05-0.25	Dark brown (5YR 4/5); light medium clay texture; moderate subangular blocky 10-20 mm structure; many large rhyolite pebbles; pH 8.5; gradual change to -
BC	0.35+	

Site: PF11

Surface (0–5 cm) Chemistry Data

pH (H_2O)	Bicarbonate extr. P (Colwell) (mg/kg)	Nitrate nitrogen (mg/kg)	Total nitrogen (%)	Boron (mg/kg)	Sulfate sulfur (mg/kg)	Organic matter (%)	Total organic carbon (%)	Trace Elements			
								Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
8.6	44	2.3	0.22	0.62	2.3	3.9	2.29	0.9	9.6	2.5	0.45

Soil Profile Chemistry Data

Depth (m)	Particle size (%)*				pH (H_2O)	EC (dS/m)	EC rating (VL, L, M, H, VH, E)	Cl^- (mg/kg)	Exchangeable cations (meq/100 g)						ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Fine sand	Coarse sand					Al	Ca	Mg	K	Na	CEC				
0-0.05	39	11	34	16	8.6	0.13	VL	<10.0	<0.10	42	7.4	0.77	0.04	50	0.1	NS	7	5.7

Notes:* Coarse sand (>2 mm), Fine sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm), ID (Indeterminable).

SITE DESCRIPTION	**Soil Unit: Ba-VE**		**Site: PF-17**	
Co-ordinates:	**Easting:** 693209	**Northing:** 5987489	**Zone:** 55	**Datum:** GDA94
ASC Soil Order:	Black Vertosol	**Sampler:**	J Claridge	

LANDFORM

Slope:	2%	**Runoff:**	Moderately rapid
Morphological type:	Lower-slope	**Permeability:**	Slowly permeable
Landform element:	Hillslope	**Drainage:**	Imperfectly drained
Landform pattern:	Rises	**Surface condition:**	Cracking and self-mulching
Relief modal class:	Very gently undulating rises	**Disturbance:**	Complete clearing
Coarse fragments:	Few medium basalt pebbles	**Rock outcrop:**	Nil
Geology:	Monaro Volcanics and Bondo Dolerite Member - basalt		
Vegetation:	Thick grass cover		

Site PF-17 landscape

Site PF-17 soil profile, surface at top right, 30 cm rows, total depth 62 cm

SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1	0.00-0.10	Very dark greyish brow (10YR 3/2); light medium clay texture; moderate granular structure; very few medium pebbles; strong dry consistence; pH 6.0; clear change to -
B2	0.10-0.55	Dark brown (7.5YR 3/2); medium clay texture; moderate angular blocky and lenticular structure; pH 7.0; clear change to -
BC	0.55-0.62	

Site: PF17

Surface (0–10 cm) Chemistry Data

pH (H_2O)	Bicarbonate extr. P (Colwell) (mg/kg)	Nitrate nitrogen (mg/kg)	Total nitrogen (%)	Boron (mg/kg)	Sulfate sulfur (mg/kg)	Organic matter (%)	Total organic carbon (%)	Trace Elements			
								Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
6.7	51	11	0.31	0.85	6.7	6	3.46	3.1	53	37	1.5

Soil Profile Chemistry Data

Depth (m)	Particle size (%)*				pH (H_2O)	EC (dS/m)	EC rating (VL, L, M, H, VH, E)	Cl^- (mg/kg)	Exchangeable cations (meq/100 g)						ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Fine sand	Coarse sand					Al	Ca	Mg	K	Na	CEC				
0-0.1	39	10	43	8	6.7	0.08	VL	<10.0	<0.10	14	13	1.7	0.13	29	0.4	NS	7	1.1
0.2-0.3	45	9	42	4	7.3	0.05	VL	<10.0	<0.10	17	20	0.52	0.28	38	0.7	NS	6	0.9

Notes:* Coarse sand (>2 mm), Fine sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm), ID (Indeterminable).

SITE DESCRIPTION	**Soil Unit: Ba-VE**		**Site: PF-18**	
Co-ordinates:	**Easting:** 693201	**Northing:** 5987576	**Zone:** 55	**Datum:** GDA94
ASC Soil Order:	Black Vertosol	**Sampler:**	J Claridge	

LANDFORM

Slope:	1%	**Runoff:**	Slow
Morphological type:	Lower-slope	**Permeability:**	Slowly permeable
Landform element:	Hillslope	**Drainage:**	Imperfectly drained
Landform pattern:	Rises	**Surface condition:**	Self-mulching and cracking
Relief modal class:	Very gently undulating rises	**Disturbance:**	Complete clearing
Coarse fragments:	Very few basalt cobbles	**Rock outcrop:**	Nil
Microrelief:	Weak normal gilgai		
Geology:	Monaro Volcanics and Bondo Dolerite Member - basalt		
Vegetation:	Thick grass cover		

Site PF-18 landscape

Site PF-18 soil profile, surface at top right, 30 cm rows total depth 70 cm

SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1	0.00-0.10	Dark brown (7.5YR 3/2); light medium clay texture; moderate granular structure; very few basalt cobbles; moist weak consistence; pH 7.0; clear change to -
B21	0.10-0.30	Dark reddish brown (5YR 3/2); light medium clay texture; moderate subangular blocky 10-20 mm structure; very few large quartz pebbles; pH 7.0; clear change to -
B22	0.30-0.60	Reddish brown (2.5YR 4/3); medium clay texture; moderate angular blocky and lenticular structure; very few basalt cobbles; pH 8.5; diffuse change to -
BC	0.60-0.7	

Site: PF18

Surface (0–10 cm) Chemistry Data

pH (H_2O)	Bicarbonate extr. P (Colwell) (mg/kg)	Nitrate nitrogen (mg/kg)	Total nitrogen (%)	Boron (mg/kg)	Sulfate sulfur (mg/kg)	Organic matter (%)	Total organic carbon (%)	Trace Elements			
								Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
6.8	57	10	0.34	1	5	6.2	3.61	2.8	51	32	1.8

Soil Profile Chemistry Data

Depth (m)	Particle size (%)*				pH (H_2O)	EC (dS/m)	EC rating (VL, L, M, H, VH, E)	Cl^- (mg/kg)	Exchangeable cations (meq/100 g)					ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Fine sand	Coarse sand					Al	Ca	Mg	K	Na	CEC			
0-0.1	31	15	47	7	6.8	0.09	VL	15		11	12	2.8	0.1	26	0.4	NS	7	0.9
0.2-0.3	47	9	38	6	7	0.06	VL	<10.0		14	19	0.8	0.2	34	0.6	NS	7	0.7
0.5-0.6	30	5	61	5	7.9	0.05	VL	<10.0		18	27	0.6	0.4	46	0.9	NS	6	0.7

Notes:* Coarse sand (>2 mm), Fine sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm), ID (Indeterminable).

Annexure C

Laboratory data

Nutrient Advantage®

Nutrient Advantage Advice® Nutrient Report

EMM CONSULTING

Cnr South Rd & Wilson Ave

WERRIBEE
VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020443
Paddock Name: PF18
Sample Name: PF18 50-60
Sample Depth (cm): 50 **To** 60

Nearest Town: BRISBANE
Test Code: 2018-171
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	30
% Sand (Fine)	%	61
% Sand (Coarse)	%	5
% Silt	%	5
Sand/Silt/Clay Texture		Sandy Clay Loam
Moisture (at 105C)	%	27
Emerson Class		6
pH (1:5 Water)		7.9
pH (1:5 CaCl2)		6.8
Carbonate	% CaCO3 equi	1
Electrical Conductivity (1:5 water)	dS/m	0.05
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	1
Ammonium Nitrogen	mg/kg	1
CEC (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	46.0
Calcium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	18.0
Magnesium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	27.0
Sodium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	0.41
Potassium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	0.64
Electrical Conductivity (Sat. Ext.)	dS/m	0.20

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 :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020443	**Test Code:**	2018-171
Paddock Name:	PF18	**Sample Type:**	Soil
Sample Name:	PF18 50-60	**Sampling Date:**	6/06/2019
Sample Depth (cm):	50 **To** 60		

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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EMM CONSULTING

Cnr South Rd & Wilson Ave

WERRIBEE
VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020444
Paddock Name: PF18
Sample Name: PF18 20-30
Sample Depth (cm): 20 **To** 30

Nearest Town: BRISBANE
Test Code: 2018-171
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	47
% Sand (Fine)	%	38
% Sand (Coarse)	%	6
% Silt	%	9
Sand/Silt/Clay Texture		Clay
Moisture (at 105C)	%	21
Emerson Class		7
pH (1:5 Water)		7.0
pH (1:5 CaCl2)		6.1
Carbonate	% CaCO3 equi	1
Electrical Conductivity (1:5 water)	dS/m	0.06
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	3
Ammonium Nitrogen	mg/kg	2
CEC (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	34.0
Calcium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	14.0
Magnesium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	19.0
Sodium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	0.20
Potassium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	0.79
Electrical Conductivity (Sat. Ext.)	dS/m	0.36

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Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020444	**Test Code:**	2018-171
Paddock Name:	PF18	**Sample Type:**	Soil
Sample Name:	PF18 20-30	**Sampling Date:**	6/06/2019
Sample Depth (cm):	20 **To** 30		

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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VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020445
Paddock Name: PF18
Sample Name: PF18 0-10
Sample Depth (cm): 0 **To** 10

Nearest Town: BRISBANE
Test Code: 2018-169
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	31
% Sand (Fine)	%	47
% Sand (Coarse)	%	7
% Silt	%	15
Sand/Silt/Clay Texture		Clay Loam
Moisture (at 105C)	%	19
Emerson Class		7
pH (1:5 Water)		6.8
pH (1:5 CaCl2)		6.1
Carbonate	% CaCO3 equi	1
Electrical Conductivity (1:5 water)	dS/m	0.09
Chloride	mg/kg	15
Organic Carbon (W&B)	%	3.6
Organic Matter (W&B * 1.72)	%	6.2
Nitrate Nitrogen	mg/kg	10
Ammonium Nitrogen	mg/kg	3
Total Nitrogen	%	0.34
Phosphorus (Colwell)	mg/kg	57
Potassium (Colwell)	mg/kg	980
Sulphur (MCP)	mg/kg	5
CEC (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	26.0
Calcium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	11.0

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020445	**Test Code:**	2018-169
Paddock Name:	PF18	**Sample Type:**	Soil
Sample Name:	PF18 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Magnesium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	12.0
Sodium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	0.07
Potassium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	2.80
Zinc (DTPA)	mg/kg	1.80
Copper (DTPA)	mg/kg	2.80
Iron (DTPA)	mg/kg	51.0
Manganese (DTPA)	mg/kg	32.0
Boron (Hot CaCl2)	mg/kg	1.0
Total Phosphorus	%	0.094
Total Potassium	%	0.620
Total Calcium	%	0.59
Total Magnesium	%	0.770
Total Sulphur	%	0.042
Total Zinc	mg/kg	88.00
Total Manganese	mg/kg	1200
Total Copper	mg/kg	45
Total Iron	mg/kg	56000
Total Aluminium	%	4.900
Total Sodium	%	0.015
Total Cadmium	mg/kg	0.220
Total Lead	mg/kg	22
Total Nickel	mg/kg	130
Total Chromium	mg/kg	110

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

EMM CONSULTING

Cnr South Rd & Wilson Ave

WERRIBEE
VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020446
Paddock Name: PF17
Sample Name: PF17 20-30
Sample Depth (cm): 20 **To** 30

Nearest Town: BRISBANE
Test Code: 2018-170
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	45
% Sand (Fine)	%	42
% Sand (Coarse)	%	4
% Silt	%	9
Sand/Silt/Clay Texture		Clay
Moisture (at 105C)	%	28
Emerson Class		6
pH (1:5 Water)		7.3
pH (1:5 CaCl2)		6.3
Electrical Conductivity (1:5 water)	dS/m	0.05
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	3
Ammonium Nitrogen	mg/kg	2
Cation Exch. Cap. (CEC)	cmol(+)/kg	38.0
Calcium (Amm-acet. with pre-wash)	cmol(+)/kg	17.0
Magnesium (Amm-acet. with pre-wa	cmol(+)/kg	20.0
Sodium (Amm-acet. with pre-wash)	cmol(+)/kg	0.28
Potassium (Amm-acet. with pre-wa	cmol(+)/kg	0.52
Available Potassium (with pre-wash)	mg/kg	200
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	0.3
Calcium % of Cations	%	45.0

ASPAC

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Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020446	**Test Code:**	2018-170
Paddock Name:	PF17	**Sample Type:**	Soil
Sample Name:	PF17 20-30	**Sampling Date:**	6/06/2019
Sample Depth (cm):	20 **To** 30		

Analyte / Assay	Units	Value
Magnesium % of Cations	%	53.0
Sodium % of Cations (ESP)	%	0.74
Potassium % of Cations	%	1.40
Calcium/Magnesium Ratio (with pre-wash)		0.9

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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EMM CONSULTING

Cnr South Rd & Wilson Ave

WERRIBEE
VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020447
Paddock Name: PF17
Sample Name: PF17 0-10
Sample Depth (cm): 0 **To** 10

Nearest Town: BRISBANE
Test Code: 2018-168
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	39
% Sand (Fine)	%	43
% Sand (Coarse)	%	8
% Silt	%	10
Sand/Silt/Clay Texture		Clay
Moisture (at 105C)	%	23
Emerson Class		7
pH (1:5 Water)		6.7
pH (1:5 CaCl2)		5.9
Electrical Conductivity (1:5 water)	dS/m	0.08
Chloride	mg/kg	<10
Organic Carbon (W&B)	%	3.5
Organic Matter (W&B * 1.72)	%	6.0
Nitrate Nitrogen	mg/kg	11
Ammonium Nitrogen	mg/kg	3
Total Nitrogen	%	0.31
Phosphorus (Colwell)	mg/kg	51
Potassium (Colwell)	mg/kg	830
Sulphur (MCP)	mg/kg	7
Cation Exch. Cap. (CEC)	cmol(+)/kg	29.0
Calcium (Amm-acet. with pre-wash)	cmol(+)/kg	14.0
Magnesium (Amm-acet. with pre-wa	cmol(+)/kg	13.0

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

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020447	**Test Code:**	2018-168
Paddock Name:	PF17	**Sample Type:**	Soil
Sample Name:	PF17 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Sodium (Amm-acet. with pre-wash)	cmol(+)/kg	0.13
Potassium (Amm-acet. with pre-wa	cmol(+)/kg	1.70
Available Potassium (with pre-wash)	mg/kg	670
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	0.3
Calcium % of Cations	%	48.0
Magnesium % of Cations	%	45.0
Sodium % of Cations (ESP)	%	0.45
Potassium % of Cations	%	5.90
Calcium/Magnesium Ratio (with pre-wash)		1.1
Zinc (DTPA)	mg/kg	1.50
Copper (DTPA)	mg/kg	3.10
Iron (DTPA)	mg/kg	53.0
Manganese (DTPA)	mg/kg	37.0
Boron (Hot CaCl2)	mg/kg	0.9
Total Phosphorus	%	0.078
Total Potassium	%	0.530
Total Calcium	%	0.63
Total Magnesium	%	0.840
Total Sulphur	%	0.033
Total Zinc	mg/kg	81.00
Total Manganese	mg/kg	1000
Total Copper	mg/kg	43
Total Iron	mg/kg	60000
Total Aluminium	%	5.700
Total Sodium	%	0.018
Total Cadmium	mg/kg	0.230
Total Lead	mg/kg	17

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020447	**Test Code:**	2018-168
Paddock Name:	PF17	**Sample Type:**	Soil
Sample Name:	PF17 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Total Nickel	mg/kg	140
Total Chromium	mg/kg	110

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

EMM CONSULTING

Cnr South Rd & Wilson Ave

WERRIBEE
VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020448
Paddock Name: PF11
Sample Name: PF11 0-10
Sample Depth (cm): 0 **To** 10

Nearest Town: BRISBANE
Test Code: 2018-168
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	39
% Sand (Fine)	%	34
% Sand (Coarse)	%	16
% Silt	%	11
Sand/Silt/Clay Texture		Clay
Moisture (at 105C)	%	14
Emerson Class		7
pH (1:5 Water)		8.6
pH (1:5 CaCl2)		7.9
Electrical Conductivity (1:5 water)	dS/m	0.13
Chloride	mg/kg	<10
Organic Carbon (W&B)	%	2.3
Organic Matter (W&B * 1.72)	%	3.9
Nitrate Nitrogen	mg/kg	2
Ammonium Nitrogen	mg/kg	1
Total Nitrogen	%	0.22
Phosphorus (Colwell)	mg/kg	44
Potassium (Colwell)	mg/kg	280
Sulphur (MCP)	mg/kg	2
Cation Exch. Cap. (CEC)	cmol(+)/kg	50.0
Calcium (Amm-acet. with pre-wash)	cmol(+)/kg	42.0
Magnesium (Amm-acet. with pre-wa	cmol(+)/kg	7.4

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

Nutrient Advantage Advice® Nutrient Report

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020448	**Test Code:**	2018-168
Paddock Name:	PF11	**Sample Type:**	Soil
Sample Name:	PF11 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Sodium (Amm-acet. with pre-wash)	cmol(+)/kg	0.04
Potassium (Amm-acet. with pre-wa	cmol(+)/kg	0.77
Available Potassium (with pre-wash)	mg/kg	300
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	0.2
Calcium % of Cations	%	84.0
Magnesium % of Cations	%	15.0
Sodium % of Cations (ESP)	%	0.08
Potassium % of Cations	%	1.50
Calcium/Magnesium Ratio (with pre-wash)		5.7
Zinc (DTPA)	mg/kg	0.45
Copper (DTPA)	mg/kg	0.90
Iron (DTPA)	mg/kg	9.6
Manganese (DTPA)	mg/kg	2.5
Boron (Hot CaCl2)	mg/kg	0.6
Total Phosphorus	%	0.078
Total Potassium	%	0.430
Total Calcium	%	6.70
Total Magnesium	%	1.300
Total Sulphur	%	0.024
Total Zinc	mg/kg	70.00
Total Manganese	mg/kg	780
Total Copper	mg/kg	41
Total Iron	mg/kg	57000
Total Aluminium	%	6.000
Total Sodium	%	0.014
Total Cadmium	mg/kg	0.340
Total Lead	mg/kg	9

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020448	**Test Code:**	2018-168
Paddock Name:	PF11	**Sample Type:**	Soil
Sample Name:	PF11 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Total Nickel	mg/kg	140
Total Chromium	mg/kg	110

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

EMM CONSULTING

Cnr South Rd & Wilson Ave

WERRIBEE
VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020449
Paddock Name: PF8
Sample Name: PF8 0-10
Sample Depth (cm): 0 **To** 10

Nearest Town: BRISBANE
Test Code: 2018-168
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	27
% Sand (Fine)	%	33
% Sand (Coarse)	%	30
% Silt	%	9
Sand/Silt/Clay Texture		Clay Loam
Moisture (at 105C)	%	14
Emerson Class		8
pH (1:5 Water)		6.5
pH (1:5 CaCl2)		5.4
Electrical Conductivity (1:5 water)	dS/m	0.08
Chloride	mg/kg	<10
Organic Carbon (W&B)	%	3.4
Organic Matter (W&B * 1.72)	%	5.9
Nitrate Nitrogen	mg/kg	5
Ammonium Nitrogen	mg/kg	3
Total Nitrogen	%	0.38
Phosphorus (Colwell)	mg/kg	260
Potassium (Colwell)	mg/kg	1300
Sulphur (MCP)	mg/kg	10
Cation Exch. Cap. (CEC)	cmol(+)/kg	19.0
Calcium (Amm-acet. with pre-wash)	cmol(+)/kg	9.5
Magnesium (Amm-acet. with pre-wa	cmol(+)/kg	7.2

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

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020449	**Test Code:**	2018-168
Paddock Name:	PF8	**Sample Type:**	Soil
Sample Name:	PF8 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Sodium (Amm-acet. with pre-wash)	cmol(+)/kg	0.38
Potassium (Amm-acet. with pre-wa	cmol(+)/kg	2.20
Available Potassium (with pre-wash)	mg/kg	870
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	0.5
Calcium % of Cations	%	50.0
Magnesium % of Cations	%	38.0
Sodium % of Cations (ESP)	%	2.00
Potassium % of Cations	%	12.00
Calcium/Magnesium Ratio (with pre-wash)		1.3
Zinc (DTPA)	mg/kg	2.70
Copper (DTPA)	mg/kg	3.90
Iron (DTPA)	mg/kg	220.0
Manganese (DTPA)	mg/kg	31.0
Boron (Hot CaCl2)	mg/kg	0.7
Total Phosphorus	%	0.120
Total Potassium	%	0.580
Total Calcium	%	0.44
Total Magnesium	%	0.970
Total Sulphur	%	0.035
Total Zinc	mg/kg	73.00
Total Manganese	mg/kg	820
Total Copper	mg/kg	43
Total Iron	mg/kg	48000
Total Aluminium	%	4.300
Total Sodium	%	0.033
Total Cadmium	mg/kg	0.190
Total Lead	mg/kg	15

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020449	**Test Code:**	2018-168
Paddock Name:	PF8	**Sample Type:**	Soil
Sample Name:	PF8 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Total Nickel	mg/kg	97
Total Chromium	mg/kg	80

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 Advice® Nutrient Report

EMM CONSULTING

Cnr South Rd & Wilson Ave

WERRIBEE
VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020450
Paddock Name: PF7
Sample Name: PF7 50-60
Sample Depth (cm): 50 **To** 60

Nearest Town: BRISBANE
Test Code: 2018-170
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	50
% Sand (Fine)	%	31
% Sand (Coarse)	%	10
% Silt	%	9
Sand/Silt/Clay Texture		Clay
Moisture (at 105C)	%	21
Emerson Class		6
pH (1:5 Water)		7.3
pH (1:5 CaCl2)		6.2
Electrical Conductivity (1:5 water)	dS/m	0.03
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	2
Ammonium Nitrogen	mg/kg	1
Cation Exch. Cap. (CEC)	cmol(+)/kg	22.0
Calcium (Amm-acet. with pre-wash)	cmol(+)/kg	10.0
Magnesium (Amm-acet. with pre-wa	cmol(+)/kg	11.0
Sodium (Amm-acet. with pre-wash)	cmol(+)/kg	0.23
Potassium (Amm-acet. with pre-wa	cmol(+)/kg	0.75
Available Potassium (with pre-wash)	mg/kg	290
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	0.5
Calcium % of Cations	%	45.0

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Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020450	**Test Code:**	2018-170
Paddock Name:	PF7	**Sample Type:**	Soil
Sample Name:	PF7 50-60	**Sampling Date:**	6/06/2019
Sample Depth (cm):	50 **To** 60		

Analyte / Assay	Units	Value
Magnesium % of Cations	%	50.0
Sodium % of Cations (ESP)	%	1.00
Potassium % of Cations	%	3.40
Calcium/Magnesium Ratio (with pre-wash)		0.9

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Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020451
Paddock Name: PF7
Sample Name: PF7 0-10
Sample Depth (cm): 0 **To** 10

Nearest Town: BRISBANE
Test Code: 2018-168
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	15
% Sand (Fine)	%	46
% Sand (Coarse)	%	26
% Silt	%	13
Sand/Silt/Clay Texture		Loam
Moisture (at 105C)	%	6
Emerson Class		7
pH (1:5 Water)		6.6
pH (1:5 CaCl2)		5.8
Electrical Conductivity (1:5 water)	dS/m	0.07
Chloride	mg/kg	11
Organic Carbon (W&B)	%	1.7
Organic Matter (W&B * 1.72)	%	3.0
Nitrate Nitrogen	mg/kg	17
Ammonium Nitrogen	mg/kg	2
Total Nitrogen	%	0.17
Phosphorus (Colwell)	mg/kg	<5
Potassium (Colwell)	mg/kg	660
Sulphur (MCP)	mg/kg	7
Cation Exch. Cap. (CEC)	cmol(+)/kg	6.9
Calcium (Amm-acet. with pre-wash)	cmol(+)/kg	4.0
Magnesium (Amm-acet. with pre-wa	cmol(+)/kg	1.9

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020451	**Test Code:**	2018-168
Paddock Name:	PF7	**Sample Type:**	Soil
Sample Name:	PF7 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Sodium (Amm-acet. with pre-wash)	cmol(+)/kg	0.03
Potassium (Amm-acet. with pre-wa	cmol(+)/kg	0.90
Available Potassium (with pre-wash)	mg/kg	350
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	1.4
Calcium % of Cations	%	58.0
Magnesium % of Cations	%	28.0
Sodium % of Cations (ESP)	%	0.48
Potassium % of Cations	%	13.00
Calcium/Magnesium Ratio (with pre-wash)		2.1
Zinc (DTPA)	mg/kg	0.65
Copper (DTPA)	mg/kg	2.00
Iron (DTPA)	mg/kg	59.0
Manganese (DTPA)	mg/kg	30.0
Boron (Hot CaCl2)	mg/kg	0.7
Total Phosphorus	%	0.036
Total Potassium	%	0.390
Total Calcium	%	0.21
Total Magnesium	%	0.340
Total Sulphur	%	0.019
Total Zinc	mg/kg	40.00
Total Manganese	mg/kg	600
Total Copper	mg/kg	20
Total Iron	mg/kg	31000
Total Aluminium	%	2.800
Total Sodium	%	0.007
Total Cadmium	mg/kg	0.130
Total Lead	mg/kg	8

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Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020451	**Test Code:**	2018-168
Paddock Name:	PF7	**Sample Type:**	Soil
Sample Name:	PF7 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Total Nickel	mg/kg	43
Total Chromium	mg/kg	57

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EMM CONSULTING

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VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020452
Paddock Name: PF5
Sample Name: PF5 0-10
Sample Depth (cm): 0 **To** 10

Nearest Town: BRISBANE
Test Code: 2018-169
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	23
% Sand (Fine)	%	37
% Sand (Coarse)	%	26
% Silt	%	14
Sand/Silt/Clay Texture		Clay Loam
Moisture (at 105C)	%	12
Emerson Class		6
pH (1:5 Water)		8.2
pH (1:5 CaCl2)		7.7
Carbonate	% CaCO3 equi	5
Electrical Conductivity (1:5 water)	dS/m	0.33
Chloride	mg/kg	330
Organic Carbon (W&B)	%	2.8
Organic Matter (W&B * 1.72)	%	4.9
Nitrate Nitrogen	mg/kg	6
Ammonium Nitrogen	mg/kg	2
Total Nitrogen	%	0.29
Phosphorus (Colwell)	mg/kg	14
Potassium (Colwell)	mg/kg	270
Sulphur (MCP)	mg/kg	8
CEC (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	20.0
Calcium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	14.0

Analyses conducted by **Nutrient Advantage Laboratory Services**
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Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020452	**Test Code:**	2018-169
Paddock Name:	PF5	**Sample Type:**	Soil
Sample Name:	PF5 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Magnesium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	5.2
Sodium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	0.16
Potassium (Alcoholic NH4Cl at pH 8.5)	cmol(+)/kg	0.74
Zinc (DTPA)	mg/kg	1.40
Copper (DTPA)	mg/kg	0.95
Iron (DTPA)	mg/kg	11.0
Manganese (DTPA)	mg/kg	7.0
Boron (Hot CaCl2)	mg/kg	0.6
Total Phosphorus	%	0.059
Total Potassium	%	0.350
Total Calcium	%	2.10
Total Magnesium	%	0.560
Total Sulphur	%	0.035
Total Zinc	mg/kg	54.00
Total Manganese	mg/kg	780
Total Copper	mg/kg	25
Total Iron	mg/kg	45000
Total Aluminium	%	3.400
Total Sodium	%	0.018
Total Cadmium	mg/kg	0.230
Total Lead	mg/kg	12
Total Nickel	mg/kg	70
Total Chromium	mg/kg	88

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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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EMM CONSULTING

Cnr South Rd & Wilson Ave

WERRIBEE
VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020453
Paddock Name: PF1
Sample Name: PF1 10-20
Sample Depth (cm): 10 **To** 20

Nearest Town: BRISBANE
Test Code: 2018-170
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	32
% Sand (Fine)	%	34
% Sand (Coarse)	%	18
% Silt	%	15
Sand/Silt/Clay Texture		Clay Loam
Moisture (at 105C)	%	19
Emerson Class		3
pH (1:5 Water)		7.6
pH (1:5 CaCl2)		6.7
Electrical Conductivity (1:5 water)	dS/m	0.04
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	2
Ammonium Nitrogen	mg/kg	1
Cation Exch. Cap. (CEC)	cmol(+)/kg	28.0
Calcium (Amm-acet. with pre-wash)	cmol(+)/kg	17.0
Magnesium (Amm-acet. with pre-wa	cmol(+)/kg	9.9
Sodium (Amm-acet. with pre-wash)	cmol(+)/kg	0.23
Potassium (Amm-acet. with pre-wa	cmol(+)/kg	0.31
Available Potassium (with pre-wash)	mg/kg	120
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	0.4
Calcium % of Cations	%	61.0

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020453	**Test Code:**	2018-170
Paddock Name:	PF1	**Sample Type:**	Soil
Sample Name:	PF1 10-20	**Sampling Date:**	6/06/2019
Sample Depth (cm):	10 **To** 20		

Analyte / Assay	Units	Value
Magnesium % of Cations	%	35.0
Sodium % of Cations (ESP)	%	0.82
Potassium % of Cations	%	1.10
Calcium/Magnesium Ratio (with pre-wash)		1.7

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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

EMM CONSULTING

Cnr South Rd & Wilson Ave

WERRIBEE
VIC 3030

Report Print Date: 14/06/2019
Agent/Dealer:
Advisor/Contact: NAA Cash Lab User
Phone:
Purchase Order No: EMM CONSULTING

Grower Name : EMM CONSULTING
Sample No: 022020454
Paddock Name: PF1
Sample Name: PF1 0-10
Sample Depth (cm): 0 **To** 10

Nearest Town: BRISBANE
Test Code: 2018-168
Sample Type: Soil
Sampling Date: 6/06/2019

Analyte / Assay	Units	Value
% Clay	%	17
% Sand (Fine)	%	31
% Sand (Coarse)	%	39
% Silt	%	14
Sand/Silt/Clay Texture		Loam
Moisture (at 105C)	%	11
Emerson Class		3
pH (1:5 Water)		7.2
pH (1:5 CaCl2)		6.2
Electrical Conductivity (1:5 water)	dS/m	0.03
Chloride	mg/kg	<10
Organic Carbon (W&B)	%	1.2
Organic Matter (W&B * 1.72)	%	2.0
Nitrate Nitrogen	mg/kg	3
Ammonium Nitrogen	mg/kg	1
Total Nitrogen	%	0.10
Phosphorus (Colwell)	mg/kg	17
Potassium (Colwell)	mg/kg	200
Sulphur (MCP)	mg/kg	1
Cation Exch. Cap. (CEC)	cmol(+)/kg	11.0
Calcium (Amm-acet. with pre-wash)	cmol(+)/kg	7.0
Magnesium (Amm-acet. with pre-wa	cmol(+)/kg	3.5

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020454	**Test Code:**	2018-168
Paddock Name:	PF1	**Sample Type:**	Soil
Sample Name:	PF1 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Sodium (Amm-acet. with pre-wash)	cmol(+)/kg	0.05
Potassium (Amm-acet. with pre-wa	cmol(+)/kg	0.27
Available Potassium (with pre-wash)	mg/kg	110
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	0.9
Calcium % of Cations	%	64.0
Magnesium % of Cations	%	32.0
Sodium % of Cations (ESP)	%	0.44
Potassium % of Cations	%	2.50
Calcium/Magnesium Ratio (with pre-wash)		2.0
Zinc (DTPA)	mg/kg	0.76
Copper (DTPA)	mg/kg	1.70
Iron (DTPA)	mg/kg	35.0
Manganese (DTPA)	mg/kg	15.0
Boron (Hot CaCl2)	mg/kg	0.4
Total Phosphorus	%	0.045
Total Potassium	%	0.270
Total Calcium	%	0.67
Total Magnesium	%	0.550
Total Sulphur	%	0.014
Total Zinc	mg/kg	49.00
Total Manganese	mg/kg	770
Total Copper	mg/kg	22
Total Iron	mg/kg	34000
Total Aluminium	%	3.100
Total Sodium	%	0.015
Total Cadmium	mg/kg	0.140
Total Lead	mg/kg	36

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	EMM CONSULTING	**Nearest Town:**	BRISBANE
Sample No:	022020454	**Test Code:**	2018-168
Paddock Name:	PF1	**Sample Type:**	Soil
Sample Name:	PF1 0-10	**Sampling Date:**	6/06/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
Total Nickel	mg/kg	63
Total Chromium	mg/kg	59

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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