APPENDIX 22

Boco Rock Wind Farm Soils Assessment

Eco Logical Australia Pty Ltd

BOCO ROCK WIND FARM

SOILS ASSESSMENT

PREPARED FOR	**Wind Prospect CWP Pty Ltd**
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Contents

1 Introduction 4

2 Regulatory Context 5

3 Methodology 5

4 Site Soils and Geology 6

5 Impact Assessment 10

6 Soil and Water Management 16

7 References 20

List of Figures

Figure 1: Geology of the study area 8

Figure 2: Soil landscapes of the study area 9

List of Tables

Table 1: Summary of soil landscapes in the study area 6

Table 2: Properties of the site's soil landscapes 7

Table 3: Potential soil issues 10

Table 4: Summary of soil erodibility K-factors 12

Table 5: Soil landscape units – slope characteristics 13

Table 6: Summary of mitigation measures 19

Glossary of Terms

TERM	DESCRIPTION
Dermosols	Dermosols do not have strong texture contrast. They have a well structured B2 horizon containing low levels of free iron and generally have high agricultural potential with good structure and moderate to high chemical fertility and water-holding capacity.
Montmorillonite	A very soft sheet silicate mineral that typically forms in microscopic crystals, forming a clay.
Solodic	Sodic soils are high in sodium, easily erodible and poor for plant growth.
Vertosols	Vertosols are clay-rich soils (>35%) of uniform texture with potential for strong cracking and slickensides. Gypsum and/or lime may be required to improve their structure. Heavy plastic clays can be difficult to cultivate especially when they are wet. Shrink-swell phenomena also creates problems for foundations of buildings built on Vertosols.

1 Introduction

Eco Logical Australia Pty Ltd (ELA) has undertaken a soil assessment of the proposed Boco Rock Wind Farm located approximately 6 km west of Nimmitabel in NSW. This soils assessment describes the soil and geological landscapes and characteristics within the study area of the proposed Boco Rock Wind Farm. The purpose of this assessment is to provide an analysis and justified treatment of soil erosion risks to address responsibilities under the *Water Management Act 2000* and standard soil and water management practices for development in NSW.

This report will form part of the Environmental Assessment documentation.

1.1 SITE INFRASTRUCTURE

Key infrastructure for the study area includes 125 turbines, crane hardstand areas, access roads, four wind monitoring masts, underground cables, overhead transmission lines, substation and switchgear, operation facilities building and connection to the electricity grid.

Clusters of turbines will be constructed and commissioned in stages depending on issues and access. A final layout will be based on a number of technical, environmental and social factors and results of site assessments. Collectively these clusters form the Boco Rock Wind Farm and are named:

- 'Yandra', the north-east cluster;
- 'Springfield', the north-west cluster;
- 'Boco', the south-east cluster, and
- 'Sherwins', the south-west cluster.

1.2 SITE ACTIVITIES

Pre-Construction activities include construction enabling activities such as geotechnical investigations, upgrading and widening of local access roads and stripping of topsoil from turbine bases and like areas.

Construction activities include construction of site access tracks, crane hardstand areas, turbine bases and turbine erection, electrical reticulation, substation compound and facilities rooms, overhead transmission lines, temporary site infrastructure and on site concrete batching plant(s).

Operational activities will largely be conducted remote to the study area. Maintenance personnel will visit the study area throughout each year for routine checks and repairs.

2 Regulatory Context

The regulatory context for soil management in NSW is provided in the *Water Management Act 2000* (WM Act) and the *Protection of the Environment Operations Act 1997* (POEO Act) (both include provisions previously contained in the repealed *Soil Conservation Act 1938* and *Rivers and Foreshores Improvement Act 1948*).

The soil and related water quality objectives for the study area are described by the Department of Environment and Climate Change (DECC) and Department of Water and Energy (DWE) in the Director General Requirements as:

- No pollution of waters (s120 of the POEO Act);
- All areas disturbed during construction must be revegetated to a high standard;
- Acceptable achievement of River Flow and Water Quality Objectives (WM Act);
- All activities to be carried out with due diligence, duty of care and according to best management practices;
- Environmental assessment to describe measures to control erosion and sedimentation;
- All personnel should be made aware of their responsibilities in this regard; and

Application of the guideline: *Managing Urban Stormwater: Soils and Construction, 4th Edition* (Landcom 2004) commonly referred to as the "Blue Book".

This soils assessment provides the technical basis addressing sedimentation and erosion impacts on the study area so as to maintain receiving waters current quality.

3 Methodology

This assessment was conducted using:

- Desktop assessment of published soils and geology data and reports;
- GIS analysis and mapping of existing soil landscape mapping and the proposed wind farm area; and
- Linking soil characteristics to erosion potential and mitigation measures.

4 Site Soils and Geology

4.1 LOCATION AND TOPOGRAPHY

The proposed wind farm will be located approximately 30 km to the south of the town of Cooma and 6 km to the west of Nimmitabel along the high altitude plateau of the Monaro Plains. The ranges are of moderate to high elevation (910 to 1090 m above sea level; Australian Height Datum), dominated by the Sherwin Range running in a north-south direction. The MacLaughlin River flows in the southern section while the Sherwin Range forms the majority of the western extent of the study area.

4.2 GEOLOGY

Information on site geology was derived from Tulua (1994) and the published geological map (Lewis and Glen, 1995).

Fine grained Tertiary basalt is the dominant geology on the crests/ridges and upper slopes in the study area. Lower lying areas have transported montmorillonite clays from the surrounding basalt dominated catchments. Along the MacLaughlin River, alluvial and fluvial deposits of gravels, sands, silts and clays dominate, particularly, downstream of the sedimentary sequences (primarily sandstones) that occur at the junction of the MacLaughlin River and Gentle Barlow Creek (Figure 1).

4.3 SOIL LANDSCAPES

Soil landscapes of the region were described in Tulau (1994) and from DECC unpublished data. The main soil landscapes of the region are Brothers, Upper Cooma Creek, Maneroo and Quidong landscapes (Table 1). The Maneroo variant landscape (maa) occupies a small section of the proposed development footprint (<2 ha) and is unlikely to be subject to development. This Maneroo variant soil landscape has similar characteristics to the Maneroo and Brothers soil landscapes so for this report will be considered part of the general Maneroo soil landscape.

Table 1: Summary of soil landscapes in the study area

SOIL LANDSCAPE	PARENT MATERIAL	AUSTRALIAN SOIL CLASSIFICATION	ERODIBILITY	AREA OF STUDY AREA (ha)
Brothers	Basalt	Dermosols	Low-moderate	1092
Maneroo	Basalt	Dermosols	Low-moderate	61
Quidong	Fluvial sediments	Rudosols	Low-moderate	49
Upper Cooma Creek	Basalt	Vertosols	Moderate-high	452

4.3.1 Brothers

The Brothers soil landscape covers the majority of the study area. This soil is formed on the side slopes of undulating to rolling hills and forms shallow to moderately deep profiles (<60 to >100 cm) over the basalt parent material. These Dermosol soils are generally uniform or gradational in texture with strongly pedal loam to clay loam texture. These soils have shrink swell characteristics with low strength when wet. They are generally stable with sufficient ground cover or non-concentrated surface flows (Tulau 1994).

4.3.2 Maneroo

The Maneroo soil landscapes form on the crests and upper slopes of the undulating basalt hills. The soil is generally shallow (<50 cm) but can form deep profiles in localised pockets (>400 cm). These Dermosol soils are generally uniform or gradational in texture with strongly pedal loam to clay loam texture. These soils have shrink swell characteristics with low strength when wet. They are generally stable with sufficient ground cover or non-concentrated surface flows (Tulau 1994).

4.3.3 Upper Cooma Creek

The Upper Cooma Creek soils exist in the north eastern region of the study area. These soils form in valley flats within basalt dominated catchments. These Vertosol soils form deep uniform profiles of strongly pedal light to heavy clay. These soils have shrink swell characteristics with low strength when wet. They are generally stable with sufficient ground cover or non-concentrated surface flows, although are high erodible when exposed or when part of a stream bank. These landscapes are subject to seasonal water logging and inundation (Tulau1994).

4.3.4 Quidong

The Quidong soil landscape occupies the lower slopes and valley flats associated with the MacLaughlin River. The soils have generally shallow sandy profiles. However, there are some solodic soils in drainage lines (DECC unpublished data).

Table 2: Properties of the site's soil landscapes

PROPERTY	BROTHERS	MANEROO	QUIDONG*	UPPER COOMA CREEK
Texture	Loam-clay loam	Loam-clay loam	Sandy	Light-heavy clay
Thickness	<60 cm	<50 cm	Shallow	>300 cm
pH	5.5-8.5	6-9	Not available	7-9.5
Sodicity	No	No	Not available	No
Fertility	High	High	Low	High
Drainage	Well drained	Well drained	Well drained	Poor

* Inferred from limited profile description

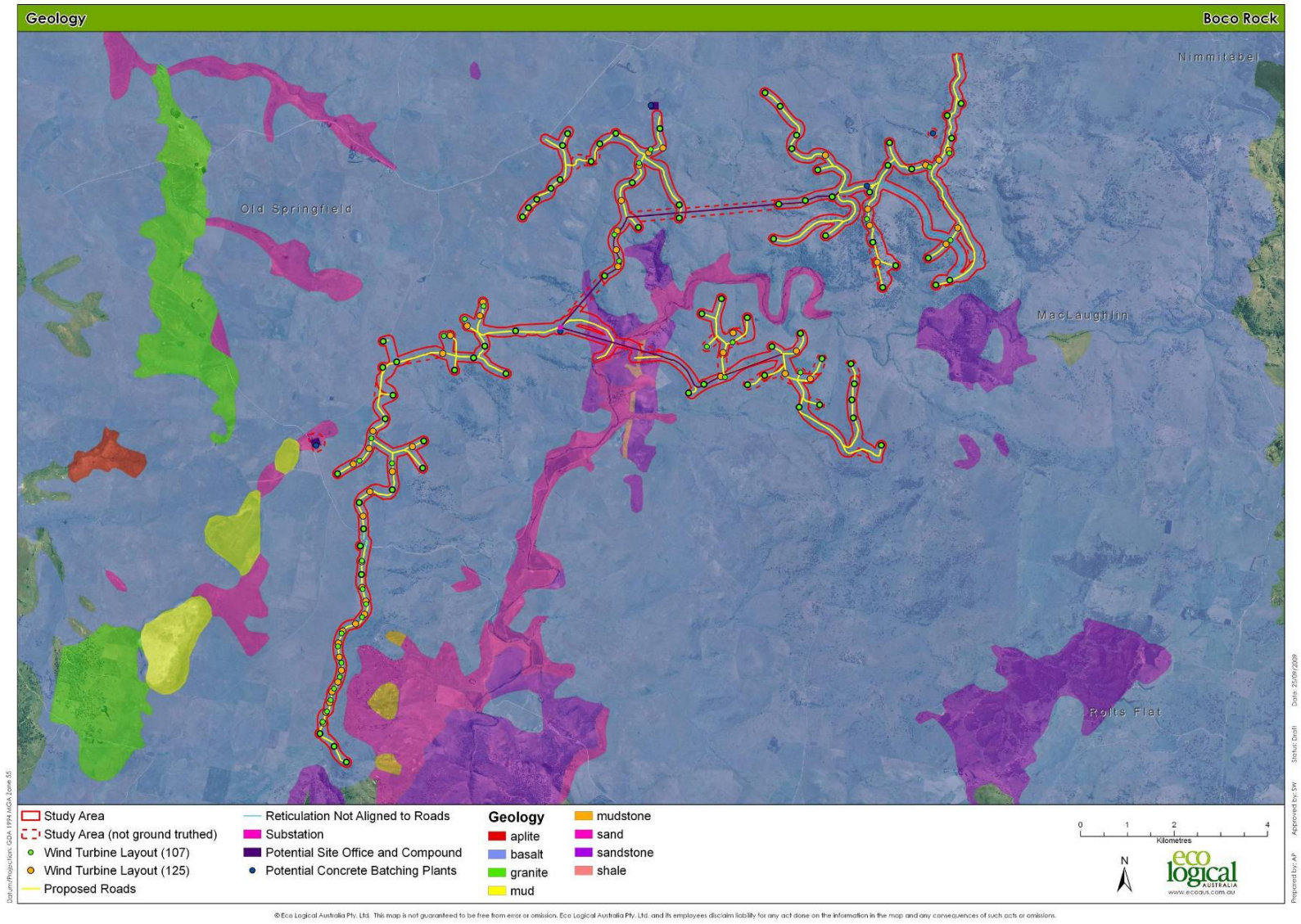

Figure 1: Geology of the study area

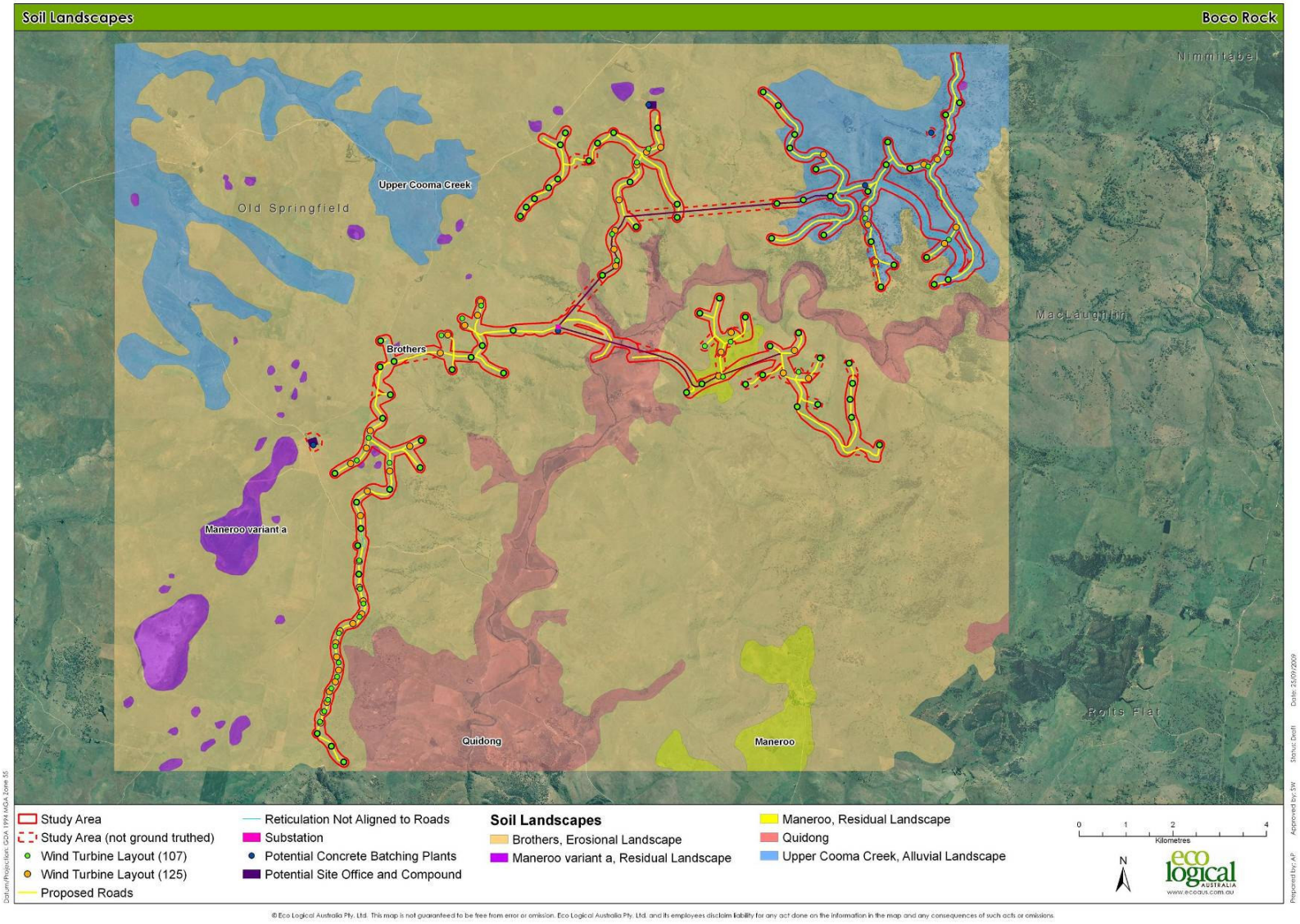

Figure 2: Soil landscapes of the study area

5 Impact Assessment

The soil landscapes of the study area are generally stable in their natural condition. However, vegetation clearing during construction will leave soils exposed to water and wind erosion and is an important issue for soil management. Activities such as the construction of tracks, reticulation trenching, foundation construction, ancillary works and vehicle movement will result in increased soils disturbance on site.

A geotechnical investigation will be conducted for the design of turbine footings. Soil samples and testing will be undertaken as part of this process. It is recommended that testing include soil types in access tracks and at substation locations.

A Soil and Water Management Plan (SWMP) will need to be completed for the site in order to manage at an appropriate level of detail the specific issues for sedimentation and erosion on site. The SWMP will be designed to practically implement the issues addressed in this assessment.

This impact assessment focuses on soil and water constraints considered in the 'Blue Book' (Landcom 2004) in order to align this impact assessment with implementation of erosion and sedimentation control measures (ie: the SWMP).

5.1 SOIL TYPE ISSUES

Potential soil related issues that have the potential to increase impacts if not managed are described in Table 3 for each soil type.

Table 3: Potential soil issues

Soil Issues	BROTHERS	MANEROO	QUIDONG*	UPPER COOMA CREEK
Geotechnical risk (Shrink/Swell)	Yes	Yes	N/A	Yes
Concrete corrosion hazard	No	No	N/A	No
Low wet bearing strength	Yes	Yes	N/A	Yes
Seasonal Water Logging	No	No	No	Yes
Steep to Moderate Slopes	Yes	No	No	Yes
Generally stable with high cover levels and non concentrated flows	Yes	Yes	Yes	Yes
High wind and water erosion when exposed	Yes	Yes	No	Yes
Difficult to restabilise if erosion is activated	Yes	Yes	No	Yes
Flooding (crossings only)	No	No	Yes	No

* Inferred from limited profile description

5.2 GENERAL SITE CONSIDERATIONS

This section presents the findings of a preliminary desktop assessment of the proposed wind farm site in relation to impacts from soil characteristics on site. These considerations include:

- Rainfall Erosivity;
- Soil Erodibility;
- Soil Erosion Hazard;
- Dispersibility and Soil Texture Group;
- Expansive and Reactive Soils;
- Runoff Coefficient;
- Soil pH;
- Watertables;
- Salinity;
- Acid Sulphate Soils;
- Soil Contamination/ Toxicities/ Pollution in Soils; and
- Mass Movement.

5.2.1 Rainfall Erosivity

Rainfall Erosivity (also called the R-Factor) is a measure of the ability of rainfall to cause erosion, and is calculated based on total energy and maximum 30 minute storm intensity (Landcom 2004).

The Rainfall Erosivity for the proposed wind farm is approximately 1,400 – 1,500 based on *Map 14: Rainfall Erosivity of the Bega 1: 250,000 Topographic Sheet in Appendix B* of the 'Blue Book' (Landcom 2004). The R-Factor varies between 750 on parts of western NSW to over 10,000 on parts of the far north coast of NSW. Given this range the Rainfall Erosivity for the study area can be considered low.

Monthly mean rainfall data collected by the Bureau of Meteorology from Nimmitabel Wastewater Treatment Facility (Station No. 70067) and Bombala, Therry Street (Station No. 70005) recorded the highest levels of rainfall in December and January. Consideration may be given to higher rainfall months in planning of construction schedules, however, due to the low levels of rainfall this may not be necessary.

5.2.2 Soil Erodibility

Soil Erodibility (also called the K-Factor) is a measure of the susceptibility of individual soil particles to detach and be transported by rainfall and runoff (Landcom 2004). The K-Factors generally ranges from 0.005 (very low) to 0.075 (very high) (Landcom 2004). K-Factor values are provided in Table 4 for the four (4) different soil landscapes identified within the study area.

For this site the highest K-Factor is 0.042 which is moderate. Due to the lack of information for the Quidong soil landscape unit and the variation between the soil landscape units on site, it is recommended that the K-Factor be derived from site specific laboratory data. Samples may be collected and analysed as part of the geotechnical assessment proposed for footing design.

Table 4: Summary of soil erodibility K-factors

SOIL LANDSCAPE UNIT	SOIL HYDROLOGIC GROUP	USCS CLASS	SEDIMENT TYPE	K-FACTOR (USLE)
Brothers	Group B	CL	Type F	0.017-0.023
	Group B/D	ML	Type F	0.038
Maneroo	Group C	ML	Type F	0.022
		CL	Type F	0.014-0.026
		ML-OL	Type F	0.034
	Group D	CL	Type D	0.011
			Type F	0.033-0.042
		SC	Type F	0.010
Quidong	No information available, determine via laboratory tests			
Upper Cooma Creek	Group C	CL	Type D	0.011-0.020
			Type F	0.021-0.029

Source: Table C27 – Cooma Soil Landscapes in Appendix C of 'Blue Book' (Landcom 2004).

5.2.3 Dispersibility and Soil Texture Group

Dispersible soils are structurally unstable in water and readily split into their constituent particles resulting in turbid water that never seems to clear (Landcom 2004) and results in poor water quality.

Based on the soil landscape unit information available for the study area, 'Type D' soils have been identified within both the Maneroo and Upper Cooma Creek soil landscapes; see Table 4 (Sediment Type). 'Type D' soils contain a significant portion of fine (<0.005 mm) 'dispersible' materials that will not settle unless flocculated.

'Type F' soils were identified within the Brother, Maneroo and Upper Cooma Creek soil landscape units, see Table 4. 'Type F' soils are not dispersible and are characterised by fine grained particles (33% are finer than 0.02 mm), these do not require flocculation to settle particles (Landcom 2004).

Quidong soils will need geotechnical analysis to determine their particle size and dispersion percentage prior to preparation of the SWMP. The dispersibility of these soils will determine the type of sediment control measures used on site during construction.

5.2.4 Soil Erosion Hazard

Soil erosion hazard refers to the susceptibility of a parcel of land to the prevailing agents of erosion and is typically described as high or low erosion hazard (Landcom 2004). Sites with high erosion hazard may require control measures beyond the normal suite of erosion control measures applied to construction sites.

The gradient of the slopes on site range from gently undulating and rolling hills to steep gullies associated with the primary waterways in the area. The slope characteristics of the study area have been summarised in Table 5, to the extent of available information.

Table 5: Soil landscape units – slope characteristics

SOIL LANDSCAPE	SOIL CONSTRAINTS	SLOPE RANGE (%)
Brothers	Steep slopes, shallow soils and localised rock outcrop underlying generally high erosion hazard	15 to 32
Maneroo	Non cohesive soils underlying high wind erosion hazard Localised shallow soil and rock outcrop contributing to local erosion hazards	1 to 10
Quidong	No information available, determine slopes via site contours	
Upper Cooma Creek	High wind and water erosion hazards	<1-3

Source: Table C27 – Cooma Soil Landscapes in Appendix C of 'Blue Book' (Landcom 2004).

Based on the above information, the R-Factor (1,400 to 1,500) and upper slope gradient 32% (Brothers Soil Landscape) and 10% (Maneroo Soil Landscape) were compared to Figure 4.6 of the 'Blue Book' to determine their potential erosion hazard. The Brothers Soil Landscape is classified as a 'high erosion hazard' and the Maneroo Soil Landscape a 'low erosion hazard'.

Further assessment will be required in the preparation of the SWMP to determine the potential erosion hazard of the Quidong soil landscape unit. Identification of erosion hazards during the detailed design phase will enable good planning and land disturbance practices to be implemented in the SWMP.

5.2.5 Expansion or Reactive Soils

Most soils will shrink or swell depending on changes in their moisture content. Soils that shrink significantly are called expansive or reactive soils and may be problematic in structures such as sediment basins and roads (Landcom 2004). The Brothers, Maneroo and Upper Cooma Creek soil landscape units all have moderate to high shrink/ swell characteristics. These characteristics along with low wet bearing strength will be considered in detail in the SWMP prior to development.

5.2.6 Runoff Coefficient

The runoff coefficient relates the ratio of catchment runoff to rainfall in a nominated storm event. It is used to estimate peaks flow running through catch drains and like structures and for sizing sedimentation basins. The runoff coefficient has not been determined in this preliminary assessment and will need to be calculated during the preparation of the SWMP for the study area.

Soil Hydrologic Groups have been developed to characterise soils based on their infiltration and permeability characteristics. Across the study area, soils belonging to Groups B, C and D have been identified; see Table 4 (Soil Hydrological Group). The groups are summarised below:

- Brothers Soil Landscape – Group B (low to moderate runoff potential) and Group D (very high runoff potential);
- Maneroo Soil Landscape – Group C (moderate to high runoff potential) and Group D (very high runoff potential);
- Upper Cooma Creek Landscape – Group C (moderate to high runoff potential); and
- No information regarding the soil hydrological group is available for the Quidong Soil Landscape Unit and this information should be determined by soil analysis.

5.2.7 Soil pH

Soil pH is a measure to describe the acidity or alkalinity of a soil. Field testing of the Brothers, Maneroo and Upper Cooma Creek soil landscapes indicate that soils in the region are generally in the neutral range (pH 6.5-7.5) throughout the profile depth. However, values as acidic as pH 5.5 and as alkaline as 9.5 were observed for some soil profiles.

5.2.8 Watertables

The design of erosion and sediment controls may be influenced by the presence of watertables near the surface, whether seasonal or permanent (Landcom 2004). The Upper Cooma Creek and Maneroo variant soil landscapes are subject to seasonal waterlogging inundation in drainage depressions. The SWMP should consider scheduling in relation to seasonal fluctuations for access road construction and footings in the 'Yanda' cluster and for the access roads across the McLaughlin River.

5.2.9 Salinity

Salt accumulation in soils can have adverse impacts on developments including damage to building foundations, breaking up of road pavements and corrosion of underground pipes and services (Landcom 2004). Generally, the study area's soil landscapes are well drained and not at risk of salt accumulation. The SWMP should assess the lower lying Quidong and Upper Cooma Creek soil landscapes for evidence of salinity.

5.2.10 Acid Sulphate Soils

Acid Sulphate Soils when exposed to air can release sulphuric acid, which is harmful to human and fauna health. Acid Sulphate Soils are typically associated with low lying coastal areas and are not expected to be present within the study area.

5.2.11 Soil Contamination/ Toxicities/ Pollution in Soils

Exposure to contaminated soils presents a health risk to construction personnel, landowners and site visitors. At the time of preparation of this risk analysis no assessment of contaminated soils had been undertaken for the study area. Potentially contaminating activities associated with agricultural activities include sheep dips, import of fill material, demolition of old buildings and stockpiling of wastes.

Landowners have been requested in writing to provide details of known areas of potential land contamination based on current and past activities. Information provided will be reviewed by Wind Prospect to relocate facilities/roads (if need be) and/or to undertake soil investigation where areas cannot be avoided.

5.2.12 Mass Movement

Identifying areas with the potential for mass movement is critical to managing soil and water during construction such that these areas can be avoided or stringent controls put in place. The Brothers and Maneroo Soil Landscapes are known to experience localised mass movement and this should be considered during preparation of the SWMP.

5.2.13 Wind Erosion

Given the frequent high winds in the locality of the proposed wind farm, consideration should be given to the potential for wind erosion of soil and mitigation measures to address this within the SWMP. When exposed the highly pedal, fine textured sediments of the Brothers, Maneroo and Upper Cooma Creek soil landscapes are prone to wind erosion.

5.3 LIMITATIONS

This study was conducted using published soil and geological maps and reports. Prior to construction activities a site specific geotechnical report and SWMP must be conducted.

The Quidong soil landscapes are not described well enough in the available data. A geotechnical report and SWMP will allow further recommendations for construction phase management.

Normal engineering practice of regular inspection and maintenance of operational areas should be carried out in accordance with the SWMP and geotechnical report.

6 Soil and Water Management

6.1 BLUE BOOK PRINCIPLES

This report is not intended to act as a SWMP. The aim of this section is to address the principles of the 'Blue Book' (Landcom 2004), and to undertake an initial assessment of their applicability to the proposed wind farm.

Land disturbance and soil erosion during construction and maintenance activities have the potential to displace soil, which can be deposited onto nearby land and downstream waterways. Of particular concern are fine, dispersible sediments that can carry other pollutants, which will not settle until they reach saline waters, and which can result in poor water quality.

This section should be read in conjunction with the riparian impact assessment section of the Environmental Assessment for the proposed wind farm, as this section proposes mitigation measures to protect riparian areas of the study area.

6.2 SOIL AND WATER MANAGEMENT PRINCIPLES

The following principles generally provide effective soil and water management during land disturbance:

- Adequate investigation of where soil disturbance is likely to expose and/ or exacerbate pre-existing problems;
- Plan for erosion and sediment control concurrently with engineering design and before earthworks begin and integration of other landscape components (eg: riparian, ecological);
- Minimise the area of soil disturbed and exposed to erosion;
- Conserve topsoil for later site rehabilitation/ revegetation;
- Control water flow from the top of, and through the study area;
- Rehabilitate disturbed lands quickly; and
- Maintain soil and water management measures appropriately during the construction phase.

These principles will need to be adopted in the SWMP and implemented in detailed design phase of footings, trenching and access roads prior to pre-construction activities.

6.3 MITIGATION MEASURES

The SWMP (informed by more detailed geotechnical investigations) will outline management actions for the study area. Design, construction and maintenance will be carried out in accordance recognised guidelines and standards, including:

- *Guidelines for planning, construction and maintenance of tracks* (NSW Department of Land and Water Conservation 1994); and
- *Managing Urban Stormwater: Soils and Construction, 4th Edition* (Landcom 2004).

The development does not propose upgrades to state roads and as such the application of RTA road design rules was not considered relevant within this soil impact assessment.

6.3.1 General Soil and Water Management

The full suite of erosion controls (e.g. catch drains upslope of earthworks, barrier fencing of 'no disturbance' areas) and sediment controls (e.g. sediment basins, sediment fences, stockpile stabilisation, stabilised access) will be determined during preparation of the SWMP. The controls for the construction and maintenance of the development will be conducted in accordance with the 'Blue Book' (Landcom 2004).

As mentioned previously some 'Type D' soils have been identified within the soil landscape units on site. These soils are dispersive and can only be settled with the aid of flocculation, e.g. treatment with a wet sedimentation basin and flocculating agent. The SWMP will need to address mitigation of pollution of suspended solids through reduction of soil erosion and minimisation of sediment pollution using:

- Drainage systems designed to minimise both the quantity of flow and its velocity, especially on unprotected land surfaces; and
- System controls that reduce the quantity of suspended solids reaching receiving waters (Landcom 2004).

In situations where perennial weed grasses are more persistent, the focus will be on over planting with vigorous native tussock grasses such as *Themeda australis* and *Poa labillardieri* to out compete and replace it.

6.3.2 Access Tracks and Trenching

In accordance with the *Guidelines for planning, construction and maintenance of tracks* (NSW Department of Land and Water Conservation 1994) the following will be incorporated into the SWMP:

- **Location** – site tracks to reduce the risk of sediment entering drainage lines, maintain effective vegetative buffers and kept above flood levels;
- **Grades** – tracks will have a slight grade to allow free surface drainage and to avoid ponding in wheel tracks;
- **Surfacing** – in areas of steep terrain and dispersible soils bitumen or gravel surfacing may be required;
- **Surface Drainage** – runoff will be prevented from concentrating and reaching erosive speeds;
- **Crossfall Drainage and Outlets** – outfall and/or infall drainage will be used for cross bank construction will and located such that flow is not directed back onto the track;
- **Earthworks** – disturbance of soil and vegetation will be minimised as much as possible, both on and adjacent to tracks and will follow land contours to minimise the amount of cut and fill;
- **Drainage Line Crossing** – drainage lines will be crossed with culverts and will not obstruct flows or create turbulent flows that will cause erosion;
- **Revegetation** – revegetation will be undertaken immediately following works and use locally native species as a base mix to stabilise soils to prevent erosion. In circumstances where 'Type D' soils are present and ecological values are low, a cover crop may be applied utilising sterile seed sources such as Chewing Fescue; and
- **Maintenance** – inspection of all tracks regularly and following heavy traffic use or heavy rainfall will be undertaken as part of both the Construction and Operational Environmental Management Plans.

6.3.3 Footings

Detailed geotechnical investigations will be required to ascertain the type and extent of footings, however soil management to avoid erosion and sedimentation will adhere to the standards of the SWMP.

6.4 SUMMARY OF CONSTRAINTS AND RECOMMENDATIONS

The disturbance area of the study area will be more than 2,500m^2 and hence a SWMP should be prepared by a suitably experienced consultant prior to any construction activities in order to adequately address the extent of disturbance and variability in soil landscapes and slopes on site. The SWMP should be prepared to meet the requirements of the 'Blue Book'.

The above preliminary constraints assessment identified additional data is required for the development of the SWMP. This includes information requirements for the Soil Landscape Unit – Quidong, where limited information is available and for which soil analysis will be required, i.e. soil erodibility, particle size, dispersion percentages. In addition, slope gradients and runoff coefficients for the study area will need to be characterised to determine appropriate sediment and erosion controls.

Some areas of construction will occur within waterfront riparian land and approval will be required by DWE for controlled activities. Flooding is unlikely to occur on ridgelines, however flood events should be considered for road upgrade activities and crossing construction. The Rainfall Erosivity across the study area is relatively low and Soil Erodibility is moderate. The steep slopes within the Brothers Soil Landscape mean that more stringent erosion and sediment controls will be required to control the high erosion potential of these areas. Some of the Soil Landscape Units identified on site potentially contain dispersive soils, of which contaminated runoff can only be effectively treated by flocculation of the sediments. The soils on site are subject to shrink and swell and this needs to be considered in determining suitable controls. Runoff from the study area varies from low to very high potential and should be addressed by site-specific controls. Works within the Upper Cooma Creek Soil Landscape Unit will need to consider the potentially high water table. There are currently no known areas of soil contamination proposed to be disturbed by construction activities. A Construction Environmental Management Plan (CEMP) will be prepared to address actions required where suspected contaminated soils are identified during earthworks and this should be referred to in the SWMP.

Table 6 summaries the process for ensuring compliance with the DGRs and relevant regulatory controls.

Table 6: Summary of mitigation measures

MITIGATION ACTION	DESIGN PHASE	PRE-CONSTRUCTION	CONSTRUCTION	OPERATION
Detailed geotechnical investigation	✓			
Develop SWMP as part of CEMP and OEMP (prior to any earthworks)	✓			
Implementation of SWMP	✓	✓	✓	✓
Design and maintain tracks in accordance with appropriate standards (e.g. DLWC, Landcom)	✓		✓	✓
Minimise exposed ground and implement appropriate sediment and erosion controls			✓	✓
Manage traffic to minimise erosion and dust potential			✓	✓
Maintain tracks to prevent erosion and sediment loss			✓	✓
Regular inspection of disturbed ground to ensure efficacy of erosion and sediment controls			✓	✓

7 References

DECC unpublished data – personal communication with members of DECC soil survey unit.

NSW Department of Land and Water Conservation (1994) *Guidelines for planning, construction and maintenance of tracks.*

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