CASINO MANAGEMENT AREA EIS AND
MURWILLUMBAH MANAGEMENT AREA EIS
SUPPORTING DOCUMENT No. 8

SOILS REPORT
CASINO AND MURWILLUMBAH MANAGEMENT AREAS
NORTHERN REGION
STATE FORESTS OF NEW SOUTH WALES

by

VENESS & ASSOCIATES

1994

STATE
FORESTS
NORTHERN REGION

SOILS REPORT
CASINO AND MURWILLUMBAH MANAGEMENT AREAS
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for
State Forests of New South Wales

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PREFACE & DISCLAIMER

Much of the work described in this report was undertaken during 1992 and the resulting report was presented to Margules and the then Forestry Commission in August 1992. At that time, the Standard Erosion Mitigation Conditions (SEMC) were in force.

Following the Department of Conservation and Land Management (CaLM) submission on the Wingham Management Area EIS in November 1992, and the release of the Standard Erosion Mitigation Guidelines for Logging (SEMGL) in March 1993 (which replaced the SEMC), additional work was undertaken for this Casino / Murwillumbah soils study. This included: the determination of soil erodibility classification, as defined in Appendix 1 (ii) of the SEMGL; determination of subsoil organic matter at each of the 33 sampling sites; superimposition of erosivity on the soil mapping unit map; and determination of erosion hazard classes as defined in Appendix 2 (ii) of the SEMGL. In this final draft, soil erodibility has also been determined by the SOILOSS K factor sub-routine and some further refinements have been made to the erosion hazard assessment section.

Veness & Associates has certain professional concerns with the application of USLE technology to forest lands. As the directors of Veness & Associates, it is the authors' professional opinion that it is inappropriate to apply USLE technology to the broad scale land assessment at which a forestry EIS is performed. Veness & Associates is further concerned about the use of the USLE factor values which may be wholly inappropriate for forest soils. Despite these reservations, the USLE technology has been applied, following the methodology outlined by the Department of Conservation and Land Management, and erosion hazard classes have been derived. This has been done so at the request of our client, State Forests of New South Wales, and should in no way be taken as professional endorsement of this methodology by Veness & Associates.

Consequently, Veness & Associates accepts no responsibility for the reliability or accuracy of erodibility and erosion hazard assessments derived from the CaLM technology. Veness & Associates reserves the right to present, in the appropriate forum, technically based criticism of the current method of applying USLE technology to forest lands.

SOILS REPORT

CASINO / MURWILLUMBAH FORESTRY MANAGEMENT AREA

EIS STUDY

1.0 INTRODUCTION

At the request of Margules Groome Poyry Pty Limited, who is compiling Environmental Impact Statements for the New South Wales Forestry Commission's Grafton Management Area and Casino / Murwillumbah Management Area, Veness & Associates Pty Limited was contracted to survey the soils.

This report records the findings of the Casino / Murwillumbah survey, with occasional reference to the Grafton study, where appropriate.

1.1 BRIEF AND LIMITS OF THIS STUDY

The State forests and relevant crown timber areas within the Casino / Murwillumbah Management Area (hereafter referred to as the study area) consist of approximately 158,500 hectares.

The brief set for this study was to examine the soils of the study area, based on geological groupings, and to determine their susceptibility to erosion as a consequence of the proposed forestry activity being addressed in the EIS document.

1.2 TIMING OF THIS STUDY

The fieldwork for this Casino / Murwillumbah study was undertaken by Veness & Associates over a total of 353 man hours during the period from January 1992 to June 1992. Variable weather conditions were experienced in the study area during this period.

1.3 METHODOLOGY

1.3.1 General Procedure

The general methodology procedure used to undertake this study is as follows:

- the geology of the whole study area was examined from available published sources
- aerial photograph interpretation was used to examine and check the geological boundaries

- preliminary grouping of rock types was undertaken, in terms of the different soils that are likely to develop on them (for example, soils occurring on the basalts are likely to be different from soils occurring on the granitoids). Refer to Table 1 in Section 2 which illustrates this grouping

- the resulting geological boundaries were pencilled in on a 1:125 000 field map

- fieldwork was undertaken. This comprised:

    - geological boundaries were field checked, modified where appropriate, and inked on to the field map

    - copies of the appropriate 1:25 000 topographic maps were used to locate soil description sites. Due attention was given to ensuring that, as far as practicable, each of the terrain components occurring within each soil unit was subjected to soil sampling and / or description. The location of each site was located on the 1:25 000 maps

    - soils occurring on each rock type within each geological group were examined and fully described. This step served as a check to ensure that soils described within rock types were indeed similar enough to group together. This also explains the variation and range of soil description site numbering. Each new soil site was given a leading two digit number to identify its group, followed by a trailing two digit number to identify its location. If a new soil was similar to one already described, the new soil inherited the former's leading two digit number

    - soil samples were collected at sites selected on their ability to be representative of the unit in which they occurred. These samples were analysed for key chemical and physical properties

- soil boundaries were then drawn up, based on the geological groupings and the similarities and/or differences of soil characteristics

- all of the data generated at each site within each soil mapping unit was collated. This forms the basis of the soil field descriptions in Section 3

- based on the assembled soil data, assessment of erosion hazard was performed

1.3.2 Methodology Detail

Aerial photograph interpretation was undertaken over most of the study area using photographs supplied by the then Forestry Commission of NSW to gain an impression of the geology and topography.

The geology of the study area was examined using existing available sources. Refinement of this geological data (and especially boundaries) presented in these sources was undertaken through aerial photograph interpretation and field checking.

The study area's soils were surveyed to determine the location and characteristics of the various soil mapping units.

The soils of the study area were mapped at a scale of 1:125 000, using the relevant Forestry Commission 1:125 000 State Forest sheets as base maps. Field mapping was undertaken using the relevant CMA 1:25 000 topographic map sheets.

Soils at 128 sites were described in the field. Of these, 33 sites were also sampled for laboratory analysis. At each site, a soil pit was dug or an existing road batter was excavated back to an unweathered face. Examination through soil augering was not used due to the inadequacy of this method in determining soil layer boundaries, soil consistence characteristics and soil structure.

At each of these sites, soils were fully described following detailed field examination. The characteristics examined were:

- surface condition - horizon depth and colour
- boundary distinctness and shape - presence of watertable
- texture grade and sand fraction - plasticity type and stickiness
- consistence and coherence - structure grade
- primary ped size and shape - secondary size and shape
- fabric - presence of cutans
- ped porosity - crack size
- stone amount, shape, distribution, size, weathering and lithology
- amount and distribution of roots - amount of bioturbation (faunal mixing)
- presence of pans - presence, form, amount and size of inclusions

Apart from these 128 description sites, numerous other observations were made to ensure consistency within soil mapping units.

The location of all description sites was dependent on the degree of access afforded by the existing road network and the prevailing weather conditions. Within these parameters, description site locations were chosen to cover the range of terrain units occurring within each soil mapping unit and to give a representative coverage throughout the whole study area. The exception to this approach relates to the three description sites which were located within the soil unit developed on granitoid material. This was not a factor of the size of this very small unit, rather it reflects the general perception that granitic soils must be erodible. However, this is not necessarily the case as is demonstrated by the results of the testing of the soils, as presented in Section 3 later in this report. (Access into some parts of Billilimbra, Ewingar and Washpool State Forests was limited due to both a lack of existing roading and the weather conditions current at that time.) The landform elements described by McDonald et al. (1990) were used to identify the various terrain components.

The relevant soils information from each description site was recorded on soil data cards. For the sake of convenience, only the cards for each of the 33 sampling sites are included in this report. They are found at Appendix 1. The remaining cards have been lodged with State Forests.

The principal profile form (Northcote, 1979) and Great Soil Group (Stace et al. 1968) were determined for each soil (where applicable).

Soil pH was determined in the field using Raupach solution. Soil colours were determined using Oyama & Takehara (1970) colour charts. In the soil descriptions, all colours refer to the moist soil unless indicated otherwise.

Soil samples were collected from each layer within each soil at each of the 33 sampling sites, generating a total of 122 samples for physical analyses. The laboratory tests undertaken were Particle Size Analysis, Dispersion Percentage and Emerson Aggregate Test. The testing methods used were those recommended and used by the Soil Conservation Service of NSW (now known as the Department of Conservation and Land Management - Soil Conservation Section). Erosion hazard classes are given for each soil mapping unit.

The 128 soil description site locations are shown on Figures 1a and 1b in Appendix 5.

Any erosion observed to be occurring within the study area was to be noted. This observation took place during both the aerial photograph interpretation program (which primarily looked at geological boundaries and terrain) and during the extensive fieldwork program.

No reference to mass wasting occurs in this report due to the absence of any significant examples being recorded. Obviously, some minor slumping of road batters can occur but these examples are not significant enough to warrant a further mention.

Soil erosion hazard assessment was performed using three different approaches which are presented in Section 4. The first was that carried out by the authors prior to the development and release of the SEMGL. This involved interpretation of laboratory and profile data to determine general erodibility characteristics of each soil mapping unit. Combined with field observations of existing erosion, this data was used to present an assessment of erosion hazard for each soil mapping unit. This assessment did not address variations of slope, rainfall or vegetation within soil mapping units as it was intended to be a broad planning scale assessment. Variation in these factors would have been addressed, and appropriate modifications to the erosion hazard made, at the harvest planning stage.

The second erosion hazard assessment was performed using methods set out in Appendix 1 and Appendix 2 of the SEMGL. This assessment allowed for variations in slope, rainfall erosivity and soil erodibility. The third method was similar in approach to the second but relied solely on output generated by the computer program SOILOSS (Rosewell & Edwards, 1988). Further details of the methodology are provided in Section 4.

An assessment of the effectiveness and applicability of the SEMGL procedures for erosion and sediment control was made, based partly on the observed erosion but mostly on the interpretation of field and laboratory soils data.

1.3.3 Comments on the Methodology

In reviewing the earlier draft of this report, the Department of Conservation and Land Management (CaLM) were critical of the fact that the study did not adopt a soil landscape approach to soil mapping. However, soil landscape mapping would entail a degree of survey intensiveness that is not, in the opinion of the authors, appropriate to areas managed for forestry. Atkinson (1992) stated the CaLM program of soil landscape mapping was being performed at scales of 1:250 000 and 1:100 000 with the latter being for areas of greatest land development pressure with the intended objectives to delineate areas with limitations or potential soil related hazards to urban and rural development (Atkinson, 1992; Chapman & Murphy, 1989). Forestry is a much less intensive form of management than even rural development and consequently a relatively broad scale of mapping is considered appropriate. In the authors' opinion, the soil characteristics which are of relevance to forestry management (erodibility, nutrient supply, roading suitability, etc) meaningfully vary at only a relatively coarse scale which is closely related to parent material. As some rock types are quite similar in this respect, it was meaningful to combine them in to geological groupings to define soil mapping units. The more detailed variations within these mapping units which might be delineated by soil landscape mapping are not believed to be of major importance to this broad scale of land resource assessment for forestry purposes.

The authors therefore stand by their professional judgement in not applying a full soil landscape study approach.

2.0 GEOLOGY

While this study was not a geological examination of the study area per se, the geological boundary information gained from geological maps, aerial photograph interpretation and field observations has been included because of both the influence that the underlying lithospheric material exerts on the development of soils in the area, and the fact that the study area's soils were examined from a geological point of view.

The geological units of the study area were taken from the 1:500 000 New England geological sheet, and the 1:250 000 Grafton, Maclean, Tweed Heads and Warwick geological sheets. As per all of the NSW 1:250 000 geological maps, the codes, boundaries and units shown on the edge of one sheet often do not agree with those on an adjoining sheet. Thus, geological boundaries were field checked, where roading access allowed, and mapping modifications made where appropriate. Twenty eight different rock types have been delineated within the study area and are presented in Figures 2a and 2b in Appendix 5. The rock type names used are those listed on the various geological sheets.

2.1 SEQUENCE OF GEOLOGICAL EVENTS

The following description gives a general idea of the sequence of geological events which led to the present distribution of rock types in the Casino / Murwillumbah area.

In the Ordovician-Silurian Period 430-500 million years ago (m.y.a.), a vast area of largely fine-grained sediments with some volcanics were deposited. These sediments have since been metamorphosed and all contain abundant quartz veins. They presently occur in Washpool and Ewingar State Forests (SFs). The next geological event occurred during the Silurian Period 395-430 m.y.a. when clay-rich sediments were deposited in the area now occupied by Mooball, Burringbar and Nullum SFs, near Murwillumbah. They have since been metamorphosed.

No further rocks were introduced to the study area before the Permian Period, 225-280 m.y.a. In the Lower Permian the Drake Volcanics erupted onto an area through the present Washpool, Billilimbra and Ewingar SFs. Also the Dumbudgery Creek Granodiorite intruded the oldest sediments (θ-S) and probably contributed to their metamorphism. This granodiorite now outcrops in a small part of Ewingar S.F. In the Middle Permian the Bungulla Porphyritic Adamellite intruded the same old sediments. This latter pluton was itself isolated by a further intrusion of the Stanthorpe Adamellite in the Upper Permian. Both now outcrop in the Billilimbra and Ewingar SFs.

In the Triassic Period, 190-225 m.y.a., the Chillingham Volcanics of rhyolite, rhyolitic tuff and claystone were deposited in the Nullum SF area. Also, the first sediments of the Clarence-Moreton Basin were deposited. This basin is oriented north-south and displays similar rock outcrops towards both western and eastern outer edges. Those sediments outcropping within the study area belong to the Marburg Formation, and consist of sequences of sandstone, siltstone and claystone, with some conglomerate. Examples occur in Sugarloaf, Keybarbin and part Mount Marsh S.Fs along the western boundary, and in the far east of Tabbimoble S.F.along the eastern boundary of the basin. Overlying these sediments are the medium to fine-grained sedimentary deposits of the Walloon (and Mallanganee) Coal Measures. They now extend down the western side of the basin from the Richmond Range S.F. in the north-west, through Cherry Tree, Mount Pikapene and Mount Belmore S.Fs to Mount Marsh S.F. in the south. They reappear along the eastern side of the basin and pass, from north to south, through Wollumbin, Mebbin, Tabbimoble, Devils Pulpit and Mororo S.Fs.

These sediments were overlain by the two youngest formations which occur in this southern part of the Clarence-Moreton Basin. Firstly, in the Upper Jurassic Period about 150 m.y.a., quartz sandstones and feldspathic quartz sandstones were deposited as the Kangaroo Creek Sandstone. They dominate in the more central areas of the basin, in Mount Belmore, Mount Marsh and Doubleduke S.Fs., and also appear in lesser amounts in Fullers, Banyabba, Gibberagee, Bungwalbin, Tabbimoble and Devils Pulpit S.Fs. Also, the Woodenbong Beds were deposited north of a facies boundary between this and the Kangaroo Creek Sandstone. Outcrops occur in the NW corner of Richmond Range S.F. and in part of Eden Creek S.F. Lastly, in the Cretaceous Period 65-136 m.y.a., lithic sandstone, siltstone, claystone and minor coal sequences were deposited and are collectively called the Grafton Formation. These rocks occupy the middle part, or geologically youngest part, of the basin. They outcrop in the following state forests: Royal Camp, Fullers, Camira, Carwong, Braemar, Ellangowan, Myrtle, Whiporie, Banyabba, Gibberagee and Bungawalbin.

65 million years ago, in the Tertiary Period, an active period of volcanism occurred. The areas of interest to this study are all north of Casino. A Mount Warning complex of trachytes and basalts in Wollumbin S.F. represents the stump of an enormous central volcano whose lavas are found in the nearby McPherson Range and Lamington Plateau. The Lamington Volcanics are largely basalts and rhyolites and extend as far west as the Richmond Range S.F. This includes the Lismore Basalt of Boorabee, Bungabee, Mebbin, Nullum, Whian Whian and Goonengerry S.Fs, the Blue Knob Basalt and the Nimbin Rhyolite of Nullum, Whian Whian and Goonengerry S.Fs. A trachyte plug (Mount Belmore S.F.) and numerous, tiny remnants of basaltic flows also occur throughout the general area (two minor occurrences within part Gibberagee, Mount Belmore and Mount Marsh S.Fs).

Most recently extensive areas of Quaternary alluvial sediments occur within the Clarence-Moreton Basin, especially around the township of Whiporie. The State forests in which the major encroachments have occurred are: Braemar, Bungwalbin, Whiporie, Gibberagee, Tabbimoble, Doubleduke and Mororo.

The 28 rock types occurring in the study area which have been discussed above, are listed below in Table 1. From them, the nine different geological groups listed below have been determined, in terms of the soils developed on them.

- Alluvials
- Metasediments
- Grafton Formation sediments
- Walloon Coal Measures
- Eruptive volcanics
- Basalts
- Granites
- Kangaroo Creek Sandstone
- Marburg Sediments

The relationship between the 28 rock types and the nine geological groups is also shown in Table 1 as follows:

Table 1: Relationship between rock types and geological units in the study area

ROCK TYPE		GEOLOGICAL GROUP	
Map Code	Name	Description	Soil Map Map Code
Qa	unnamed sediments (Quaternary)	alluvial mud, silt, sand, gravel deposits	A
Twc	part Mt Warning Central Complex	trachyte	B
Twb	part Mt Warning Central Complex	basalt	B
Tmb	part Lamington Volcanics	basalt	B
Tml	part Lamington Volcanics	basalt, minor tuff & agglomerate	B
Tll	part Lamington Volcanics	basalt	B
Tlb	Lismore Basalt (pt Lamington Volcanics)	basalt (agglomerate, bole)	B
Tp	unnamed Tertiary volcanics	trachyte plugs	B
Tv	unnamed Tertiary extrusive volcanics	basalts & dolerites	B
θ-S	Ordovician - Silurian sediments	argillites, phyllites, slates & intermediate volcanics all with abundant quartz veins	C
Pzn	Neranleigh - Fernvale "Group"	greywacke, slate, phyllite, quartz	C
Pgdw	Dumbudgery Creek Granodiorite	granodiorite	D
Pab	Bungulla Porphyritic Adamellite	very coarsely porphyritic in feldspar, sphene-rich adamellite	D
Pas	Stanthorpe Adamellite	Biotite adamellite	D
Kg	Grafton Formation	lithic sandstone, siltstone, claystone & minor coal	E
Js	Woodenbong Beds	medium feldspathic to feldspathic sublabile sandstone, siltstone	F
Jk	Kangaroo Creek Sandstone	quartz sandstone & feldspathic quartz sandstone, often iron-rich	F
Jw	Walloon Coal Measures	sandstone, siltstone, shale and coal	G
Jws	Mallanganee Coal Measures	massive feldspathic quartz sandstone facies	G
RJb	Bundamba Group Marburg Formation	sandstone, shale, conglomerate	H
Jlm	Marburg Sandstone (part Bundamba Group) "	feldspathic sandstone, pebbly in part	H
RJm	Marburg Formation "	sandstone, siltstone with some coal. Silicified fossil wood as base equivalent to Blaxland Fossil Wood Conglomerate Member	H
Jmr	Koukandowie Sandstone "	sandstone and siltstone, with Blaxland Fossil Wood Conglomerate Member at base	H
Plv	Drake Volcanics	acid to intermediate eruptives with minor interbedded sediments	I
Pld	part Drake Volcanics	acid to intermediate eruptives with minor interbedded sediments	I
Rc	Chillingham Volcanics	rhyolite, rhyolitic tuff, claystone	I
Tnr	Nimbin Rhyolite (pt Lamington Volcanics)	rhyolite, obsidian, pitchstone, tuff, agglomerate	I
Tnb	Blue Knob Basalt	basalt and andesite	I

3.0 SOILS

The various soil mapping units recorded in the study area are described below, followed by a discussion on the differences between each unit. The results of the laboratory analyses are presented and discussed.

The erosion hazard associated with these soils will be discussed later in Section 4.

3.1 SOIL MAPPING UNITS

On the basis of the information presented in Section 2 above, the study area is divided into nine main geological groups. The soils occurring throughout the study area were examined within each of these geological groups resulting in the recording of nine different soil units. (The soils occurring on each of the nine geological provinces are similar enough to group into a common soil unit, thus resulting in nine separate soil mapping units). The location of these soil mapping units is shown in Figures 1a and 1b in Appendix 5. These soil mapping units are as follows:

Map Code	Soil Unit
A	- Soil Mapping Unit A - soils developed on alluvials
B	- Soil Mapping Unit B - soils developed on basalts
C	- Soil Mapping Unit C - soils developed on metasediments
D	- Soil Mapping Unit D - soils developed on granitoids
E	- Soil Mapping Unit E - soils developed on Grafton Formation
F	- Soil Mapping Unit F - soils developed on Kangaroo Creek Sandstones
G	- Soil Mapping Unit G - soils developed on Walloon Coal Measures
H	- Soil Mapping Unit H - soils developed on Marburg Sediments
I	- Soil Mapping Unit I - soils developed on volcanics

Each of these soil units is described below. Each soil unit description is an amalgamation of all the data recorded within each unit at each of the relevant 128 description sites. The number of sites described for each soil mapping unit is set out in Table 2 below.

Within each soil mapping unit the number of sites in each of six existing terrain components is recorded in Table 3. Further detail in respect of the terrain situations of each soil description site is included later in section 3.2.

TABLE 2: Number of soil description sites within each soil mapping unit

Soil Mapping Unit	No. of sampled description sites	No. of other description sites	Total No. of description sites
A	2	8	10
B	6	9	15
C	2	4	6
D	3	3	6
E	3	21	24
F	2	19	21
G	6	15	21
H	4	4	8
I	5	12	17
TOTAL	33	95	128

TABLE 3: Location of soil description sites in terms of terrain components, for each Soil Mapping Unit

	Soil Mapping Unit									
Terrain Component	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**Total**
Crest					5			1	1	7
Ridgeline		1	1		2	3	5	2	5	19
Upper slope		7	3	4	6	8	8	2	8	45
Midslope	3	4		1	7	5	3	1	2	25
Lower slope		3	2	1	2	4	5	2	1	17
Flat	7				2	1				10
Total No. sites	**10**	**15**	**6**	**6**	**24**	**21**	**21**	**8**	**17**	**128**

It should be noted that not all soil layers described for each soil mapping unit are necessarily present at all sites. This variation in soil layering highlights the need to examine a number of soil sites within each unit before an understanding of that unit can be gained. The occurrence of each layer at the various sampled description sites can be gauged by examining each unit's soil data cards presented in Appendix 1.

The description of each soil unit is given as a summary which precedes a more detailed version. The detailed soil description lists the appearance and behaviour of each soil examined during the fieldwork. The parameters used in this description are mostly self-explanatory except for the following:

- bioturbation which refers to the mixing of soil particles by the soil fauna, chiefly ants and worms. The degree to which this occurs gives a good indication of the biological activity within that soil which in turn reflects favourable soil physical and chemical properties

- coherence which refers to the structure grade of the soil. The higher the grade the more pedal the soil

- consistence is divided into two parts which are separated by a slash within the descriptions. These two parts describe the amount of finger and thumb force which is required to disrupt peds and the behaviour of that disrupted soil when sheared between the palms of the hands. Together they reflect the soils ped strength, the amount of clay present and, where applicable, the effects of soil moisture in working the soil

- colour is recorded in the layer descriptions as moist unless otherwise indicated

For a definition of these and other technical terms used in this report, refer to McDonald et al (1990) and/or Houghton & Charman (1986).

3.2 SOIL FIELD DESCRIPTIONS

Each of the soil mapping units is described below. The summary at the beginning of each description is a non-technical, "plain English" version, keeping in mind the general EIS readership. This is followed by a more detailed and technical version. The use of the term "soil materials" is not used in the specific soil landscape context - rather, it is consistent with common usage as are the terms "parent materials", "lithospheric materials", etc.

3.2.1 Soil Mapping Unit A - (soils developed on alluvials)

3.2.1.1 Summary

These soils encroach into forest areas along boundaries and up creek lines. They tend to be well-developed clayey soils which reflect the surrounding sedimentary hillslope soils.

In general they consist of a brownish black, pedal, silty clay loam to silty clay topsoil over a bleached, dull brown, weakly to moderately pedal, sandy clay loam or fine sandy clay loam lower topsoil layer, over a brownish black, greyish brown or dull yellow orange, acid, pedal, light to light medium clay master colour subsoil layer. At depth these layers may be underlain by other, genetically different alluvial clay layers.

Ten sites were described within this unit. Of these, seven were located on an alluvial flat situation, with slopes up to 2% but commonly less than 1%. The remaining three sites were located in a midslope or midslope to lower slope situation.

3.2.1.2 Dominant soil materials

Northcote Codings:	Uf 6.23, Uf 6.33, Gn 2.94, Gn 3.04, Gn 3.11, Gn 3.41, Gn 3.74; Dy 4.11, Dy 5.31, Dy 5.41
Great Soil Groups:	Structured plastic clays, Yellow podzolic soils
Surface Condition:	friable with up to 10% surface stone (ironstone), 2 – 6mm in size

3.2.1.3 Description

Layer 1 (slightly moist to wet)

Diagnostic features:	brownish black to greyish brown, moderately pedal silty clay loam to silty light clay
Occurrence:	always present as an A or A11 horizon or topsoil layer, 3 – 25cm thick
Colour:	brownish black (7.5YR 3/2, 10YR 2/3, 3/1) to greyish brown (7.5YR 4/2)
pH:	strongly to slightly acid (pH 4.5 – 6.0)
Texture:	silty clay loam or silty light clay; also fine sandy clay loam, sandy clay loam, loam, fine sandy, light sandy clay loam or sandy loam, all normal plastic
Stickiness:	usually slight, but sometimes moderate
Structure:	weakly to strongly pedal with sub-angular blocky peds 20 – 100mm breaking to crumb and sub-angular blocky peds 5 – 10mm diameter, and earthy or rough-faced porous ped fabric
Coherence:	weak to moderate
Stone content:	0 – <2% of rounded pebbles up to 6mm in size may be present
Roots:	usually abundant
Faunal mixing:	abundant
Inclusions:	charcoal fragments may occur

Boundary:	sharp or clear and even or wavy to layers 2, 3, 4, or 5

Layer 2 (slightly moist to wet)

Diagnostic features:	brownish black or dark brown, moderately pedal light sandy clay loam or silty light clay
Occurrence:	uncommonly present as an A12 horizon or lower topsoil layer, 5 - 12cm thick
Colour:	brownish black (7.5YR 3/2) or dark brown (10YR 3/3)
pH:	moderately acid (pH 5.0)
Texture:	light sandy clay loam or silty light clay, normal plastic
Stickiness:	slight to moderate
Structure:	moderately pedal with sub-angular blocky peds 50 - 200mm breaking to 5 - 20mm, and rough-faced porous ped fabric
Coherence:	weak
Stone content:	none present
Roots:	many
Faunal mixing:	abundant
Inclusions:	none observed
Boundary:	clear and wavy to layers 3 or 5

Layer 3 (moderately moist to wet)

Diagnostic features:	dull brown, usually bleached, weakly to moderately pedal sandy clay loam or fine sandy clay loam
Occurrence:	commonly present as an A2 horizon or lower topsoil layer, 7 - 25cm thick
Colour:	dull brown (7.5YR 5/3(m), 6/3(d); 7.5YR 6/3(m), 8/1(d)), but ranges from brown (10YR 4/4(m), 6/4(d)) to dull yellowish brown (10YR 5/3(m), 7/3(d)) and greyish yellow brown (10YR 5/2(m), 7/2(d))
pH:	strongly to slightly acid (pH 4.5 - 6.0)
Texture:	sandy clay loam or fine sandy clay loam and rarely clayey sand, all normal plastic

Stickiness:	slight to moderate
Structure:	weakly to moderately pedal with sub-angular blocky peds 20 - 100mm breaking to 5 - 20mm and earthy or rough-faced porous ped fabric
Coherence:	weak to moderate
Stone content:	<2 - 20% rounded to sub-angular ironstone fragments up to 20mm in size occur
Roots:	common to many
Faunal mixing:	usually abundant
Inclusions:	charcoal fragments may occur
Boundary:	sharp to gradual and even or wavy to layer 5

Layer 4 (slightly moist to wet)

Diagnostic features:	dull brown, pedal light clay
Occurrence:	sometimes present immediately underlying Layer 1, as a B1 horizon or upper subsoil layer, 11 - 22cm thick
Colour:	dull brown (7.5YR 5/3) or greyish brown (7.5YR 4/2)
pH:	strongly acid (pH 4.0)
Texture:	light clay, normal plastic
Stickiness:	slight
Structure:	moderately to strongly pedal with sub-angular blocky peds 20 - 200mm breaking to angular blocky and sub-angular blocky peds 2 - 10mm diameter, and smooth-faced dense or rough-faced porous ped fabric
Coherence:	moderate to strong
Stone content:	none observed
Roots:	common
Faunal mixing:	many infilled faunal burrows occur
Inclusions:	charcoal fragments or soft iron nodules may occur

Boundary:	sharp to gradual and even to layer 5

Layer 5 (moderately moist to wet)

Diagnostic features:	brownish black or greyish brown, pedal light clay
Occurrence:	always present as a B2 or B21 horizon, or master colour subsoil layer, 15 – 38+cm thick
Colour:	brownish black (5YR 3/1, 10YR 3/2), greyish brown (7.5YR 4/2, 5/2) or dull yellow orange (10YR 6/3, 7/4)
pH:	strongly to slightly acid (pH 4.0 – 6.0)
Texture:	usually light to light medium clays, all normal plastic
Stickiness:	slight to moderate
Structure:	moderately to strongly pedal with angular blocky and sub–angular blocky peds 20 – 200mm breaking to <2 – 10mm diameter, and smooth–faced dense ped fabric
Coherence:	moderate to strong
Stone content:	usually none are present; rarely 50 – 90% rounded and sub–rounded ironstone fragments occur up to 60mm in size
Roots:	few to common
Faunal mixing:	few to abundant
Inclusions:	none observed
Boundary:	clear and even to layers 6 or 7

Layer 6 (moderately moist)

Diagnostic features:	greyish brown, strongly pedal light medium clay
Occurrence:	rarely present as a B22 horizon or lower subsoil layer, 27+cm thick
Colour:	greyish brown (7.5YR 4/2)
pH:	strongly acid (pH 4.5)
Texture:	light medium clay, normal plastic
Stickiness:	moderate

Structure: strongly pedal with angular blocky peds 50 - 100mm breaking to <2mm, and smooth-faced porous ped fabric

Coherence: strong

Stone content: no stones

Roots: few

Faunal mixing: few

Inclusions: none observed

Boundary: not reached at depth

Layer 7 (moderately moist)

Diagnostic features: black, strongly pedal light clay

Occurrence: rarely present as a D1 horizon or different genetic layer, 27+cm thick

Colour: black (5YR 1.71)

pH: moderately acid (pH 5.0)

Texture: light clay, normal plastic

Stickiness: slight

Structure: strongly pedal with sub-angular blocky peds 100 - 200mm breaking to angular blocky peds 2 - 5mm diameter, and smooth-faced dense ped fabric

Coherence: not recorded

Stone content: no stones are present

Roots: few

Faunal mixing: rare

Inclusions: none observed

Boundary: not reached at depth

3.2.2 Soil Mapping Unit B – (soils developed on basalts)

3.2.2.1 Summary

These soils are most common in the Richmond Range and Eden Creek State Forests. They also occur throughout Bungabbee and Boorabee State Forests, and in the western half of Mebbin State Forest.

They are generally described as having a topsoil layer over two subsoil layers. Other layers are uncommon to rare and, therefore, will not be mentioned here. In summary then, a brownish black, moderately acid to slightly alkaline, strongly pedal, moderately coherent, strongly bioturbated clay loam or silty clay loam topsoil layer is underlain by a dark reddish brown, neutral to strongly acid, strongly pedal, stony, coherent, moderately to strongly bioturbated light clay, light medium clay, medium clay or heavy clay master colour subsoil layer sometimes over a dark reddish brown, neutral to moderately acid, strongly pedal, coherent, weakly bioturbated light to medium clay lower subsoil layer. At depths below 50cm a strongly weathered igneous rock layer occurs. This was not always reached at every site, especially where the subsoil was very deep, 100 – 150+cm, over the weathered layer.

Of the fifteen description sites recorded within this unit, seven were located in an upper slope situation (gradients ranging from 12% to 32%), one in an upper slope to midslope situation (16%), three midslope (10 – 13%), three lower slope (8% to 14%) and one on a ridgeline (35%).

3.2.2.2 Dominant soil materials

Northcote Codings:	Uf 5.3; Gn 3.11, Gn 3.14, Gn 3.22, Gn 4.51; Dr 4.11 and Dr 4.21
Great Soil Groups:	Structured sub-plastic clays, Krasnozems and Chocolate soils
Surface Condition:	self-mulching litter layer with mycelium is common and the surface is often stony with rounded and sub-rounded basalt fragments up to 600mm in size, in varying amounts up to 10%

3.2.2.3 Description

Layer 1 (slightly to moderately moist)

Diagnostic features:	brownish black, strongly pedal clay loam to silty clay loam
Occurrence:	always present as a topsoil layer or A, A1, A11 horizon 3 – 45cm thick but usually <10cm thick
Colour:	usually brownish black (5YR 2/1, 2/2; 7.5YR 2/2, 3/2; 10YR 3/2) or very dark reddish brown (2.5YR 2/2, 5YR 2/3)

pH: moderately acid to slightly alkaline (pH 5.5 – 8.0)

Texture: commonly clay loam or silty clay loam, all normal plastic

Stickiness: slight to moderate

Structure: strongly pedal with round and sub–angular blocky peds 10 – 100mm breaking to crumb or lenticular peds <2 – 5mm diameter, and smooth–faced slowly porous or, most commonly, rough–faced porous ped fabric

Coherence: weak to moderate

Stone content: 0 – 10% rounded to angular igneous fragments may be present, most commonly up to 20mm in size but not so commonly up to 600mm in size

Roots: abundant

Faunal mixing: abundant

Inclusions: charcoal fragments are usually present

Boundary: sharp or clear and wavy to irregular to layers 2, 3, 4 or 5

Layer 2 (moderately moist)

Diagnostic features: brownish black, pedal, fine sandy clay loam

Occurrence: rarely present as a lower topsoil layer or A12 horizon, 22 – 28cm thick

Colour: brownish black (7.5YR 2/2) or greyish yellow brown (10YR 5/2)

pH: moderately to slightly acid (pH 5.0 – 6.0)

Texture: fine sandy clay loam or silty clay, normal plastic

Stickiness: slight to moderate

Structure: moderately to strongly pedal with sub–angular blocky peds 20 – 100mm breaking to lenticular peds <2mm diameter, and rough–faced porous ped fabric

Coherence: weak to moderate

Stone content: up to 10% rounded or sub–rounded igneous fragments occur up to 60mm in size

Roots:	abundant
Faunal mixing:	abundant
Inclusions:	charcoal fragments are present
Boundary:	sharp or clear and wavy or irregular to layer 5

Layer 3 (slightly moist)

Diagnostic features:	brownish black to dark brown, strongly pedal light clay
Occurrence:	uncommonly present as a lower topsoil layer or unbleached A2 horizon, 17 - 23cm thick
Colour:	brownish black (7.5YR 3/2) or dark brown (7.5YR 3/4); also very dark reddish brown (5YR 2/4)
pH:	slightly acid to neutral (pH 6.0 - 7.0)
Texture:	light clay or silty light clay, normal plastic
Stickiness:	slight to moderate
Structure:	strongly pedal with sub-angular blocky peds 20 - 100mm breaking to sub-angular, angular blocky or lenticular 2 - 5mm diameter, and rough-faced or smooth-faced porous ped fabric
Coherence:	moderate to strong
Stone content:	0 - 10% sub-angular and angular igneous fragments may occur up to 20mm in size
Roots:	abundant to many
Faunal mixing:	abundant
Inclusions:	charcoal fragments may occur
Boundary:	sharp, clear or gradual and wavy or irregular to layers 4 or 5

Layer 4 (slightly moist to wet)

Diagnostic features:	dark reddish brown, strongly pedal light medium clay
Occurrence:	uncommonly present as an upper subsoil layer or B1 horizon, 13 - 47cm thick

Colour:	dark reddish brown (2.5YR 3/3, 5YR 3/4) or very dark reddish brown (5YR 2/3) or brownish black (7.5YR 2/2)
pH:	moderately acid to neutral (pH 5.5 – 7.0)
Texture:	light clay, light medium clay or medium clay, all normal plastic
Stickiness:	moderate to slight
Structure:	strongly pedal with sub-angular blocky or lenticular peds 20 – 100mm breaking to lenticular peds 2 – 5mm diameter, and smooth-faced slowly porous ped fabric
Coherence:	moderate to strong
Stone content:	up to 20% rounded to sub-angular igneous fragments occur up to 200mm in size
Roots:	many to abundant
Faunal mixing:	abundant
Inclusions:	charcoal fragments may occur
Boundary:	sharp, clear or gradual and wavy or irregular to layer 5

Layer 5 (slightly moist to wet)

Diagnostic features:	dark reddish brown, strongly pedal light medium clay
Occurrence:	always present as a master colour subsoil layer or B2 horizon, 25 – 98+cm thick
Colour:	dark reddish brown (2.5YR 3/4, 5YR 3/2, 3/4, 3/6) or brown (7.5YR 4/3, 4/4, 4/6); also very dark reddish brown (5YR 2/3, 2/4) or dark brown (7.5YR 3/3, 3/4)
pH:	strongly acid to neutral (pH 4.5 – 7.0)
Texture:	usually light medium clay, normal plastic but ranges from silty light clay to heavy clay, normal plastic or super-plastic
Stickiness:	slight to moderate
Structure:	strongly pedal with sub-angular blocky, angular blocky or lenticular peds 20 – 200mm diameter breaking to lenticular <2 – 5mm diameter, and rough-faced or smooth-faced, slowly porous ped fabric

Coherence:	slight to strong
Stone content:	nil up to 50% rounded to angular, igneous fragments may occur up to 200mm in size
Roots:	common to abundant
Faunal mixing:	common to abundant
Inclusions:	charcoal fragments usually occur
Boundary:	clear or gradual and wavy or irregular to layers 6, 7 or 8

Layer 6 (slightly to moderately moist)

Diagnostic features:	dark reddish brown, strongly pedal light medium clay
Occurrence:	uncommonly present as a lower subsoil layer or B3 horizon, 48+cm thick
Colour:	dark reddish brown (5YR 3/3, 3/4); also greyish brown (5YR 4/2) dark brown (10YR 3/3) or dull yellowish brown (10YR 5/3)
pH:	moderately acid to neutral (pH 5.5 - 7.0)
Texture:	light medium clay, medium clay or light clay, normal plastic or super-plastic
Stickiness:	slight
Structure:	strongly pedal with lenticular or sub-angular blocky peds 20 - 100mm breaking to lenticular peds <2 - 5mm diameter, and smooth-faced slowly porous to dense ped fabric
Coherence:	not recorded
Stone content:	0 - 20% rounded and sub-rounded igneous fragments may occur up to 200mm in size
Roots:	common
Faunal mixing:	common but decreasing with depth
Inclusions:	none observed
Boundary:	not reached at depth

Layer 7 (slightly moist)

Diagnostic features:	bright brown, pedal, light medium clay
Occurrence:	probably rarely present but not always reached at depth as a transitional layer or BC horizon, 19+cm thick
Colour:	bright brown (7.5YR 5/6)
pH:	moderately acid (pH 5.0)
Texture:	light medium clay, normal plastic
Stickiness:	slight
Structure:	moderately pedal with rough–faced porous ped fabric
Coherence:	moderate
Stone content:	igneous stone fragments occur
Roots:	few
Faunal mixing:	uncommon
Inclusions:	none observed
Boundary:	not reached at depth

Layer 8

Diagnostic features:	>90% igneous, strongly weathered igneous bedrock
Occurrence:	always present but not always reached at depth as a weathered bedrock layer or C horizon at >64cm depth

3.2.3 Soil Mapping Unit C - (soils developed on metasediments)

3.2.3.1 Summary

These soils occur in two distinct, geographically separate locations: in the Mooball, Burringbar and northern arm of Nullum State Forests south of Murwillumbah, and in most of Washpool and the south–eastern parts of Ewingar State Forests, west of Baryulgil. Both areas are steep.

They are, however, similar in terms of their physical characteristics. They are clay soils with one topsoil layer over two subsoil layers. They generally consist of a dark reddish brown, slightly acid, strongly pedal, coherent, strongly bioturbated silty light clay to light clay topsoil layer over a reddish brown, slightly acid, strongly pedal, coherent, strongly bioturbated light to light medium clay master colour subsoil layer. This layer usually grades into a strongly weathered, moderately acid argillite rock layer at depths ranging from 44cm to 140cm or greater.

Of the six description sites recorded within this unit, three were located in an upper slope situation (gradients ranging from 8% to 33%), two in a lower slope situation (6% - 25%) and one on a ridgeline (10%).

3.2.3.2 Dominant soil materials

Northcote Codings:	Uf 5.22, Uf 6.21, Uf 6.31, Uf 6.33
Great Soil Groups:	Structured plastic clays and Krasnozems
Surface Conditions:	self-mulching with up to 20% sub-angular and angular quartz and argillite, phyllite and slate fragments occur up to 200mm in size

3.2.3.3 Description

Layer 1 (slightly to moderately moist)

Diagnostic features:	dark reddish brown, acid, strongly pedal, silty light clay or light clay
Occurrence:	always present as a topsoil layer or A horizon, 8 - 22cm thick
Colour:	dark reddish brown (2.5YR 3/3, 5YR 3/2, 3/3), also very dark reddish brown (5YR 2/3) or brownish black (10YR 2/2)
pH:	slightly acid (pH 6.0 - 6.5)
Texture:	silty light clay or light clay, subplastic or normal plastic
Stickiness:	usually moderate but may also be slight
Structure:	strongly pedal with sub-angular blocky peds 20 - 100mm breaking to crumbs and occasionally angular blocky peds 2 - 5mm diameter, and rough-faced porous and sometimes smooth-faced slowly porous ped fabric
Coherence:	moderate to strong
Stone content:	<2 - 20% sub-angular and angular quartz and metamorphic rock fragments occur up to 200mm in size
Roots:	abundant

Faunal mixing: abundant

Inclusions: charcoal fragments occur at all sites

Boundary: sharp or clear and even or wavy to layers 2 or 4

Layer 2 (slightly to moderately moist)

Diagnostic features: reddish brown, slightly acid, strongly pedal light to light medium clay

Occurrence: usually present as an upper subsoil layer or B1, B11 horizon, 13 - 29cm thick

Colour: reddish brown (5YR 4/6, 2.5YR 4/6), or dark reddish brown (5YR 3/3)

pH: slightly acid (pH 6.0)

Texture: light or light medium clay, normal plastic

Stickiness: moderate

Structure: strongly pedal with sub-angular blocky peds 20 - 100mm breaking to crumbs <2mm diameter, and smooth-faced slowly porous to dense or rough-faced porous ped fabric

Coherence: moderate

Stone content: <2 - 20% sub-angular and angular metamorphic rock fragments occur up to 20mm in size

Roots: many

Faunal mixing: abundant

Inclusions: charcoal fragments are usually present

Boundary: clear to gradual and even to wavy to layers 3 or 4

Layer 3 (moderately moist)

Diagnostic features: reddish brown, acid, strongly pedal light medium clay

Occurrence: sometimes present as an upper subsoil layer or B12 horizon, 26cm thick

Colour: reddish brown (2.5YR 4/6)

pH:	moderately acid (pH 5.5)
Texture:	light medium clay, normal plastic
Stickiness:	moderate
Structure:	strongly pedal with sub-angular blocky peds 20 - 100mm in size breaking to lenticular and angular blocky peds <2mm in diameter, and smooth-faced slowly porous to dense ped fabric
Coherence:	strong
Stone content:	<2% of metamorphic and quartz fragments occur up to 6mm in size
Roots:	not recorded
Faunal mixing:	not recorded
Inclusions:	charcoal fragments occur
Boundary:	gradual and even to layer 4

Layer 4 (slightly to moderately moist)

Diagnostic features:	reddish brown, acid, strongly pedal light medium clay
Occurrence:	always present as a master colour subsoil layer or B2 horizon, 24 - 68+cm thick
Colour:	usually reddish brown (2.5YR 4/8, 5YR 4/8); also dark reddish brown (2.5YR 3/6), or dull yellowish brown (10YR 5/4)
pH:	moderately to slightly acid (pH 5.0 – 6.0)
Texture:	light to light medium clay, normal plastic
Stickiness:	moderate
Structure:	strongly pedal with sub-angular blocky peds 20 - 100mm, breaking to angular blocky and lenticular <2mm diameter and smooth-faced slowly porous to dense, or rough-faced porous ped fabric
Coherence:	weak to moderate
Stone content:	<2 - 50% sub-angular and angular metamorphic rock fragments occur up to 200mm in size
Roots:	many

Faunal mixing: common to abundant

Inclusions: charcoal fragments may occur at some sites

Boundary: gradual or sharp and irregular or broken to layers 5 or 6

Layer 5 (moderately moist)

Diagnostic features: reddish brown, acid, pedal light medium clay

Occurrence: sometimes present as a transition layer or B3, BC horizon, 22+cm thick (upper boundary at 60cm depth)

Colour: reddish brown (2.5YR 4/8)

pH: moderately acid (pH 5.5)

Texture: light medium clay, normal plastic

Stickiness: slight

Structure: moderately to strongly pedal with sub-angular blocky peds 20 - 50mm breaking to angular blocky peds <2mm diameter

Coherence: moderate

Stone content: 50 - 90% angular metamorphic rock fragments occur up to 60mm in size

Roots: many

Faunal mixing: common

Inclusions: none observed

Boundary: not recorded

Layer 6

Diagnostic features: strongly weathered rock

Occurrence: always present but not always reached at depth as a weathered rock layer or C horizon, 75 - 156+cm thick

Colour: not recorded

pH: moderately acid (pH 5.5)

Texture: not obtainable

Stickiness:	not obtainable
Structure:	not obtainable
Coherence:	not obtainable
Stone content:	>90% metamorphic rock fragments occur
Roots:	uncommon
Faunal mixing:	absent
Inclusions:	none
Boundary:	not recorded

Layer 7

Diagnostic features:	unweathered rock
Occurrence:	always present but rarely reached at depth as a rock layer or R horizon, below 140cm depth

No other details were recorded for this layer

3.2.4 Soil Mapping Unit D – (soils developed on granitoids)

3.2.4.1 Summary

These soils occur in the very steep country of the Billilimbra and Ewingar State Forests.

They typically consist of a brownish black, slightly to strongly acid, moderately to strongly pedal, moderately coherent, strongly bioturbated, stony, silty light clay or light clay, commonly over an unbleached A2 horizon or lower topsoil layer which is a dark reddish brown to dark brown, slightly to moderately acid, pedal, stony, silty clay loam or light clay. This layer commonly overlies a reddish brown to dull yellowish brown, slightly to moderately acid, pedal, strongly bioturbated, weakly to moderately coherent, stony, light to medium clay upper subsoil layer, over a bright reddish brown, slightly to strongly acid, pedal, strongly bioturbated, weakly to moderately coherent, stony, light to light medium clay master colour subsoil layer. This layer grades into a strongly weathered granite rock layer, which comes in at depths between 50cm and 92cm or greater.

Of the six description sites recorded within this unit, four were located in an upper slope situation (gradients ranging from 8% to 20%), one in a midslope situation (8%) and one in a midslope to lower slope situation (12%).

3.2.4.2 Dominant soil materials

Northcote Codings: Uf 4.43, Uf 5.11, Uf 6.2(4); Gn 3.14; Dy 4.11

Great Soil Groups: Structured subplastic and plastic clays, Krasnozems, Yellow podzolic soils

Surface Condition: loose and sandy or self-mulching or friable usually with a thin layer of scattered sand grains on the surface and a plant litter layer of varying thickness. Usually there are some rounded to angular stones present up to 600+mm in size, but generally up to 60mm. These are igneous fragments but feldspar, quartz and mica crystals are also commonly present.

3.2.4.3 Description

Layer 1 (moderately moist)

Diagnostic features: brownish black, acid, pedal silty light clay to light clay

Occurrence: always present as an A, A1, A11 horizon, 2 - 30cm thick

Colour: brownish black (5YR 2/2, 2/1, 7.5YR 2/2), and ranges from very dark reddish brown (2.5YR 2/2) to dark brown (10YR 3/4)

pH: strongly to slightly acid (pH 4.5 - 6.5)

Texture: silty light clay or light clay, one subplastic, the others normal plastic; also some sandy loam, clay loam or silty clay loam

Stickiness: slight to moderate

Structure: usually strongly pedal, but also moderately or weakly pedal, with sub-angular blocky and round peds, and rarely platy peds 20 - 100mm in size, breaking to round peds and crumbs 2 - 10 mm diameter, and earthy smooth-faced or rough-faced porous ped fabric

Coherence: moderate to strong

Stone content: 0 - 50% rounded to angular igneous rock fragments and feldspar quartz and mica crystals may occur from 2 - >600mm in size

Roots: abundant

Faunal mixing: abundant

Inclusions: charcoal fragments are usually present

Boundary:	sharp to clear and even or wavy to layers 2, 3 or 6

Layer 2 (moderately moist)

Diagnostic features:	dull reddish brown, acid, weakly or strongly pedal, light to light medium clay
Occurrence:	sometimes present as a lower topsoil layer or A12 horizon, 8 – 16cm thick
Colour:	dull reddish brown (5YR 4/3) or dark brown (10YR 3/3)
pH:	moderately acid (pH 5.0 – 5.5)
Texture:	usually light to light medium clay, but also light sandy clay loam, all normal plastic
Stickiness:	slight
Structure:	weakly or strongly pedal with sub–angular blocky and round peds 50 – 100mm breaking, in the more strongly pedal case, to angular blocky, round and crumb peds <2 – 10mm in size, and earthy or smooth–faced porous ped fabric
Coherence:	weak to moderate
Stone content:	0 – 20% sub–angular and angular igneous and quartz feldspar fragments may occur up to 20mm in size
Roots:	abundant
Faunal mixing:	abundant
Inclusions:	charcoal fragments occur
Boundary:	clear to sharp and wavy to layers 4 or 5

Layer 3 (moderately moist)

Diagnostic features:	reddish brown, acid, pedal, sandy light clay or light clay
Occurrence:	commonly present as a lower topsoil layer or unbleached A2 horizon, 12 – 23cm thick
Colour:	reddish brown (5YR 4/6), dark reddish brown (2.5YR 3/3), or dark brown (7.5YR 3/3)
pH:	moderately to slightly acid (pH 5.0 – 6.0)

Texture:	sandy light clay, light clay or silty clay loam, normal plastic
Stickiness:	slight
Structure:	moderately to strongly pedal with sub-angular blocky and some round peds 20 - 100mm, breaking to angular blocky and round peds 2 - 10mm diameter, and smooth-faced or rough-faced porous ped fabric
Coherence:	moderate
Stone content:	10 - 50% sub-rounded to angular quartz feldspar crystals or igneous rock fragments occur up to 60mm in size, although some may range from 200 to >600mm in size
Roots:	many to abundant
Faunal mixing:	abundant
Inclusions:	charcoal fragments occur
Boundary:	clear or gradual and wavy to layers 5 or 6

Layer 4 (moderately moist)

Diagnostic features:	dull reddish brown, acid, pedal sandy clay loam
Occurrence:	rarely present as a transition layer or A3 horizon, 10cm thick
Colour:	dull reddish brown (5YR 4/4)
pH:	moderately acid (pH 5.5)
Texture:	sandy clay loam
Stickiness:	slight
Structure:	moderately pedal (held together largely by mycelium threads) with sub-angular blocky peds 50 - 100mm
Coherence:	moderate
Stone content:	10 - 20% sub-angular and angular igneous rock fragments and quartz and feldspar crystal fragments occur up to 20mm in size
Roots:	many
Faunal mixing:	abundant

Inclusions:	charcoal fragments occur
Boundary:	not recorded

Layer 5 (moderately moist)

Diagnostic features:	reddish brown to bright reddish brown, acid, pedal, light to medium clay
Occurrence:	commonly present as an upper subsoil layer or B1 horizon, 10 – 19cm thick
Colour:	reddish brown (5YR 4/8) to bright reddish brown (5YR 5/6) or dull yellowish brown (10YR 4/3)
pH:	moderately to slightly acid (pH 5.0 – 6.0)
Texture:	light, light medium or medium clay, all normal plastic
Stickiness:	slight
Structure:	moderately to strongly pedal with sub–angular blocky peds 50 – 100mm breaking to angular blocky, round and crumb peds <2 – 10mm in diameter, and smooth–faced or rough–faced, slowly porous to porous ped fabric
Coherence:	weak to moderate
Stone content:	either nil or up to 50% sub–rounded to angular igneous fragments and quartz and feldspar crystal fragments may occur up to 60mm in size
Roots:	common to many
Faunal mixing:	many to abundant
Inclusions:	charcoal fragments usually occur
Boundary:	clear to gradual and wavy to layer 6

Layer 6 (moderately moist)

Diagnostic features:	bright reddish brown or reddish brown, acid, pedal light to light medium clay
Occurrence:	always present as a master colour subsoil layer or B2 horizon, 20 – 46cm thick

Colour:	bright reddish brown (5YR 5/8) or reddish brown (5YR 4/8), and ranges from dark reddish brown (2.5YR 3/6) to yellowish brown (10YR 5.8)
pH:	strongly to slightly acid (pH 4.5 - 5.0)
Texture:	light or light medium clay, normal plastic
Stickiness:	slight
Structure:	moderately to strongly pedal with sub-angular blocky and occasionally some lenticular peds 20 - 100mm breaking to angular blocky, sub-angular blocky, round, granular or crumb peds <2 - 10mm diameter, and smooth-faced slowly porous to rough-faced porous ped fabric
Coherence:	weak to moderate
Stone content:	0 - 50% rounded to angular igneous fragments and quartz, feldspar and mica crystal fragments may occur up to 600mm in size
Roots:	common to many
Faunal mixing:	common to abundant, predominantly many
Inclusions:	charcoal fragments occasionally occur but not at all sites
Boundary:	gradual and wavy to layers 7 or 8

Layer 7 (moderately moist)

Diagnostic features:	very stony, slightly acid light clay
Occurrence:	rarely present as a transition layer or BC horizon, 10cm thick
Colour:	not recorded
pH:	slightly acid (pH 6.0)
Texture:	light clay, normal plastic
Stickiness:	slight
Structure:	moderately pedal
Coherence:	weak
Stone content:	50 - 90% rounded to angular igneous fragments occur up to 200mm in size

Roots: common

Faunal mixing: common

Inclusions: none observed

Boundary: not recorded

Layer 8

Diagnostic features: strongly weathered igneous rock

Occurrence: always present but not always reached at depth as a weathered layer or C horizon, 40+cm thick and located below 50 - 90cm depth

No other parameters were recorded for this layer

3.2.5 Soil Mapping Unit E – (soils developed on Grafton Formation sediments)

3.2.5.1 Summary

The soils in this unit predominate in the central forests of Bungawalbin, Braemar, Ellangowan, Carwong, Royal Camp, Camira, Myrtle, Whiporie, Banyabba and Gibberagee, unless otherwise overlain by Quaternary alluvium of the same-named unit. Terrain is very gently to gently undulating.

The soils are best divided into topsoils and subsoils because of the strong distinction between their relative field textures.

The topsoil generally consists of brownish black to dark reddish brown, slightly to strongly acid, moderately pedal, weakly to moderately coherent, strongly bioturbated sandy loam to fine sandy clay loam, with every texture in between. This layer has a sharp to clear boundary to either a brown, slightly to moderately acid, moderately pedal, moderately coherent, strongly bioturbated, light sandy clay loam, sandy clay loam, silty or fine sandy clay loam, sandy or silty light clay lower topsoil layer, or a brown, slightly to strongly acid, weakly to strongly pedal, weakly to moderately coherent, moderately to strongly bioturbated light sandy clay loam or light clay (textures range from sand to heavy clay) generally unbleached lower topsoil layer, or both. These layers show a sharp to clear boundary to the underlying subsoil.

The upper subsoil layer or transition layer is rare and is described as a reddish brown to bright reddish brown, moderately pedal sandy clay loam. The master colour subsoil layer is always present as a reddish brown, dark reddish brown, brown or greyish brown, slightly to strongly acid, strongly pedal, strongly to very strongly coherent, weakly bioturbated, light to heavy clay. It is commonly underlain by a dark reddish brown to dull brown, usually acid, strongly pedal, strongly coherent, weakly bioturbated light medium clay or heavy clay lower subsoil layer. The subsoil layers change, through a clear boundary to a strongly weathered sedimentary rock layer, which has pockets of strongly pedal light medium clay, below 43 – 87cm depth.

Of the 24 description sites recorded within this unit, five were located in an upper slope situation (gradients ranging from 2% to 20%), one in an upper slope to midslope situation (27%), seven in a midslope situation (1% - 13%), two lower slope (4% - 6%), two ridgetop (8% - 12%), five hilltop (1% - 8%), and one each in a drainage flat (1%) and gullyline (4%).

3.2.5.2 Dominant soil materials

Northcote Codings:	Gn 2.21, Gn 2.41, Gn 3.04, Gn 3.11, Gn 3.14, Gn 3.16, Gn 3.21, Gn 3.24, Gn 3.91, Gn 3.94; Dr 1.11 Dr 4.11, Dr 4.41, Dr 5.11, Dr 5.41; Dy 1.41, Dy 5.11, Dy 5.41
Great Soil Groups:	Yellow earths, Yellow-brown earths, Chocolate soils, Euchrozems, Red podzolic soils, Lateritic podzolic soils, Yellow podzolic soils and Minimal prairie soils
Surface Condition:	friable, firm, crusting, soft or loose, with litter layer, often in the form of sand grains over the top, with thin plant litter cover, or the top may be quite stony. Surface stone ranges from 0 - 20% rounded to angular, iron-rich, sedimentary fragments up to 200mm in size

3.2.5.3 Description

Layer 1 (usually slightly moist)

Diagnostic features:	brownish black, dark brown or brown, pedal sandy loam to fine sandy clay loam
Occurrence:	always present as a topsoil layer or A, A1, A11 horizon, 1 - 24cm thick
Colour:	brownish black (7.5YR 3/2, 10YR 3/2), dark brown (7.5YR 3/3) or brown (7.5YR 4/3, 4/4) and ranges from black (7.5YR 1.71, 2/1) to dull reddish brown (5YR 4/4, 4/3)
pH:	strongly to slightly acid (pH 4.5 - 6.5)
Texture:	this ranges from sandy loam to fine sandy clay loam but is commonly fine sandy loam, sandy clay loam or silty clay loam, all normal plastic
Stickiness:	usually slight to moderate
Structure:	weakly or moderately pedal with platy, round or sub-angular blocky peds 5 - 50mm breaking to crumbs, round, platy or sub-angular blocky peds 2 - 10mm diameter, and earthy or rough-faced porous ped fabric

Coherence: weak to moderate

Stone content: 0 – 20% rounded to sub-angular ironstone, quartz or sedimentary rock fragments may occur up to 200mm in size

Roots: abundant

Faunal mixing: abundant

Inclusions: charcoal fragments occur at most sites

Boundary: sharp and even or wavy to layers 2, 3, 5 or 7

Layer 2 (slightly to moderately moist)

Diagnostic features: brown pedal sandy clay loam

Occurrence: commonly present as a lower topsoil layer or A12 horizon 5 – 35cm thick

Colour: commonly brown (7.5YR 4/3, 4/4, 4/6) dark brown (7.5YR 3/3, 3/4) or brownish black (7.5YR 3/2)

pH: moderately to slightly acid (pH 5.5 – 6.5)

Texture: this is highly variable and ranges from fine sandy loam through sandy clay loam to light clay, all normal plastic

Stickiness: slight to moderate

Structure: weakly to moderately pedal with sub-angular blocky peds 20 – 100mm breaking to round and sub-angular blocky peds 5 – 10mm diameter, and earthy or rough-faced porous ped fabric

Coherence: weak to moderate

Stone content: 0 – 50% round to angular sedimentary quartz fragments may occur up to 60mm in size

Roots: many to abundant

Faunal mixing: abundant

Inclusions: charcoal fragments commonly occur

Boundary: sharp or clear and even or wavy to layer 3 or more commonly to layer 6 or 7

Layer 3 (usually slightly to moderately moist)

Diagnostic features:	brown or dull brown, weakly to strongly pedal light clay
Occurrence:	commonly present as a bleached or unbleached lower topsoil layer or A2, A21 horizon, 5 - 37cm thick
Colour:	brown (7.5YR 4/3, 4/4) or dull brown (7.5YR 5/3, 5/4); also dull reddish brown (5YR 4/3) greyish brown (5YR 5/2) or dull orange (5YR 6/4). Bleaching of this layer is common
pH:	strongly to slightly acid (pH 4.5 - 6.0)
Texture:	texture of this layer is highly variable ranging from sand at the one end to heavy clay at the other. The two textures which are present more often than others are light clay and light sandy clay loam, all normal plastic
Stickiness:	non-sticky to moderate
Structure:	weakly, moderately or strongly pedal with sub-angular blocky peds 10 - 200mm diameter breaking, in the more strongly pedal cases, to round, sub-angular blocky, angular blocky, lenticular or platy peds 5 - 10mm diameter, and earthy, smooth-faced or rough-faced porous to slowly porous ped fabric. Also on two occasions the structure was apedal single-grained or apedal massive
Coherence:	weak to moderate
Stone content:	0 - 10% rounded to angular ironstone sedimentary or quartz fragments may occur, commonly up to 20mm in size
Roots:	few to abundant
Faunal mixing:	few to abundant (highly variable)
Inclusions:	charcoal fragments may occur
Boundary:	always sharp and even, wavy or irregular to layer 7 and clear and irregular to layer 4

Layer 4 (slightly moist)

Diagnostic features:	yellowish brown, weakly pedal fine sandy loam
Occurrence:	very rarely present as a lower bleached topsoil layer or A22 horizon, 28cm thick
Colour:	yellowish brown (10YR 5/6)

pH:	not recorded
Texture:	fine sandy loam
Stickiness:	slight
Structure:	weakly pedal with round peds 5 – 20mm diameter and earthy porous ped fabric
Coherence:	not recorded
Stone content:	20 – 50% rounded sedimentary fragments occur up to 20mm in size
Roots:	few
Faunal mixing:	common
Inclusions:	none observed
Boundary:	sharp to layer 7

Layer 5 (slightly moist)

Diagnostic features:	brownish black, weakly pedal loamy sand
Occurrence:	very rarely present as a lower topsoil layer or A3 horizon, 12cm thick
Colour:	brownish black (10YR 3/2)
pH:	not recorded
Texture:	loamy sand, loose
Stickiness:	non-sticky
Structure:	weakly pedal with round peds 10 – 20mm diameter and earthy porous ped fabric
Coherence:	not recorded
Stone content:	none
Roots:	common
Faunal mixing:	common
Inclusions:	none observed

Boundary: diffuse and wavy to layer 7

Layer 6 (slightly moist)

Diagnostic features: reddish brown to dull yellowish brown, moderately pedal, sandy clay loam

Occurrence: rarely present as a transitional layer or B1 horizon, 13 – 24 cm thick

Colour: ranges from reddish brown (5YR 4/6) or bright reddish brown (5YR 5/6) through dark brown (7.5YR 3/4) to dull yellowish brown (10YR 4/3)

pH: not recorded

Texture: sandy clay loam, also fine sandy loam or light clay, normal plastic

Stickiness: slight to moderate

Structure: moderately pedal with sub-angular blocky peds 20 - 100mm breaking to sub-angular blocky, round or lenticular peds 5 - 10mm diameter, and earthy or rough-faced porous ped fabric

Coherence: not recorded

Stone content: 10 – 20% rounded and sub-rounded quartz fragments occur up to 20mm in size

Roots: common

Faunal mixing: usually abundant

Inclusions: charcoal fragments commonly occur

Boundary: usually clear and wavy to layer 7

Layer 7 (slightly to moderately moist)

Diagnostic features: reddish brown, strongly pedal light medium clay

Occurrence: always present as a master colour subsoil layer or B2, B21 horizon, 10 – 51+cm thick

Colour: usually reddish brown (2.5YR 4/8, 4/6); also dark reddish brown (2.5YR 3/6, 5YR 3/6), brown (7.5YR 4/6, 4/3, 10YR 4/6) or greyish brown (7.5YR 6/2, 5/2, 4/2). Other not so common colours range from dull reddish brown (5YR 5/4, 4/4) to dull yellow orange (10YR 6/3)

pH:	strongly to slightly acid (pH 4.5 - 6.0)
Texture:	usually light medium clay, light clay or heavy clay, all normal plastic. Less commonly textures of sandy loam, fine sandy loam, light sandy clay loam, fine sandy clay loam and sandy light clay also occur
Stickiness:	slight to moderate
Structure:	usually strongly pedal but also can be weak to moderate with lenticular, angular-blocky and sub-angular blocky peds 20 - 200mm diameter breaking to <2 - 10mm diameter, and earthy or rough-faced porous ped fabric or smooth-faced slowly porous to dense ped fabric
Coherence:	moderate to very strong
Stone content:	0 - 50% rounded to angular quartz sedimentary or ironstone fragments can occur up to 60mm in size
Roots:	few to common
Faunal mixing:	common, becoming less common with depth
Inclusions:	charcoal fragments may be present and rarely manganese nodules may occur
Boundary:	clear and wavy to layer 9, and rarely gradual to layers 8 or 10

Layer 8 (wet)

Diagnostic features:	greyish brown, strongly pedal, light medium clay
Occurrence:	very rarely present as a lower subsoil layer or B22 horizon, 35+cm thick
Colour:	greyish brown (7.5YR 4/2)
pH:	moderately acid (pH 5.0)
Texture:	light medium clay, normal plastic
Stickiness:	slight
Structure:	strongly pedal with angular blocky and sub-angular blocky peds 100 - 200mm breaking to sub-angular blocky peds 2 - 5mm diameter, and smooth-faced dense ped fabric
Coherence:	not recorded

Stone content:	not recorded
Roots:	few
Faunal mixing:	uncommon
Inclusions:	none observed
Boundary:	not reached at depth

Layer 9 (usually moderately moist to wet)

Diagnostic features:	dark reddish brown to dull brown, strongly pedal, light medium clay
Occurrence:	commonly present as a lower subsoil layer or B3 horizon, 13 - 46+cm thick
Colour:	dark reddish brown (2.5YR 3/6) or dull brown (7.5YR 5/3, 6/3). Other less common colours range from reddish brown (2.5YR 4/8) to dull yellow (2.5Y 6/4)
pH:	strongly acid to slightly alkaline (pH 4.5 - 8.5)
Texture:	light medium clay with some heavy clay, normal plastic
Stickiness:	slight to moderate
Structure:	strongly pedal with sub-angular blocky, angular blocky or lenticular peds 50 - 200mm breaking to <2 - 5mm diameter, and smooth-faced, slowly porous to dense ped fabric
Coherence:	moderate to strong
Stone content:	0 - 90% rounded to angular, sedimentary, iron-rich pebbles may occur up to 60mm in size
Roots:	few to common on ped faces
Faunal mixing:	uncommon to rare. Normally at this depth open channels are observed with no mixing of soil either within the layer or across layers
Inclusions:	none observed
Boundary:	sharp to clear and broken to layer 10

Layer 10 (soil moisture not recorded)

Diagnostic features:	very strongly weathered rock with some light medium clay
Occurrence:	always present but not always reached at depth as a weathered rock layer or C horizon at depth, below 43 - 87cm
Colour:	not recorded
pH:	not recorded
Texture:	light medium clay, normal plastic
Stickiness:	slight
Structure:	not recorded
Coherence:	not recorded
Stone content:	50 - 90% angular, strongly weathered, sedimentary stones are present up to 60mm in size
Roots:	few
Faunal mixing:	rare
Inclusions:	none observed
Boundary:	not reached at depth

3.2.6 Soil Mapping Unit F - (soils developed on Kangaroo Creek Sandstone)

3.2.6.1 Summary

These soils predominantly occur on Kangaroo Creek Sandstones in the Mount Belmore, Mount Marsh, and Doubleduke State Forests. Other smaller localities are in part Banyabba, part Gibberagee, part Richmond Range, and part Eden Creek State Forests.

The terrain is moderately steep on side slopes and more gentle on ridgelines and footslopes.

The soils generally consist of a brownish black, slightly to strongly acid, weakly to moderately pedal, weakly coherent, strongly bioturbated, loamy sand or sandy loam topsoil layer, over either a dark brown to brown, moderately acid, weakly to moderately pedal, weakly coherent, bioturbated, clayey sand lower topsoil layer, or a brown to dull yellowish brown (bleached or unbleached) slightly to moderately acid, weakly pedal, weakly coherent, moderately bioturbated, clayey sand, loamy sand or light sandy clay loam lower topsoil layer, sometimes over a brown, slightly to moderately acid, moderately pedal, weakly coherent, moderately bioturbated , clayey sand or sandy clay loam transition layer or upper subsoil layer.

The master colour subsoil layer is always present and is characterised by a bright brown to yellow brown, slightly to strongly acid, weakly to strongly pedal, weakly to moderately coherent, weakly bioturbated (except where the layer is directly overlain by the topsoil layer, in which case it is strongly bioturbated), clayey sand, sandy light clay or light medium clay, occasionally over a dull yellow orange, moderately acid, strongly pedal, moderately coherent, light medium clay lower subsoil layer. This sharply changes to strongly weathered, bright brown sandstone at depths between 50 – 140+cm.

Of the 21 description sites recorded within this unit, eight were located in an upper slope situation (gradients ranging from 7% to 27%), five in a midslope situation (10% – 22%), two lower slope (7% – 17%), three ridgetop (8% – 18%), two footslope (2% – 12%), and one in a drainage flat (<1%).

3.2.6.2 Dominant soil materials

Northcote Codings: Uc 4.21, Uc 4.24, Uc 6, Uc 6.14; Gn 2.14, Gn 2.21, Gn 3.11, Gn 3.21; Dr 5.11, Dr 5.21; Db 3.41; Dy 1.11, Dy 4.11, Dy 4.21, Dy 5.21, Dy 5.31, Dy 5.41

Great Soil Groups: Sands, Structured sands, Earthy sands, Yellow earths, Red earths, Krasnozems, Red podzolic soils, Yellow podzolic soils

Surface Condition: thin, loose, sandy or crusting up to 1cm; organic matter can be present. Usually there are no stones but there may be up to 2% rounded quartz or coarse quartz sandstone pebbles, up to 20mm in size

3.2.6.3 Description

Layer 1 (slightly to moderately moist)

Diagnostic features: brownish black, weakly to moderately pedal, loamy sand to sandy loam

Occurrence: always present as an A, A1, A11 horizon, 2 – 35cm thick

Colour: brownish black (7.5YR 3/2, 2/2, 2/3) but can range from dark reddish brown (5YR 3/3) to dull yellowish brown (10YR 5/3)

pH: strongly to slightly acid (pH 4.0 – 6.5)

Texture: usually loamy sand or sandy loam but texture may be as clayey as fine sandy clay loam, all normal plastic

Stickiness:	non-sticky to slight
Structure:	weakly to moderately pedal with round and sub-angular blocky peds 10 - 100mm breaking to crumbs, granular, round or sub-angular blocky peds <2 - 10 mm diameter, and earthy, sandy or rough-faced porous ped fabric
Coherence:	weak
Stone content:	usually no stones are present; occasionally there are up to 10% rounded, sub-angular or angular quartz or coarse quartz sandstone fragments up to 20mm in size
Roots:	many to abundant
Faunal mixing:	usually abundant
Inclusions:	charcoal fragments usually occur
Boundary:	sharp or clear and even, wavy or broken to layers 2, 3, 5 or 6

Layer 2 (slightly to moderately moist)

Diagnostic features:	dark brown to brown, weakly to moderately pedal, clayey sand
Occurrence:	occasionally present as an A12 horizon or lower topsoil layer, 7 - 58+cm thick
Colour:	dark brown (7.5YR 3/3) or brown (7.5YR 4/4, 4/3), but ranges from brownish black (7.5YR 3/2) to yellowish brown (10YR 5/6)
pH:	moderately acid (pH 5.5)
Texture:	clayey sand or loamy sand but also light sandy clay loam, loam fine sandy, normal plastic
Stickiness:	usually slight
Structure:	weakly to moderately pedal with round and sub-angular blocky peds 10 - 100mm breaking to round sub-angular and angular blocky peds 2 - 10mm diameter, and earthy, sandy or rough-faced porous ped fabric
Coherence:	weak
Stone content:	0 - 10% rounded sub-angular or angular quartz or quartz sandstone fragments up to 60mm in size may occur
Roots:	common to many

Faunal mixing:	many to abundant, infilled faunal channels can be observed
Inclusions:	charcoal fragments are usually present
Boundary:	clear or gradual and wavy to layers 3, 4, 5 or 6

Layer 3 (slightly to moderately moist)

Diagnostic features:	brown to dull yellowish brown weakly to moderately pedal, loamy sand or clayey sand
Occurrence:	commonly present as a second topsoil layer (i.e. present where layer 2 is not present) or either bleached or unbleached A2 horizon, 13 – 38cm thick
Colour:	dull yellowish brown (10YR 4/3, 5/3) or brown (7.5YR 4/3, 4/4) also dark reddish brown (5YR 3/3) and dull yellow orange (10YR 6/4). This layer is usually not bleached
pH:	moderately to slightly acid (pH 5.0 – 6.5)
Texture:	loamy sand, clayey sand or light sandy clay loam, normal plastic
Stickiness:	non–sticky to slight
Structure:	weakly to moderately pedal with round and sub–angular blocky peds 10 – 100mm diameter which break, in the moderately pedal cases to round peds 5 – 10mm diameter, and earthy, sandy or rough–faced porous ped fabric
Coherence:	weak
Stone content:	stones are not usually present but at one site up to 90% rounded quartz and coarse–grained quartz sandstone fragments up to 20mm diameter occurred, with some bigger floaters up to 200mm on the slope
Roots:	common to abundant
Faunal mixing:	common
Inclusions:	charcoal fragments may occur
Boundary:	sharp, clear or gradual and usually wavy to either layer 4 or more commonly layers 5 or 6

Layer 4 (slightly to moderately moist)

Diagnostic features:	dark brown to brown, pedal clayey sand or silty clay loam

Occurrence:	rarely present as a transition layer or A3 horizon, 6 - 29cm thick
Colour:	dark brown (7.5YR 3/3) or brown (7.5YR 4/6)
pH:	not recorded
Texture:	clayey sand or silty clay loam, normal plastic
Stickiness:	slight to moderate
Structure:	moderately pedal with sub-angular blocky peds 20 - 50mm breaking to round peds 5 - 10mm diameter, and rough-faced porous ped fabric
Coherence:	not recorded
Stone content:	none present
Roots:	many
Faunal mixing:	common
Inclusions:	charcoal fragments may occur
Boundary:	sharp or clear and wavy or irregular to layer 6

Layer 5 (slightly to moderately moist)

Diagnostic features:	brown, weakly to moderately pedal clayey sand or sandy clay loam
Occurrence:	sometimes present as an upper subsoil layer or B1 horizon, 8 - 27cm thick
Colour:	brown (7.5YR 4/4, 4/6) and ranges from dark brown (7.5YR 3/3) to orange (7.5YR 6/6)
pH:	moderately to slightly acid (pH 5.5 - 6.0)
Texture:	clayey sand, sandy clay loam or light clay, all normal plastic
Stickiness:	non-sticky to moderate
Structure:	usually weakly to moderately pedal with sub-angular blocky, angular blocky or round peds 10 - 100mm, breaking in the more pedal cases to 2 - 20mm diameter, and earthy, sandy, smooth-faced or rough-faced porous ped fabric
Coherence:	weak

Stone content:	0 – 10% rounded to angular ironstone or sedimentary fragments may occur up to 20mm in size
Roots:	usually common
Faunal mixing:	common
Inclusions:	charcoal fragments commonly occur
Boundary:	clear and wavy or broken to layer 6

Layer 6 (slightly moist to wet)

Diagnostic features:	bright brown or yellow brown, weakly to strongly pedal clayey sand, sandy clay or light medium clay
Occurrence:	always present as a master colour subsoil layer or B2, B21 horizon, 13 – 70+cm thick
Colour:	bright brown (7.5YR 5/6, 5/8) or yellow brown (10YR 5/6, 5/8) and ranges from reddish brown (2.5YR 4/8) to bright yellowish brown (10YR 6/6)
pH:	strongly to slightly acid (pH 4.5 – 6.0)
Texture:	clayey sand, sandy light clay or light medium clay, all normal plastic
Stickiness:	non–sticky to moderate
Structure:	weakly, moderately or strongly pedal with round and sub–angular blocky peds 5 – 100mm diameter breaking to round sub–angular blocky, angular blocky or lenticular peds 2 – 10mm diameter, and either earthy, sandy or rough–faced porous ped fabric or smooth–faced, slowly porous to dense ped fabric
Coherence:	weak to moderate
Stone content:	usually no stones are present but there may be <2 – 90% rounded to angular quartz or iron–rich quartz sandstone fragments up to 600mm in size
Roots:	many to few
Faunal mixing:	common and becoming less common with depth
Inclusions:	charcoal fragments may occur but these tend to be less common than in overlying layers
Boundary:	sharp, clear or gradual and wavy to layers 7, 8, 9 or 10

Layer 7 (moderately moist to wet)

Diagnostic features: bright brown, apedal to weakly pedal sandy light clay

Occurrence: rarely present as a lower subsoil layer or B22 horizon, 15 - 43+cm thick

Colour: bright brown (7.5YR 5/6); also dull yellow orange (10YR 6/4) or brown (7.5YR 4/4)

pH: moderately acid (pH 5.0)

Texture: sandy light clay or loamy sand, normal plastic

Stickiness: non-sticky to slight

Structure: either apedal massive or weakly pedal with sub-angular blocky and platy peds 10 - 50mm diameter, and earthy, sandy or rough-faced porous ped fabric

Coherence: slight

Stone content: up to 2% sub-angular and angular quartz fragments may occur up to 20mm in size

Roots: few

Faunal mixing: rare

Inclusions: none observed

Boundary: sharp or clear and even to layers 8 or 10

Layer 8 (slightly moist)

Diagnostic features: dull yellow orange, strongly pedal light medium clay

Occurrence: occasionally present as a lower subsoil layer or B3 horizon, 16 - 31+cm thick

Colour: dull yellow orange (10YR 6/4, 7/2); also bright brown (7.5YR 5/6) or dull yellowish brown (10YR 5/3)

pH: moderately acid (pH 5)

Texture: normally light medium clay and rarely loamy sand, all normal plastic

Stickiness: non-sticky to slight

Structure:	strongly pedal with angular and sub–angular blocky peds 50 – 100mm breaking to lenticular peds <2 – 5mm diameter, and smooth–faced slowly porous ped fabric
Coherence:	usually moderate
Stone content:	none observed at any site
Roots:	few
Faunal mixing:	rare
Inclusions:	none observed
Boundary:	gradual and wavy to layer 9

Layer 9

Diagnostic features:	bright brown, weakly pedal, strongly weathered rock layer
Occurrence:	always present but not usually reached at depth and a transitional layer or C horizon, 32+cm thick
Colour:	bright brown (7.5YR 5/8)
pH:	not recorded
Texture:	not obtainable
Stickiness:	not obtainable
Structure:	weakly pedal with sub–angular blocky peds 20 – 50mm diameter
Coherence:	not obtainable
Stone content:	>90% stones
Roots:	few
Faunal mixing:	none
Inclusions:	none
Boundary:	not reached at depth

3.2.7 Soil Mapping Unit G – (soils developed on Walloon Coal Measures)

3.2.7.1 Summary

These soils occupy areas adjacent to basalt soils in the Richmond Range State Forest, and also dominate in the Cherry Tree State Forest. South of this they occur exclusively in Mount Pikapene State Forest and partly extend southwards into Mount Belmore State Forest. Terrain is generally moderately gentle throughout.

The soils consist of a brownish black, slightly to strongly acid, pedal, weakly to moderately coherent, strongly bioturbated light sandy clay loam, clay loam, silty light clay or light clay topsoil, uncommonly over a dull yellowish brown, usually bleached, slightly to strongly acid, pedal, moderately coherent, strongly bioturbated, light sandy clay loam, sandy clay loam or light clay lower topsoil layer, sometimes over a brown, slightly to strongly acid, strongly pedal, either moderately coherent and strongly bioturbated or strongly to very strongly coherent and weakly bioturbated, light medium clay upper subsoil layer. The boundary between the overlying layer (A1, A12, A2, B1) and the master colour subsoil layer, which always occurs, is usually sharp to clear, but may also be gradual. This layer is characterised by a reddish brown, slightly to strongly acid, moderately to very strongly coherent, strongly to weakly bioturbated at depth, slightly stony, strongly pedal, light to light medium clay. This is commonly underlain by a yellowish brown to greyish yellow brown, slightly to moderately acid, pedal, moderately coherent, non to weakly bioturbated, light medium clay. At depth is the strongly weathered sedimentary bedrock which extends to the unweathered rocks through a thickness of 12 – 85+cm.

Of the 21 description sites recorded within this unit, eight were located in an upper slope situation (gradients ranging from 5% to 32%), three in a midslope situation (7% – 20%), five lower slope (4% – 20%), and five ridgetop (3% – 47%).

3.2.7.2 Dominant soil materials

Northcote Codings: Uf 5.22, Uf 5.31, Uf 6.31, Uf 6.33, Uf 6.34; Gn 3.14, Gn 3.84, Gn 3.91, Gn 3.94; Dr 2.21, Dr 4.11, Dr 4.21, Dr 5.11, Dr 5.21; Db 0.41;

Great Soil Groups: Structured plastic and sub-plastic clays, Krasnozems, Xanthozems, Chocolate soils, Red podzolic soils, Yellow podzolic soils

Surface Condition: gravelly, firm, rarely hard-setting or friable with some stones and a plant litter layer up to 1cm thick. One soil had a crust but this is unusual. Surface stones range from 0 – 20% and are rounded, sub-rounded, sub-angular or angular and range in size from 2 – 600mm although they are generally up to 60mm in size, and they may be lithic sandstone, ironstone or quartz fragments

3.2.7.3 Description

Layer 1 (usually slightly to moderately moist)

Diagnostic features:	brownish black, pedal light clay
Occurrence:	always present as an A A1 or A11 horizon or topsoil layer, 2 - 38cm thick
Colour:	usually brownish black (5YR 2/2, 7.5YR 2/2, 3/2, 10YR 2/2, 3/2) but can range from dark reddish brown (5YR 3/2) to greyish yellow brown (10YR 4/2, 5/2)
pH:	usually strongly to slightly acid (pH 4.5 - 6.5)
Texture:	light clay, light sandy clay loam, clay loam or silty light clay, all normal plastic
Stickiness:	slight to moderate
Structure:	usually moderately to strongly pedal with round and sub-angular blocky peds 10 - 100mm breaking to angular blocky, sub-angular blocky, granular and crumb peds <2 - 20mm diameter, and smooth-faced or rough-faced, porous to dense ped fabric
Coherence:	weak to moderate
Stone content:	0 - 20% rounded to angular quartz, lithic sandstone or ironstone pebbles may occur up to 60mm in size
Roots:	many to abundant
Faunal mixing:	abundant
Inclusions:	charcoal fragments usually occur and rarely, soft iron nodules may also occur
Boundary:	sharp to gradual and even or wavy to layers 2, 3, 4 or 5

Layer 2 (slightly to moderately moist)

Diagnostic features:	dark reddish brown, pedal light sandy clay loam
Occurrence:	rarely present as a A12 horizon or lower topsoil layer, 15 - 33cm thick
Colour:	dark reddish brown (5YR 3/2); also greyish brown (7.5YR 4/2), brown (7.5YR 4/4) or bright yellowish brown (10YR 6/6)

pH:	moderately to slightly acid (pH 5.0 – 6.0)
Texture:	light sandy clay loam, clay loam, or light clay, all normal plastic
Stickiness:	slight to moderate
Structure:	moderately pedal with sub-angular blocky peds 50 – 100mm breaking to 5 – 20mm diameter, and rough-faced porous ped fabric
Coherence:	weak to moderate
Stone content:	<2 – 10% rounded to sub-angular, quartz, sedimentary or ironstone fragments occur up to 20mm in size
Roots:	many to common
Faunal mixing:	abundant
Inclusions:	charcoal fragments usually occur
Boundary:	sharp to gradual and even to irregular to layers 3 or 5

Layer 3 (slightly to moderately moist)

Diagnostic features:	dull yellowish brown, pedal light sandy clay loam, sandy clay loam or light clay
Occurrence:	uncommonly present as a bleached A2 horizon or lower topsoil layer, 9 – 26cm thick
Colour:	dull yellowish brown (10YR 5/3, 5/4) but ranges from dark reddish brown (5YR 3/6) to dull yellow orange (10YR 7/4)
pH:	strongly to slightly acid (pH 4.5 – 6.0)
Texture:	light sandy clay loam, sandy clay loam, or light clay, all normal plastic
Stickiness:	slight
Structure:	usually moderately pedal with sub-angular blocky peds 20 – 100mm breaking to 2 – 10mm diameter, and rough-faced porous ped fabric
Coherence:	moderate
Stone content:	usually 2 – 10% rounded and sub-rounded quartz lithic sandstone or ironstone pebbles occur up to 20mm in size
Roots:	many to common

Faunal mixing:	abundant
Inclusions:	charcoal fragments usually occur, rarely soft iron nodules also can occur
Boundary:	sharp or clear and usually wavy to layers 4 or 5

Layer 4 (moderately moist)

Diagnostic features:	brown, strongly pedal light medium clay
Occurrence:	sometimes present as a B1 horizon or upper subsoil layer, 9 – 23cm thick
Colour:	brown (7.5YR 4/6, 4/4) but ranges from dark reddish brown (5YR 3/4) to dull yellowish brown (10YR 5/4)
pH:	strongly to slightly acid (pH 4.5 – 6.0)
Texture:	usually light medium clay but also light clay or light sandy clay loam, all normal plastic
Stickiness:	slight to moderate
Structure:	strongly pedal with sub-angular blocky peds 20 – 100mm breaking to lenticular, angular blocky or sub-angular blocky peds <2 – 5mm diameter, and smooth-faced dense to slowly porous ped fabric
Coherence:	moderate to very strong
Stone content:	<2 – 10% rounded to angular lithic sandstone or ironstone pebbles occur up to 20mm in size
Roots:	many to common
Faunal mixing:	common
Inclusions:	charcoal fragments are usually present
Boundary:	clear to gradual and wavy to layer 5

Layer 5 (slightly moist to wet)

Diagnostic features:	reddish brown, pedal light medium clay
Occurrence:	always present as a B2, B21 horizon or master colour subsoil horizon, 8 – 51cm thick

Colour:	usually reddish brown (2.5YR 4/8, 5YR 4/6, 4/8) or dark reddish brown (2.5YR 3/6, 5YR 3/6); also brown (7.5YR 4/6, 10YR 4/4) and greyish brown (7.5YR 4/2, 5/2)
pH:	strongly to slightly acid (pH 4.5 – 6.0)
Texture:	light to light medium clays, normal plastic; rarely super–plastic heavy clays
Stickiness:	slight to moderate
Structure:	moderately to strongly pedal with sub–angular blocky, lenticular or prismatic peds 20 – 200mm breaking to lenticular, angular blocky or sub–angular blocky peds <2 – 10mm diameter, and smooth–faced slowly porous to dense ped fabric
Coherence:	moderate
Stone content:	0 – 10% rounded to angular quartz lithic sandstone or ironstone fragments may occur usually up to 20mm in size but sometimes up to 200mm diameter
Roots:	many to common
Faunal mixing:	common in the upper part of the layer but decreasing with depth
Inclusions:	charcoal fragments occasionally occur; rarely manganese or iron nodules also occur
Boundary:	gradual and wavy to layers 6, 7 or 9

Layer 6 (moderately moist)

Diagnostic features:	dark reddish brown, pedal light medium clay
Occurrence:	very rarely present as a B22 horizon or lower subsoil layer, <30 – 59cm thick
Colour:	dark reddish brown (2.5YR 3/4) or bright brown (7.5YR 5/6)
pH:	moderately acid (pH 5.0)
Texture:	light to light medium clay, normal plastic or super–plastic heavy clay
Stickiness:	slight

Structure:	strongly pedal with angular and sub-angular blocky peds 50 – 100mm breaking to lenticular and angular blocky peds 2 – 10mm diameter, and smooth-faced slowly porous ped fabric
Coherence:	moderate
Stone content:	<2% angular and sub-angular sedimentary fragments occur up to 200mm in size
Roots:	common
Faunal mixing:	uncommon
Inclusions:	none observed
Boundary:	clear to diffuse and wavy to layer 7

Layer 7 (moderately moist to wet)

Diagnostic features:	greyish yellow brown, pedal light medium clay
Occurrence:	commonly present as a B3 horizon or lower subsoil layer, 16 – 52+cm thick
Colour:	usually either greyish yellow brown (10YR 4/2) or yellowish brown (10YR 5/6) but can range from brown (7.5YR 4/6) to bright yellowish brown (10YR 6/6)
pH:	moderately to slightly acid (pH 5.0 – 6.0)
Texture:	normally light to light medium clay, all normal plastic and rarely super-plastic heavy clay
Stickiness:	slight to moderate
Structure:	moderately to strongly pedal with lenticular, angular blocky or sub-angular blocky peds 20 – 200mm breaking to <2 – 20mm diameter, and smooth-faced slowly porous to dense ped fabric
Coherence:	moderate
Stone content:	0 – 90%, but usually up to 10% sub-angular and angular sedimentary or ironstone fragments occur up to 20mm in size and occasionally up to 200mm in size
Roots:	few to common
Faunal mixing:	uncommon to rare

Inclusions: charcoal fragments are not normally observed and rarely, manganese nodules are observed

Boundary: clear to diffuse and wavy to layers 8, 9 or 10

Layer 8 (moderately moist)

Diagnostic features: none have been recorded for this layer

Occurrence: very rarely present as a transitional layer or BC horizon, 27+cm thick

Layer 9 (slightly to moderately moist)

Diagnostic features: very stony, weathered bedrock

Occurrence: always present but not always reached at depth as a C horizon or weathered parent material layer, at depth >52cm

Colour: not recorded

pH: not recorded

Texture: not obtainable

Stickiness: not obtainable

Structure: orthogonal to oblique planar void pattern is apparent

Coherence: not obtainable

Stone content: >90% angular stones are present up to 60mm in size

Roots: few to common

Faunal mixing: none

Inclusions: none

Boundary: sharp to gradual to layer 10

Layer 10 (slightly moist to dry)

Diagnostic features: rock

Occurrence: always present but usually not reached at depth as an R horizon or unweathered bedrock at >60cm depth

Colour: not recorded

pH:	not obtainable
Texture:	not obtainable
Stickiness:	not obtainable
Structure:	oblique to orthogonal planar void pattern is faintly observable
Coherence:	not obtainable
Stone content:	100% sedimentary rock
Roots:	not present
Faunal mixing:	none
Inclusions:	none

3.2.8 Soil Mapping Unit H - (soils developed on Marburg sediments)

3.2.8.1 Summary

These soils occur in three, widely separated localities in the management areas: the largest of the three localities occurs in the Sugarloaf, Keybarbin and part Mount Marsh State Forests, east of the Clarence River and east and north of Baryulgil. The smaller locality is in parts of Wollumbin and Nullum State Forests south-west of Murwillumbah, and the smallest site is in the eastern-most area of Tabbimoble State Forest, east of the Pacific Highway.

In general the terrain is gentle to flat, except for those areas where the bedrock outcrops as modified escarpments. In these instances the terrain tends to be steeper and quite broken (e.g. Site 0902).

The soils are generally dark coloured, sandy and weakly to moderately pedal in the topsoil and redder, clayey and moderately to strongly pedal in the subsoil.

In more detail then, a brownish black to very dark reddish brown, neutral to moderately acid, weakly to moderately pedal, weakly to moderately coherent, strongly bioturbated sandy (loamy sand to fine sandy clay loam) topsoil layer has a sharp boundary to either, sometimes a bleached, dull brown to greyish yellow brown, moderately acid, moderately pedal, weakly coherent, light sandy clay loam or sandy clay loam lower topsoil layer, or commonly a dark reddish brown to dull yellow orange, slightly acid, pedal, weakly to moderately coherent, commonly bioturbated, more clayey (fine sandy clay loam to medium clay) transition or upper subsoil layer, or both. These layers have a sharp to clear boundary to a dark reddish brown to bright yellowish brown, moderately acid, strongly pedal, coherent, commonly bioturbated, light, light medium or heavy clay master colour subsoil layer. This layer sometimes overlies a bright brown, moderately acid, pedal, light to light medium clay transition or lower subsoil layer, always over a strongly weathered iron–rich sandstone layer, below 58 – 72cm depth. This is occasionally observed to grade into unweathered rock below 96cm depth.

Of the eight description sites recorded within this unit, two were located in an upper slope situation (gradients ranging from 20% to 23%), one in a midslope situation (12%), two lower slope (5% – 9%), one hilltop flat (3%), and two ridgetop (12% – 40%).

3.2.8.2 Dominant soil materials

Northcote Codings: Uf 5.32; Gn 2.21, Gn 3.11; Dy 4.11, Dy 5.21, Dy 5.41

Great Soil Groups: Krasnozems, Yellow earths, Yellow podzolic soils

Surface Condition: loose to friable or crusting with a plant litter layer up to 1cm thick. Stones are usually present in amounts up to 20%. They may be angular to rounded and up to 200mm in size and consist of iron–rich sandstone fragments and quartz fragments

3.2.8.3 Description

Layer 1 (slightly moist to wet)

Diagnostic features: brownish black, weakly acid, pedal loamy sand to light clay

Occurrence: always present as an A, A1 horizon, 3 – 18cm thick

Colour: commonly brownish black (7.5YR 2/2, 10YR 2/2, 3/2) or very dark reddish brown (5YR 2/3)

pH: moderately acid to neutral (pH 5.5 – 7.0)

Texture: generally sandy but highly variable, ranging from loamy sand through to light clay with sandy loam, light sandy clay loam, loam fine sandy, silty clay loam and fine sandy clay loam being textured in between those two extremes

Stickiness: slight

Structure: weakly to strongly pedal with sub–angular blocky and round peds 10 – 100mm, breaking to sub–angular blocky, round, granular and crumb peds 2 – 10mm in size, and earthy or rough–faced porous
ped fabric

Coherence: weak to moderate

Stone content: usually 2 – 10% rounded to angular, iron–rich sandstone and quartz fragments are present up to 200mm in size but generally around 2 – 20mm in size

Roots:	many to abundant
Faunal mixing:	abundant
Inclusions:	charcoal fragments may occur
Boundary:	usually sharp and even to layers 2, 3 or 4

Layer 2 (slightly moist or wet)

Diagnostic features:	dull brown, acid, moderately pedal, light sandy clay loam or sandy clay loam
Occurrence:	sometimes present as a bleached A2 horizon, 18 – 21cm thick
Colour:	dull brown (7.5YR 5/4) or greyish yellow brown (10YR 6/2)
pH:	moderately acid (pH 5.0)
Texture:	either a light sandy clay loam or a sandy clay loam
Stickiness:	slight
Structure:	moderately pedal with sub-angular blocky and round peds 20 – 100mm in size breaking to 2 – 10mm diameter, and earthy, sandy or rough-faced porous ped fabric
Coherence:	very weak
Stone content:	<2 – 50% rounded, sub-rounded or sub-angular stones occur, ranging in size from 2 – 60mm. They consist of quartz and sedimentary fragments
Roots:	common
Faunal mixing:	many
Inclusions:	none observed
Boundary:	sharp and wavy to layers 3 or 4

Layer 3 (moderately moist to wet)

Diagnostic features:	dull yellow orange, slightly acid, pedal fine sandy clay loam
Occurrence:	commonly present as transition layer or B1 horizon, 23 – 30cm thick

Colour:	dull yellow orange (10YR 6/4) or bright yellowish brown (10YR 6/8); also dark reddish brown (2.5YR 3/4) and bright brown (7.5YR 5/6)
pH:	slightly acid (pH 6.0)
Texture:	usually clayey - fine sandy clay loam, silty light clay or medium clay, and rarely sandy - sandy loam, all normal plastic
Stickiness:	slight to moderate
Structure:	moderately to strongly pedal with sub-angular blocky and round peds 20 - 100mm breaking to 2 - 20mm diameter, and rough-faced or earthy porous ped fabric
Coherence:	very weak to moderate
Stone content:	<2 - 20% rounded and sub-rounded quartz and iron-rich sandstone fragments occur up to 60mm in size
Roots:	common
Faunal mixing:	common to many
Inclusions:	charcoal fragments are observed
Boundary:	clear to gradual and wavy to layer 4

Layer 4 (moderately moist to wet)

Diagnostic features:	dark reddish brown or bright yellowish brown, acid, pedal light to light medium clay
Occurrence:	always present as a master colour subsoil layer or B2, B21 horizon, 19 - 35cm thick
Colour:	dark reddish brown (5YR 3/6, 2.5YR 3/6) or bright yellowish brown (10YR 6/6) and includes other colours ranging from reddish brown (5YR 4/8) to yellowish brown (10YR 5/6)
pH:	moderately to slightly acid (pH 5.5 - 6.5)
Texture:	light clay to light medium clay, normal plastic. Other less common textures which can occur are sandy loam, sandy light clay or heavy clay, normal plastic
Stickiness:	usually slight (rarely moderate or non-sticky)

Structure:	moderately to strongly pedal with predominantly sub-angular blocky, with some lenticular, angular blocky and round peds 50 - 100mm breaking to lenticular, angular blocky or sub-angular blocky with some platy and round peds <2 - 20mm diameter, and smooth-faced dense or rough-faced porous ped fabric
Coherence:	weak to very strong
Stone content:	0 - 20% rounded and sub-rounded quartz and iron-rich sandstone fragments may occur up to 200mm in size
Roots:	common
Faunal mixing:	common
Inclusions:	charcoal was observed at some sites
Boundary:	diffuse or gradual and wavy to layers 5, 6 or 7

Layer 5 (wet)

Diagnostic features:	dull yellowish brown, alkaline, strongly pedal light medium clay
Occurrence:	rarely present as a lower subsoil layer or B22 horizon, 99+cm thick
Colour:	dull yellowish brown (10YR 5/4)
pH:	slightly alkaline (pH 8.0)
Texture:	light medium clay, normal plastic
Stickiness:	slight
Structure:	strongly pedal with lenticular peds 50 - 100mm breaking to 2 - 5mm diameter, and smooth-faced dense ped fabric
Coherence:	not recorded
Stone content:	2 - 10% sub-rounded to angular sedimentary fragments occur up to 200mm in size
Roots:	not recorded
Faunal mixing:	not recorded
Inclusions:	not recorded
Boundary:	not recorded

Layer 6 (slightly to moderately moist)

Diagnostic features:	bright brown, acid, pedal light medium clay
Occurrence:	sometimes present as a transition layer or B3 horizon, 27 - 48cm thick
Colour:	bright brown (7.5YR 5/6, 5/8) or reddish brown (2.5YR 4/8)
pH:	strongly to moderately acid (pH 5.0 - 5.5)
Texture:	light or light medium clay, normal plastic
Stickiness:	slight to moderate
Structure:	moderately to strongly pedal with sub-angular blocky and lenticular peds 20 - 100mm breaking to 2 - 10mm diameter, and smooth-faced dense ped fabric
Coherence:	not recorded
Stone content:	2 - 50% rounded to sub-angular, sedimentary fragments occur up to 200mm in size
Roots:	common
Faunal mixing:	many
Inclusions:	none observed
Boundary:	sharp and broken or diffuse to layers 7 or 8

Layer 7

Diagnostic features:	strongly weathered sandstone
Occurrence:	always present but not always reached at depth as a weathered rock layer or C horizon, at or below 58 - 72cm depth.

No other parameters were recorded for this layer

Layer 8

Diagnostic features:	unweathered rock
Occurrence:	always present but rarely reached at depth as an unweathered rock layer or R horizon, below 96cm depth

No other parameters were recorded for this layer

3.2.9 Soil Mapping Unit I - (soils developed on volcanics)

3.2.9.1 Summary

These soils occupy all of Whian Whian and Goonengerry State Forests, the majority of Nullum State Forest in the north-east, and a significant portion of Ewingar State Forest in the far west of the Casino Management Area.

The soils can be described as a brownish black, dark brown or dark reddish brown, slightly to strongly acid, strongly pedal, moderately coherent, strongly bioturbated, sandy clay loam, silty clay loam, silty clay or light clay topsoil layer usually over either a brownish black, acid, strongly pedal, coherent, strongly bioturbated, silty light clay or light clay lower topsoil layer or a dark reddish brown to bright yellowish brown, acid, pedal, coherent, strongly bioturbated silty light clay to light clay bleached or unbleached lower topsoil layer, or both, over a reddish brown, dull reddish brown or bright reddish brown, acid, strongly pedal, coherent, strongly bioturbated light to light medium clay upper subsoil layer over a dark reddish brown, reddish brown or bright reddish brown, acid, strongly pedal, coherent, strongly bioturbated light to light medium clay master colour subsoil layer over a strongly weathered igneous rock layer, below 47 - 91cm depth.

Of the 17 description sites recorded within this unit, eight were located in an upper slope situation (gradients ranging from 4% to 18%), two in a midslope situation (6% - 12%), one lower slope (10%), one hilltop (5%), and five ridgeline (9% - 40%).

3.2.9.2 Dominant soil materials

Northcote Codings: Uf 2, Uf 5.22, Uf 5.23, Uf 6.21, Uf 6.31; Gn 3.11, Gn 3.14, Gn 3.71, Gn 3.74, Gn 4.81; Dr 4.41; Dy 4.11

Great Soil Groups: Structured plastic and sub-plastic clays, Krasnozems, Red podzolic soils, Yellow podzolic soils

Surface Condition: usually self-mulching with a plant litter layer up to about 1cm thick with varying degrees of decomposing roots, twigs, leaves and bark, also charcoal fragments and up to 50% stones may occur. These are rounded to angular up to 600mm in size and are composed of igneous tuff

3.2.9.3 Description

Layer 1 (slightly to moderately moist)

Diagnostic features: brownish black, dark brown or dark reddish brown pedal silty clay loam to silty light clay

Occurrence:	always present as a topsoil layer or A, A1, A11 horizon 3 - 26cm thick
Colour:	commonly brownish black (5YR 2/2, 7.5YR 2/2, 3/2) dark brown (7.5YR 3/4, 3/3, 10YR 3/3) dark reddish brown (5YR 3/4, 3/3, 3/2, 3/6) or very dark reddish brown (2.5YR 2/2, 5YR 2/3)
pH:	strongly to slightly acid (pH 4.5 - 6.5)
Texture:	usually silty clay loam or silty light clay; also sandy clay loam or light clay, usually normal plastic with some sub-plastic
Stickiness:	usually moderate, sometimes slight
Structure:	moderately to strongly pedal, with sub-angular blocky and round peds 10 - 100mm breaking to crumbs, granular, round, sub-angular blocky, angular or lenticular peds <2 - 10mm diameter, and sandy, smooth-faced or rough-faced porous ped fabric
Coherence:	moderate to weak
Stone content:	0 - 50%, but usually 10 - 20% rounded to angular igneous tuff fragments occur up to 600mm in size
Roots:	abundant
Faunal mixing:	abundant
Inclusions:	charcoal fragments usually occur
Boundary:	usually sharp or clear and even or wavy to layers 2, 3, 4 or 6

Layer 2 (slightly to moderately moist)

Diagnostic features:	brownish black, pedal, silty light clay to light clay
Occurrence:	uncommonly present as a lower topsoil layer or A12 horizon, 11 - 24cm thick
Colour:	brownish black (7.5YR 2/2, 3/2, 10YR 2/3), and ranges from very dark reddish brown (2.5YR 2/3) to dull yellowish brown (10YR 5/4)
pH:	strongly to slightly acid (pH 4.5 - 6.5)
Texture:	usually silty light clay or light clay, all normal plastic, also sandy clay loam
Stickiness:	slight to moderate

Structure:	moderately to strongly pedal with sub-angular blocky and angular blocky peds 20 - 100mm breaking to crumb, granular, lenticular angular blocky or sub-angular blocky peds <2 - 10mm diameter, and smooth-faced or rough-faced porous ped fabric
Coherence:	moderate to weak
Stone content:	2 - 20% rounded to angular igneous tuff fragments occur up to 200mm in size
Roots:	usually abundant
Faunal mixing:	abundant
Inclusions:	charcoal fragments commonly occur
Boundary:	clear and even or wavy to layers 3, 4 or 6

Layer 3 (slightly to moderately moist)

Diagnostic features:	dark reddish brown or bright yellowish brown, pedal, light clay
Occurrence:	sometimes present as a lower topsoil layer or bleached and unbleached A2 horizon 7 - 38cm thick
Colour:	commonly dark reddish brown (5YR 3/4, 3/6) to brown (7.5YR 4/6, 10YR 4/6, 6/6) unbleached, or dark brown (7.5YR 5/6) to bright yellowish brown (10YR 6/6, 7/6) bleached
pH:	strongly to slightly acid (pH 4.5 - 6.0)
Texture:	usually silty light clay or light clay, also sandy clay loam or light medium clay, all normal plastic
Stickiness:	usually slight, sometimes moderate
Structure:	moderately to strongly pedal with sub-angular blocky, angular blocky or lenticular peds 10 - 100mm breaking to <2 - 10mm diameter, and smooth-faced slowly porous or rough-faced porous ped fabric
Coherence:	moderate to weak, sometimes strong
Stone content:	10 - 20% rounded and sub-rounded igneous or sedimentary rock fragments occur up to 200 mm in size
Roots:	many

Faunal mixing: abundant

Inclusions: charcoal fragments commonly occur

Boundary: usually sharp to clear and wavy to layers 4 or 6

Layer 4 (slightly to moderately moist)

Diagnostic features: reddish brown to bright reddish brown, pedal, light to light medium clay

Occurrence: sometimes present as an upper subsoil layer or B1, B11 horizon, 10 - 42cm thick

Colour: reddish brown (2.5YR 4/6, 5YR 4/6), bright reddish brown (5YR 5/6, 5/8) or dull reddish brown (5YR 4/4)

pH: strongly to slightly acid (pH 4.5 – 6.0)

Texture: light to light medium clay, or silty light clay, all normal plastic

Stickiness: slight to moderate

Structure: mainly strongly pedal with sub–angular blocky, angular blocky or lenticular peds 20 – 100mm breaking to angular blocky and lenticular peds <2 – 5mm diameter, and smooth–faced slowly porous or rough–faced porous ped fabric

Coherence: weak to moderate, sometimes strong

Stone content: 0 – 50% rounded to angular, igneous tuff fragments up to 600mm in size may occur

Roots: many

Faunal mixing: many to abundant

Inclusions: charcoal fragments may occur

Boundary: sharp to gradual and wavy to layers 5 or 6

Layer 5 (slightly to moderately moist)

Diagnostic features: bright reddish brown, strongly pedal light medium clay

Occurrence: rarely present as an upper subsoil layer or B12 horizon, 26cm thick

Colour:	bright reddish brown (5YR 5/6)
pH:	moderately acid (pH 5.5)
Texture:	light medium clay, normal plastic
Stickiness:	slight
Structure:	strongly pedal with sub-angular blocky peds 20 – 100mm breaking to angular blocky peds <2mm diameter, and smooth-faced slowly porous ped fabric
Coherence:	moderate
Stone content:	no stones are present
Roots:	many
Faunal mixing:	abundant
Inclusions:	charcoal fragments are commonly observed
Boundary:	wavy to layer 6

Layer 6 (slightly to moderately moist)

Diagnostic features:	dark reddish brown to bright reddish brown, pedal light to light medium clay
Occurrence:	always present as a master colour subsoil layer or B2 horizon 27 – 193+cm thick
Colour:	commonly dark reddish brown (2.5YR 3/6), reddish brown (2.5YR 4/8) or bright reddish brown (5YR 5/8); colours range from brown (7.5YR 4/3) to bright yellowish brown (10YR 6/6)
pH:	strongly to slightly acid (pH 4.0 – 6.0)
Texture:	usually light to light medium clay, normal plastic; also sandy light clay or silty light clay
Stickiness:	slight to moderate
Structure:	moderately to strongly pedal with lenticular, sub-angular blocky or angular blocky peds 20 – 100mm, breaking to lenticular or angular blocky peds <2 – 5mm diameter, and smooth-faced slowly porous or rough-faced porous ped fabric

Coherence: moderate to weak

Stone content: 0 - >90% rounded to angular igneous fragments may occur up to 600mm in size

Roots: common to many

Faunal mixing: many to abundant

Inclusions: charcoal fragments sometimes occur

Boundary: sharp to gradual and wavy to layers 7, 8 or 9

Layer 7 (slightly to moderately moist)

Diagnostic features: dark reddish brown, pedal light to light medium clay

Occurrence: rarely present as a lower subsoil layer or B3 horizon, 36+cm thick

Colour: dark reddish brown (5YR 3/6), bright brown (2.5YR 5/8) or yellow orange (7.5YR 7/8)

pH: strongly acid (pH 4.5)

Texture: light to light medium clay, normal plastic

Stickiness: slight to moderate

Structure: moderately to strongly pedal with lenticular and sub-angular blocky peds 20 - 100mm, breaking to lenticular and angular blocky peds <2mm diameter, and smooth-faced slowly porous ped fabric

Coherence: moderate

Stone content: 0 - 50% rounded and sub-rounded igneous fragments may occur up to 60mm in size

Roots: common

Faunal mixing: uncommon to rare

Inclusions: sometimes charcoal fragments may occur

Boundary: not reached at depth

Layer 8 (slightly moist)

Diagnostic features: a mixture of strongly weathered rock fragments and soil

Occurrence:	probably often present but not usually reached at depth as a transitional layer or BC horizon, at 130cm depth and thickness is 70+cm

No other parameters were recorded for this layer

Layer 9

Diagnostic features:	strongly weathered igneous bedrock
Occurrence:	always present but not usually reached at depth as a weathered bedrock layer or C horizon, below 47 – 91cm depth
Stone content:	> 90% rounded to sub-rounded igneous rock fragments up to 600mm in size occur
Roots:	rare
Faunal mixing:	absent
Inclusions:	absent
Boundary:	boundary was not reached at depth

No other parameters have been recorded for this layer

3.3 SOIL LABORATORY ANALYSIS

Various soil samples were collected from throughout the study area for a range of laboratory analyses. The results of these analyses are presented below.

3.3.1 Results

3.3.1.1 Physical Analyses

Laboratory analyses were carried out on 122 soil samples collected from a total of 34 sampling sites. The results of these physical analyses, presented below in Table 4, have been grouped into the nine different soil mapping units.

Note that two different sets of values are presented for the Particle Size Analysis test. One set of values represents the results which include the percentage proportion of gravels, while the second set of values, presented inside square brackets (i.e. [ ]) represents the results where the proportion of gravels has been excluded.

TABLE 4: Results of soil laboratory physical analyses

Site	Layer	Horizon	PARTICLE SIZE ANALYSIS (%) Clay	Silt	Fine Sand	Coarse Sand	Gravel	D%	EAT
Soil Mapping Unit A - Alluvials									
1301	1	A11	22 [26]	15 [18]	47 [55]	1 [1]	15	6	8
1301	2	A12	28 [34]	25 [30]	29 [35]	1 [1]	17	21	8
1301	3	B2	27 [52]	10 [19]	15 [29]	0	48	19	3(2)
1301	4	D1	31 [66]	6 [13]	10 [21]	0	53	11	3(1)
1306	1	A1	12	9	24	55	0	21	8
1306	2	A2	14 [14]	5 [5]	24 [25]	55 [56]	2	21	2(1)
1306	3	B2	12	6	26	56	0	17	2(1)
Soil Mapping Unit B - Basalts									
0102	1	A	23 [31]	23 [31]	20 [26]	9 [12]	25	18	8
0102	2	B2	54 [66]	12 [15]	11 [13]	5 [6]	18	11	6
0201	1	A11	18 [25]	27 [37]	25 [35]	2 [3]	28	19	8
0201	2	A12	20 [28]	26 [36]	24 [33]	2 [3]	28	26	3(3)
0201	3	B2	20 [34]	15 [26]	21 [36]	2 [4]	42	20	3(1)
0201	4	B3	16 [25]	10 [15]	29 [45]	10 [15]	35	30	3(3)
0503	1	A	20 [27]	22 [29]	29 [39]	4 [5]	25	5	3(2)
0503	2	B1	18 [32]	14 [25]	22 [39]	2 [4]	44	14	3(2)
0503	3	B2	21 [41]	10 [20]	19 [37]	1 [2]	49	17	3(1)
0503	4	B3	17 [29]	11 [19]	21 [36]	9 [16]	42	22	3(3)
1201	1	A	14 [16]	27 [31]	38 [44]	8 [9]	13	16	8
1201	2	B2	45 [54]	16 [19]	19 [22]	4 [5]	16	5	2(1)
1201	3	B3	43 [54]	14 [17]	22 [28]	1 [1]	20	23	3(3)
1701	1	A1	32 [44]	15 [21]	18 [25]	7 [10]	28	8	8
1701	2	A2	61 [66]	16 [17]	13 [14]	3 [3]	7	13	3(1)
1701	3	B1	72 [74]	14 [14]	9 [9]	3 [3]	2	1	5
1701	4	B2	78 [81]	13 [13]	3 [3]	3 [3]	3	1	5
1801	1	A	22 [31]	16 [23]	23 [33]	9 [13]	30	19	2(1)
1801	2	B1	21 [30]	13 [18]	28 [39]	9 [13]	29	30	2(1)
1801	3	B2	23 [34]	13 [19]	21 [31]	10 [16]	33	36	2(1)
Soil Mapping Unit C - Metasediments									
1401	1	A	10 [21]	15 [31]	16 [33]	7 [15]	52	22	8
1401	2	B2	15 [21]	25 [35]	19 [27]	12 [17]	29	70	2(2)
2202	1	A	26 [31]	14 [16]	39 [46]	6 [7]	15	3	8
2202	2	B11	41 [43]	17 [18]	36 [37]	2 [2]	4	11	3(2)
2202	3	B12	45 [46]	17 [17]	36 [36]	1 [1]	1	15	3(1)
2202	4	B2	51 [55]	17 [18]	23 [26]	1 [1]	8	3	2(1)
Soil Mapping Unit D - Granitoids									
2101	1	A1	10 [10]	20 [21]	56 [59]	10 [10]	4	25	8
2101	2	A2	12 [14]	19 [22]	40 [47]	15 [17]	14	30	2(1)
2101	3	B2	12 [24]	6 [12]	22 [45]	9 [19]	51	21	2(1)

Site	Layer	Horizon	PARTICLE SIZE ANALYSIS (%) Clay	Silt	Fine Sand	Coarse Sand	Gravel	D%	EAT
Soil Mapping Unit D cont'd									
2404	1/2	A11/A12	10 [12]	4 [5]	25 [30]	44 [53]	17	17	8
2404	3	A3	14 [16]	9 [10]	24 [26]	43 [48]	10	17	8
2404	4	B1	32 [37]	5 [6]	20 [23]	30 [34]	13	3	3(2)
2404	5	B2	43 [49]	5 [6]	17 [20]	22 [25]	13	2	3(1)
2501	1	A1	9 [16]	6 [11]	21 [36]	21 [37]	43	15	8
2501	2	A2	13 [19]	8 [12]	18 [26]	29 [43]	32	22	8
2501	3	B1	16 [23]	10 [14]	13 [19]	30 [44]	31	37	2(1)
2501	4	B2	21 [34]	8 [13]	9 [15]	23 [38]	39	20	2(1)
Soil Mapping Unit E - Grafton Formation									
1109	1	A1	13 [16]	19 [23]	48 [57]	3 [4]	17	20	2(1)
1109	2	A2	17 [23]	19 [25]	36 [48]	3 [4]	25	35	2(1)
1109	3	B2	42 [54]	13 [17]	23 [29]	0 [0]	22	22	2(1)
1109	4	B3	39 [52]	13 [17]	22 [30]	1 [1]	25	28	2(1)
1114	1	A11	20 [23]	15 [17]	37 [44]	14 [16]	14	22	8
1114	2	A12	12 [13]	27 [30]	42 [47]	9 [10]	10	40	2(1)
1114	3	A2	10 [12]	31 [37]	37 [44]	6 [7]	16	59	2(3)
1114	4	B2	42 [54]	8 [10]	23 [30]	5 [6]	22	9	2(1)
1114	5	B3	28 [39]	13 [18]	24 [34]	6 [9]	29	54	2(3)
1124	1	A1	7 [8]	8 [8]	41 [42]	42 [43]	2	40	2(1)
1124	2	A2	6 [6]	13 [14]	30 [32]	45 [48]	6	58	2(1)
1124	3	B2	37 [48]	4 [5]	23 [30]	13 [17]	23	32	2(1)
Soil Mapping Unit F - Kangaroo Creek Sandstone									
0601	1	A11	14 [15]	12 [12]	38 [39]	33 [34]	3	5	8
0601	2	A12	20 [22]	12 [13]	26 [29]	33 [36]	9	12	2(1)
0601	3	B1	29 [30]	10 [10]	18 [19]	40 [41]	3	12	2(1)
0601	4	B21	30 [30]	7 [7]	15 [15]	47 [48]	1	9	2(2)
0601	5	B22	25 [26]	6 [6]	9 [9]	57 [59]	3	14	2(2)
0601	6	B3	24 [38]	11 [17]	18 [29]	10 [16]	37	7	2(2)
0602	3	B21	5	10	40	45	0	55	8
0707	1	A1	5	5	22	68	0	57	8
0707	2	A2	6	4	28	62	0	62	3(2)
0707	3	B1	7 [7]	2 [2]	32 [32]	58 [59]	1	75	n.a.
0707	4	B2	5 [7]	1 [2]	18 [26]	45 [65]	31	75	n.a.
Soil Mapping Unit G - Walloon Coal Measures									
0404	1	A11	16 [17]	15 [16]	47 [52]	14 [15]	8	42	8
0404	2	A12	22 [26]	15 [18]	36 [42]	12 [14]	15	15	3(2)
0404	3	B2	29 [40]	11 [15]	27 [37]	6 [8]	27	30	3(3)
0404	4	B3	29 [38]	10 [13]	32 [41]	6 [8]	23	46	2(2)
0407	1	A	29 [38]	12 [16]	31 [41]	4 [5]	24	9	2(2)
0407	2	B2	39 [53]	10 [14]	22 [30]	2 [3]	27	25	5
0407	3	B3	36 [43]	20 [24]	23 [28]	4 [5]	17	33	2(2)

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Site	Layer	Horizon	PARTICLE SIZE ANALYSIS (%) Clay	Silt	Fine Sand	Coarse Sand	Gravel	D%	EAT
Soil Mapping Unit G cont'd									
0408	1	A	32 [40]	20 [25]	27 [33]	2 [2]	19	26	2(1)
0408	2	B2	36 [46]	18 [23]	22 [28]	2 [3]	22	31	2(1)
0408	3	B3	28 [57]	9 [18]	11 [23]	1 [2]	51	42	2(2)
0413	1	A	27 [29]	26 [28]	35 [37]	6 [6]	6	15	3(2)
0413	2	B1	39 [43]	25 [27]	19 [21]	8 [9]	9	13	2(1)
0413	3	B21	47 [56]	15 [18]	18 [21]	4 [5]	16	5	2(1)
0413	4	B22	51 [63]	12 [15]	15 [18]	3 [4]	19	3	2(1)
0415	1	A1	10 [11]	20 [22]	58 [64]	3 [3]	9	26	8
0415	2	A2	12 [17]	14 [19]	43 [60]	3 [4]	28	48	2(1)
0415	3	B2	46 [62]	9 [12]	17 [23]	2 [3]	26	10	2(2)
1002	1	A11	12 [13]	13 [14]	36 [38]	33 [35]	6	30	8
1002	2	A12	13 [15]	12 [14]	35 [40]	28 [31]	12	33	2(1)
1002	3	A2	12 [15]	9 [12]	34 [44]	23 [29]	22	59	2(2)
1002	4	B2	30 [35]	5 [6]	22 [25]	29 [34]	14	26	2(2)
Soil Mapping Unit H - Marburg Sediments									
0802	1	A	18 [22]	8 [10]	48 [58]	8 [10]	18	36	2(1)
0802	2	B2	44 [48]	7 [8]	39 [42]	2 [2]	8	25	3(3)
0802	3	B3	31 [41]	8 [11]	34 [44]	3 [4]	24	24	3(2)
0902	1	A1	5 [6]	4 [5]	40 [52]	29 [37]	22	60	3(2)
0902	2	A2	6 [10]	6 [10]	19 [32]	29 [48]	40	64	n.a.
0902	3	B2	23 [27]	5 [6]	49 [59]	7 [8]	16	61	2(2)
0902	4	B3	29 [35]	9 [11]	41 [50]	3 [4]	18	54	2(2)
1601	1	A	19 [22]	11 [12]	38 [43]	20 [23]	12	14	8
1601	2	B1	25	16	42	17	0	57	2(1)
1601	3	B2	25	19	43	13	0	53	2(2)
2001	1	A1	7 [7]	7 [7]	48 [49]	37 [37]	1	38	2(1)
2001	2	A2	6 [6]	7 [7]	39 [41]	44 [46]	4	63	2(1)
2001	3	B1	38 [48]	6 [8]	17 [22]	17 [22]	22	44	2(1)
2001	4	B2	44 [47]	6 [6]	18 [20]	25 [27]	7	37	2(1)
Soil Mapping Unit I - volcanics									
1501	1	A1	11 [19]	13 [22]	22 [38]	12 [21]	42	12	8
1501	2	A2	20 [29]	18 [26]	17 [25]	14 [20]	31	18	2(1)
1501	3	B1	22 [32]	16 [24]	16 [24]	14 [20]	32	36	2(1)
1501	4	B2	36 [51]	8 [11]	14 [21]	12 [17]	30	4	5
1903	1	A1	26 [38]	15 [22]	22 [31]	6 [9]	31	12	8
1903	2	A2	41 [49]	22 [26]	18 [21]	3 [4]	16	0	3(1)
1903	3	B2	50 [56]	21 [23]	17 [19]	2 [2]	10	2	5
1902	4	B3	49 [54]	23 [26]	14 [16]	4 [4]	10	0	5

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Site	Layer	Horizon	PARTICLE SIZE ANALYSIS (%) Clay	Silt	Fine Sand	Coarse Sand	Gravel	D%	EAT
Soil Mapping Unit I cont'd									
1908	1	A11	18 [20]	16 [18]	36 [41]	19 [21]	11	8	8
1908	2	A12	23 [26]	18 [20]	30 [33]	19 [21]	10	9	8
1908	3	A2	26 [30]	17 [20]	22 [26]	20 [24]	15	16	2(1)
1908	4	B1	26 [36]	12 [17]	20 [28]	14 [19]	28	5	2(1)
1908	5	B2	14 [22]	6 [9]	37 [58]	7 [11]	36	7	2(1)
2302	1	A	15 [19]	10 [13]	44 [56]	9 [12]	22	4	8
2302	2	B1	20 [23]	18 [21]	41 [48]	7 [8]	14	3	8
2302	3	B2	28 [38]	18 [25]	23 [32]	4 [5]	27	2	3(3)
2303	1	A	16 [16]	26 [27]	50 [51]	6 [6]	2	20	3(2)
2303	2	B11	31 [32]	23 [24]	40 [42]	2 [2]	4	24	3(1)
2303	3	B12	41 [46]	17 [19]	29 [32]	3 [3]	10	11	6
2303	4	B2	48 [49]	20 [20]	30 [31]	0	2	3	2(1)

n.a. = not attainable

3.3.1.2 Organic Matter

Samples from the surface layer and the top of the subsoil layer at each of the 33 sampling sites were analysed to determine organic matter content. This information, required for consideration in Section 4, is presented below.

TABLE 5: Results of Organic Matter content

ORGANIC MATTER TOPSOIL Site	Horizon	Depth (cm)	OM %	SUBSOIL Site	Horizon	Depth (cm)	OM %
Soil Mapping Unit A - Alluvials							
1301	A11	0-3	20.50	1301	B2	8-23	4.59
1306	A1	0-17	1.39	1306	B2	42-80+	0.138
Soil Mapping Unit B - Basalts							
0102	A	0-45	4.00	0102	B2	45-90	1.44
0201	A11	0-12	5.50	0201	B2	40-94	1.23
0503	A	0-3	8.03	0503	B1	3-27	4.53
1201	A	0-7	8.82	1201	B2	7-56	2.10
1701	A1	0-24	9.39	1701	B1	43-90	1.42
1801	A	0-12	4.41	1801	B1	12-57	0.993

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ORGANIC MATTER

TOPSOIL Site	Horizon	Depth (cm)	OM %	SUBSOIL Site	Horizon	Depth (cm)	OM %
Soil Mapping Unit C - Metasediments							
1401	A	0–22	7.11	1401	B2	22–65	1.45
2202	A	0–13	15.30	2202	B11	13–26	7.68
Soil Mapping Unit D - Granitoids							
2101	A1	0–15	7.07	2101	B2	38–60+	0.677
2404	A11/12	0–10	3.30	2402	B1	20–36	0.841
2501	A1	0–30	8.82	2501	B1	48–67	1.04
Soil Mapping Unit E - Grafton Formation							
1109	A1	0– 4	13.00	1109	B2	9–38	1.00
1114	A11	0– 7	3.38	1114	B2	35–49	0.802
1124	A1	0– 5	4.80	1124	B2	32–75+	0.464
Soil Mapping Unit F - Kangaroo Creek Sandstone							
0601	A11	0– 7	8.26	0601	B1	16–33	0.975
0707	A1	0–15	2.02	0707	B1	43–70	0.332
Soil Mapping Unit G - Walloon Coal Measures							
0404	A11	0–10	2.83	0404	B2	25–33	0.586
0407	A	0– 3	7.06	0407	B2	3–19	1.61
0408	A	0– 9	6.24	0408	B2	9–47	4.35
0413	A	0–16	6.48	0413	B1	16–32	2.55
0415	A1	0–27	4.21	0415	B2	53–76+	0.777
Soil Mapping Unit H - Marburg Sediments							
0802	A	0– 5	3.94	0802	B2	5–40	0.860
0902	A1	0– 5	7.22	0902	B2	22–48	0.611
1601	A	0–12	7.37	1601	B1	12–35	0.533
2001	A1	0– 3	4.63	2001	B1	24–54	1.32
Soil Mapping Unit I - volcanics							
1501	A1	0–16	11.30	1501	B1	38–62	1.22
1903	A1	0–16	5.04	1903	B2	35–81	0.269
1908	A11	0– 6	9.91	1908	B1	37–53	1.51
2302	A	0–15	16.40	2302	B1	15–57	10.20
2303	A	0–16	7.86	2303	B11	16–29	3.37

3.3.2 Discussion of Results

The results shown in Table 4 assist in the determination of the degree of erodibility of each of the soil units within the study area. Each of the three physical tests undertaken indicate specific aspects of the soil and its behaviour to erosive forces. When the results of these tests are combined, a good overview of the soil's erodibility is gained.

3.3.2.1 Particle Size Analysis

The Particle Size Analysis test (PSA) proportions the amounts of clay, silt, fine sand, coarse sand and gravel which exist in a given sample, on a percentage basis. Thus, layer 1 of sample 1301 consists of 22% clay, 15% silt, and so on, including 15% gravel. To negate the effect of the gravel content, and concentrate only on the soil fraction (i.e. <2 mm), the proportion of clay, silt, fine sand and coarse sand on a percentage basis have been recalculated and are presented as the value in the square brackets. Thus, without gravel content, layer 1 of sample 1301 consists of 26% clay, 18% silt, and so on.

Given the geological basis of the soil mapping, the soils tested reflect the lithology from which they have been formed. The fine-grained soils derived from the metasediments, basalts and volcanics have the highest clay contents (excluding gravels) while the granitic soils are the sandiest soil unit. Note also that in most cases, the soils are gravelly throughout.

3.3.2.2 Dispersion Percentage

The Dispersion Percentage (D%) test indicates the proportion of the soil fraction less than 0.005 mm (i.e. the clay and some of the fine silt material) that will disperse on wetting. Consequently, the results of this test should normally be read in conjunction with the PSA results.

A sample which has a very high D% value (e.g. 90%) and a high clay content (e.g. 45%) would be more dispersive than a sample with the same D% value and a low clay content (e.g. 10%).

An interpretation of the D% values can be based on the following, taken from Simpson & Veness (1984):

TABLE 6: Interpretation of D% values

D % Value	Comment
>67%	severely erodible; unstable
37–67%	moderately erodible
17–37%	slightly erodible
<17%	stable

It should be noted that the interpretation of these values should also take into account the PSA and EAT (see Section 3.3.2.3) data.

When the results of the Dispersion % values in Table 4 are read in this context, none of the soils sampled within the study area has a high dispersion problem. Two thirds of the 17 samples with a medium dispersion value (say, greater than 50 - 60%) have a correspondingly low to medium clay content (i.e. less than 20% when the gravels are excluded) while the remaining six samples have medium to high clay contents ranging from 21% [without gravels] (1401 layer 2) to 39% (1114/5).

All of the soils derived from sediments (i.e. soil mapping units E, F, G and H) have D% values ranging from very low (3%) to high (75%). Likewise, the metasediment-derived soils range from very low (3%) to high (70%). The D% values for the alluvial soils are very low to low (6% to 21%) as they are for the basaltic soils (1% to 36%), the granitic soils (2% to 37%), and the volcanically derived soils (2% to 36%). None of the samples tested recorded very high D% values.

Throughout the study area, each of the 36 samples with high clay contents (> 40%), especially without gravels, correspond to very low to low D% values (up to 50%), with fourteen of these samples recording D% values of <10%. It is interesting to note that the highest D% values generally correspond to low clay contents while the highest clay contents generally correspond to low or very low D% values.

Thus, from a Dispersion Percentage point of view, all of the soils in the study area, represented by the results of those tested in Table 4, are considered to be stable, with a generally low, but sometimes moderate, erosion potential.

3.3.2.3 Emerson Aggregate Test

The Emerson Aggregate Test (EAT) classifies soil aggregates based on their coherence when immersed in water. As stated in Houghton & Charman (1986), this test uses natural peds, with the first separation being based on slaking. Those aggregates that do not slake are placed in class 7 if they swell and class 8 if they do not. Of those which do slake, those which show complete soil dispersion are placed in class 1 and those showing only partial dispersion are placed in class 2. Those showing no dispersion are remoulded and reimmersed in water. Aggregates which disperse after remoulding are placed in class 3 and those which do not are further separated by the presence or absence of carbonate or gypsum. Those with carbonate or gypsum fall into class 4 while those without are made up into a 1:5 soil:water suspension and shaken. Those soils which then show dispersion are placed in class 5 and those which show flocculation fall into class 6. Classes 2 and 3 are further subdivided into four subclasses with an increasing tendency to disperse with an increase in numerical value. The degree of stability of soils increases from class 1 through to class 8, with classes 1 and 2 generally being considered to be unstable, class 3 generally considered to be stable while classes 4 to 8 are considered to be stable. (Charman, 1978).

As shown in Table 4, there is a range of EAT values for the samples tested. EAT values for three samples (site 0707, layers 3 & 4, and site 0902 layer 2) could not be attained due to the lack of naturally occurring aggregates. Of the other 119 samples 48% (57 samples) have a class 2 EAT, 22% (26 samples) have a class 3 EAT and the remaining 30% (36 samples) have EAT classes 5 to 8.

The samples having a class 2 EAT value range from very low clay contents of 6% [without gravels] (1124/2 and 2001/2) to very high clay contents up to 63% [without gravels] (0413/4). Those samples with high to very high clay contents generally have low D% values while conversely, those samples with low clay contents usually have up to medium to high D% values. Consequently the soil layers represented by these class 2 EAT values are considered to have a generally moderate, but sometimes low, erosion potential.

The 26 class 3 samples have very low to low D% values, ranging from 0% to 30% (with the exception of 0902/1 and 0707/2 which have D% values of 60% and 62% but only 6% clay contents), and generally medium to high clay contents. The soil layers represented by these class 3 samples are thus considered to have a generally low erosion potential.

The remaining 36 samples which have EAT values of 5 to 8 are, by definition, considered to be stable. There is a good correlation between these samples and very low to low and sometimes medium (0602/3 and 0707/1) D% values, despite clay contents ranging from 5% to 81% (without gravels).

From an EAT point of view therefore, the soils in the study area are considered to range from a generally low erosion potential to a sometimes moderate erosion potential.

4.0 EROSION HAZARD

Due to the historical evolution of this report, erosion hazard has been examined in three ways, each placing emphasis on slightly different aspects. The first simply examines the laboratory results and marries the soils' predicted behaviour to field observation and the authors' experience. The second examines the soils through the SEMGL Appendix 1 and Appendix 2 which use descriptive variables to determine erodibility and erosion hazard. The third uses CaLM's SOILOSS computer program to calculate the USLE 'K' factor and the predicted soil loss for a given set of parameters. The results of each of these, while not significantly differing from each other, are presented in this chapter.

4.1 METHOD 1: PRE SEMGL ASSESSMENT

In the original version of this report, erosion hazard was assessed within the framework of the definition given by Houghton & Charman (1986). By this definition erosion hazard is determined by the susceptibility of a parcel of land to the prevailing agents of erosion. It is dependent on a combination of climate, landform, soil, land use and land management factors. The qualitative categories of erosion hazard used are low, moderate, high, very high and extreme.

Extreme erosion hazard implies that erosion will occur to such an extent that it will be normally uneconomic to address satisfactorily. Very high erosion hazard implies significant erosion occurring during and after development, even with intensive soil conservation measures. High erosion hazard implies significant erosion during development, with short-term erosion controlled by simple soil conservation measures but long-term erosion control requiring intensive measures. Moderate erosion hazard implies that significant erosion may occur during development, but short- and long-term erosion problems can be avoided by adopting appropriate soil conservation measures during development. Low erosion hazard results in no appreciable erosion during or after development.

This assessment found that the lands within the Casino / Murwillumbah EIS study area under a forest land use and under a forest harvesting land management operation, as is currently practised by NSW State Forests, would incur a low to moderate erosion hazard based on the Houghton & Charman definition. Consequently, this implies that significant erosion may occur during development of the particular land use (in this case forestry operations). However, provided appropriate soil conservation measures are adopted during development both short-term and long-term erosion problems may be avoided (Houghton & Charman, 1986).. The soil erosion and sedimentation safeguards contained within the SEMGL are appropriate in respect of these measures, as discussed below in Section 5.

4.2 METHOD 2 & 3: EROSION HAZARD ASSESSMENT BASED ON SEMGL

4.2.1 Methodology

Both of these methods are based on a technique originally developed by CaLM (1992) which uses a computer program, SOILOSS (Rosewell & Edwards, 1988) to generate predicted soil loss values as an indicator of erosion hazard. SOILOSS is based on the Universal Soil Loss Equation or USLE (Wischmeier & Smith, 1978):

$$A = R * K * L * S * P * C$$

where

A	is the average annual soil loss (t/ha)
R	is the rainfall erosivity factor
K	is the soil erodibility factor
L	is the slope length factor
S	is the slope steepness factor
P	is the support practice factor, a measure of the effect on erosion of soil conservation measures such as contour cultivation and bank systems
C	is the crop and cover management factors

In order to obtain an erosion hazard from the calculated soil loss, the following erosion hazard classes have been defined (CaLM, 1993):

Class	**Soil Loss**
LOW	<40 t/ha/yr
MODERATE	40 – 400 t/ha/yr
HIGH	400 – 800 t/ha/yr
EXTREME	>800 t/ha/yr

The USLE output is in tonnes/hectare/year i.e. it is the long–term average value based on the factor inputs also being long–term averages. Because of the revegetation and long rotation aspects of forest management CaLM adopted the assumption that the entire predicted soil loss occurs in year 1 and so the figures provided above would be divided by the rotation length to give an actual average annual soil loss for the whole rotation.

One of the key factor inputs, soil erodibility (K), can be determined from laboratory data (soil particle size analysis, organic matter) and structure and profile permeability. SOILOSS has a subroutine to calculate K from these inputs. Appendix 1 (ii) of the SEMGL provides a means of estimating K if laboratory data is not available. Appendix 2 (ii) of the SEMGL provides a method of determining erosion hazard from varying combinations of K, S and R.

Method 2 below is based solely on the appendices from the SEMGL. Method 3 estimates erosion hazard directly from the SOILOSS program (versions earlier than 5.1).

4.2.2 Method 2: Applying SEMGL Appendices 1 and 2

4.2.2.1 Soil erodibility

Data from each of the soil mapping units were collated in to the format of the soil erodibility classification as set out in Appendix 1 (ii) of the SEMGL. The results are attached to this report at Appendix 2 and the results summarised below in Table 7. It can be seen that the results do not significantly differ from the conclusion reached by Method 1.

Despite the similarity in results with Method 1, some problems are experienced in applying Appendix 1 (ii) to forest soils of the study area. Organic matter contents in the forest soils cover a range much greater than that of the appendix. Twenty nine out of the 33 topsoil samples exceeded the 3% value considered to indicate topsoils of high organic matter content. Likewise, 17 out of the 33 subsoil samples exceeded the subsoil 1% value. The choices of soil structure, texture and lithology did not cover the conditions for the forest soils. Nor do many of the forest soils easily fit the soil classifications in the SEMGL Appendix. Much of the data collected during the soil survey of the study area is not catered for in the appendix which is not surprising since the original source was aimed at agricultural rather than forest soils.

TABLE 7: Summary of soil erodibility classification for each soil mapping unit, based on the SEMGL's Appendix 1 (ii)

Soil Mapping Unit	SOIL ERODIBILITY CLASSIFICATION Whole Unit	Topsoil	Subsoil
A (alluvials)	low to moderate	low to moderate	low to moderate
B (basalts)	generally low, sometimes mod	low	low to moderate
C (metased's)	generally low, sometimes mod	low	low to moderate
D (granitoids)	low to moderate	low	low to moderate
E (Grafton Form'n)	low to moderate	low to moderate	moderate
F (K'roo Ck ss)	low to moderate	low to moderate	low to moderate
G (Walloon Coal)	low to moderate	low to moderate	low to moderate
H (Marburg Seds)	low to moderate	low to moderate	low to moderate
I (volcanics)	low, sometimes moderate	low, sometimes mod	low, sometimes mod

4.2.2.2 Erosivity

Erosivity is the "potential ability to cause erosion" (Houghton & Charman, 1986) and is commonly referred to in respect of rainfall. An erosivity map of the study area, prepared from data contained within Australian Rainfall and Runoff (Pilgrim, 1987) according to the method of Rosewell & Turner (1992) was prepared by the Forestry Commission (Figure 1a and 1b in Appendix 5). Also refer to Maps 5 and 6 in Volume A of the Casino Management Area EIS.

4.2.2.3 Slopes and Erosion Hazard Classes

Appendix 2 (i) of the SEMGL utilises soil erodibility (from Appendix 1 (ii)), slope and rainfall erosivity to produce four classes of erosion hazard viz, low, moderate, high and extreme.

To determine erosion hazard in the SEMGL context, the study area was examined to determine the maximum slope gradients for the range of erosivities, on a per soil unit basis (using Figures 1a and 1b), in order to determine erosion hazard classes occurring within each soil mapping unit. (The relevant CMA 1:25 000 topographic maps were used to measure slope gradients. This exercise was not meant to be a slope analysis study. It did not record the range of slopes occurring within each Soil Mapping Unit but rather gave an indication of the maximum slopes occurring. Consequently, neither lower slopes nor necessarily the highest occurring slope values have been recorded. However, it should be appreciated that the "maximum" slopes recorded do actually occur.) The data generated by this exercise is presented in Appendix 3 for each of the Soil Mapping Units. The results of this exercise are summarised below in Table 8.

The authors have some difficulty reconciling the definition of erosion hazard in Houghton & Charman (1986), with some of the assessed erosion hazard classes in Table 8. This viewpoint stems from examination of the study area as it exists today through API and extensive fieldwork. Despite decades of past forestry activity, there is no real evidence to support the high to extreme erosion hazard classifications, the ramifications of which, according to the definition of Houghton a & Charman, would otherwise be observable. Nevertheless, extreme erosion hazard has been found to exist within soil mapping units B, C, D, E, F, G, H and I. Appendix 3 shows the erosivity and slope circumstances under which high or extreme hazard occurs in each mapping unit. These conditions could be used as a warning to managers that wherever they exist, more detailed erosion hazard assessment and more careful harvest planning is required.

TABLE 8: Summary of soil erosion hazard classification for each soil mapping unit, based on the SEMGL's Appendix 2 (ii)

Soil Mapping Unit	Appendix 2 (ii) Erosivity	SEMGL Erosion Hazard Class
A	<4000	Moderate
B	<4000	Moderate to High
	<6000	Extreme
	<8000	High to Extreme
C	<2000	Moderate
	<4000	Moderate to High
	<8000	Extreme
D	<2000	Moderate to High
	<4000	Extreme
E	<4000	Moderate to Extreme
F	<4000	Moderate to Extreme
G	<4000	Moderate to Extreme
	<6000	High to Extreme
	<8000	Extreme
H	<2000	Moderate
	<4000	Moderate to High
	<8000	Extreme
I	<2000	Moderate
	<4000	Moderate to High
	<8000	Extreme

4.2.3 Method 3: The SOILOSS Method

This assessment utilised SOILOSS to determine a soil erodibility (K) value and erosion hazard rating for all sampling sites. The variation of K value by terrain unit was also determined as far as the data allowed (there were some gaps in this analysis since the study was not a soil landscape study as explained earlier). An erodibility value was then determined for each soil mapping unit based on a composite of topsoil and subsoil as there was very little variation in K value with terrain. SOILOSS was used to derive a table of erosion hazards that would occur for various combinations of erodibility, slope steepness and rainfall erosivity. This was performed for two C values, 0.45 and 0.1, for comparative purposes.

4.2.3.1 Erodibility of terrain units

The results of K value determination for each of the sampling locations are provided in Appendix 4. These K values have been arranged according to the terrain units in which they occurred (Table 9). It can be seen that there are a number of gaps in the table which stem from some of the units not being sampled and from the fact that some of the terrain units did not occur within the relevant soil mapping unit. Where terrain units were not sampled this was generally because they had a low frequency of occurrence and would therefore have a low likelihood of interacting with logging operations. The majority of soil mapping units had samples from ridgelines, upper slopes and/or mid slopes. These are the terrain units that will be most frequently subjected to logging operations since access to logged areas is most commonly from major ridgelines. There are no strong patterns within any of the soil mapping units to suggest a relationship between terrain unit and K value.

TABLE 9: Erodibility (K) values for terrain components for each soil mapping unit

Unit		TERRAIN Ridge	Upper Slope	Midslope	Lower Slope	Flat
A	Topsoil					.008 - .017
	Subsoil					.014 - .015
B	Topsoil		.006 - .031	.020	.016 - .025	
	Subsoil		.008 - .038	.006	.027 - .041	
C	Topsoil				.006 - .023	
	Subsoil				.009 - .044	
D	Topsoil		.009 - .022	.010		
	Subsoil		.033 - .036	.023		
E	Topsoil	.011		.026		.029
	Subsoil	.019		.023		.016
F	Topsoil		.012		.012	
	Subsoil		.018		.018	
G	Topsoil	.018	.026 - .044	.023	.017 - .032	
	Subsoil	.019	.013 - .024	.023	.016 - .034	
H	Topsoil	.011	.014		.026 - .029	
	Subsoil	.039	.042		.014 - .022	
I	Topsoil	.020	.004 - .016		.004	
	Subsoil	.027	.007 - .025		.020	

4.2.3.2 Erodibility of each soil mapping unit

From the preceding discussion, there appears to be no basis for further subdividing soil mapping units into areas of different K value by terrain unit. Hence a K value for each soil mapping unit was obtained primarily from a composite of K values from topsoil and subsoil layers. The results are shown in Table 10. The use of a composite value is based on the fact that snig track soil disturbance varies considerably within a logged area and often within short distances. Sometimes subsoil is exposed and sometimes only very shallow disturbance occurs. The composite K value gives a reasonable balance between the range of conditions that could be expected.

TABLE 10: Erodibility (K) values and erodibility ratings for each soil mapping unit using SOILOSS

Unit	Topsoil value / range	Subsoil value / range	Whole Soil Average 'K'	Unit Erodibility rating
A	.008 - .017	.014 - .015	.014	LOW
B	.006 - .031	.006 - .041	.020	LOW - MOD
C	.006 - .023	.009 - .044	.021	MOD
D	.009 - .022	.023 - .036	.022	LOW - MOD
E	.011 - .029	.016 - .023	.021	LOW - MOD
F	.012	.018	.015	LOW
G	.017 - .032	.013 - .034	.024	MOD
H	.011 - .029	.014 - .042	.025	MOD
I	.004 - .020	.007 - .027	.015	LOW

4.2.3.3 Erosion hazard assessment

The SOILOSS program was used twice on data from the topsoil and the upper subsoil layer from each of the sampling sites to determine erosion hazard. The first time, the different variables for each of the factors were chosen from the data which had already been collected for the study area's soils. These included a variation in rainfall zone, erosivity and particle size analyses results. 'P' was constant at 1.0 while 'C' was constant at 0.003 (refer to discussion below). Soil structure was taken usually as '3' but sometimes varied, depending on the secondary ped size. (The four SOILOSS choices for soil structure do not fit comfortably when dealing with these forest soils – this is a reflection on its greater applicability for agricultural soils.) Permeability was determined from Charman & Murphy (1991) [Table 10.4 which determined permeability from texture and structure data]. Slope steepness was the value recorded in the field at each sampling site. SOILOSS gives a choice of 0 – 300 metres for slope length. Various values were chosen, depending on each site's field situation.

The second set of calculations adopted a P factor of 1, a C value of 0.45 and a slope length of 10 metres.

In determining 'C', SOILOSS's handbook directs the user to its appendix D which lists suggested 'C' factors for permanent (mulch) cover, improved pasture, permanent pasture, undisturbed forest land and rangeland, scrub, etc. The section dealing with forest situations lists a range of 'C' factors from 0.0001 to 0.009, depending on the area covered by tree canopy and organic layer. While 0.003 (representing the mean value of 45 – 70% canopy and 75 – 85% organic layer cover; also representative of the lower end of 20 – 40 % canopy and 40 – 70% organic layer cover) was used for the first set of calculations, the requirements' use of 0.45 does not appear in the forest situation of appendix D. Rather, this value can be found in the scrub situation representing no appreciable canopy and zero percent ground cover.

The results of these two sets of calculations are summarised below in Table 11. The detail of these calculations are presented in Appendix 4.

TABLE 11: Erodibility (K) values and erosion hazard for sampled sites using SOILOSS

Unit	Site	First Set Topsoil 'K'	Soil Loss C=.003	Erosion Hazard	*Second Set Topsoil Soil Loss C=.45*	*Erosion Hazard*	First Set Subsoil 'K'	Soil Loss C=.003	Erosion Hazard	*Second Set Subsoil Soil Loss C=.45*	*Erosion Hazard*
A	1301	.008	.02	LOW	*1.0*	*LOW*	.015	.04	LOW	*1.9*	*LOW*
	1306	.017	.02	LOW	*1.8*	*LOW*	.014	.02	LOW	*1.4*	*LOW*
B	0102	.020	2.5	LOW	*68*	*MOD*	.006	.76	LOW	*20*	*LOW*
	0201	.031	5.4	LOW	*148*	*MOD*	.038	6.6	LOW	*181*	*MOD*
	0503	.016	.62	LOW	*17*	*LOW*	.027	1.1	LOW	*29*	*LOW*
	1201	.012	.61	LOW	*20*	*LOW*	.015	.76	LOW	*25*	*LOW*
	1701	.006	1.9	LOW	*57*	*MOD*	.008	2.8	LOW	*75*	*MOD*
	1801	.025	2.9	LOW	*81*	*MOD*	.041	4.8	LOW	*133*	*MOD*
C	1401	.023	8.8	LOW	*241*	*MOD*	.044	17	LOW	*461*	*HIGH*
	2202	.006	.08	LOW	*2.3*	*LOW*	.009	.12	LOW	*3.4*	*LOW*
D	2101	.022	2.5	LOW	*84*	*MOD*	.036	4.1	LOW	*137*	*MOD*
	2404	.010	.19	LOW	*5.4*	*LOW*	.023	.44	LOW	*12*	*LOW*
	2501	.009	.24	LOW	*6.3*	*LOW*	.033	.84	LOW	*23*	*LOW*
E	1109	.011	.25	LOW	*8.7*	*LOW*	.019	.45	LOW	*15*	*LOW*
	1114	.029	.26	LOW	*10*	*LOW*	.016	.15	LOW	*5.5*	*LOW*
	1124	.026	.32	LOW	*11*	*LOW*	.023	.28	LOW	*9.5*	*LOW*
F	0601	.012	.24	LOW	*6.9*	*LOW*	.018	.38	LOW	*10*	*LOW*
	0707	.012	.64	LOW	*17*	*LOW*	.018	.96	LOW	*26*	*LOW*
G	0404	.032	1.1	LOW	*30*	*LOW*	.034	1.2	LOW	*32*	*LOW*
	0407	.026	1.9	LOW	*53*	*MOD*	.024	1.8	LOW	*49*	*MOD*
	0408	.018	.29	LOW	*9.5*	*LOW*	.019	.29	LOW	*10*	*LOW*
	0413	.023	.97	LOW	*27*	*LOW*	.023	.96	LOW	*27*	*LOW*
	0415	.044	1.5	LOW	*41*	*MOD*	.013	.45	LOW	*12*	*LOW*
	1002	.017	.78	LOW	*21*	*LOW*	.016	.73	LOW	*20*	*LOW*
H	0802	.029	.64	LOW	*17*	*LOW*	.022	.48	LOW	*13*	*LOW*
	0902	.014	1.6	LOW	*53*	*MOD*	.042	4.7	LOW	*158*	*MOD*
	1601	.011	.65	LOW	*32*	*LOW*	.039	.09	LOW	*112*	*MOD*
	2001	.026	.40	LOW	*11*	*LOW*	.014	.22	LOW	*6*	*LOW*
I	1501	.004	.91	LOW	*27*	*LOW*	.025	6.3	LOW	*170*	*MOD*
	1903	.016	3.3	LOW	*90*	*MOD*	.015	3	LOW	*85*	*MOD*
	1908	.004	.37	LOW	*11*	*LOW*	.020	2.1	LOW	*56*	*MOD*
	2302	.008	.51	LOW	*15*	*LOW*	.007	.50	LOW	*13*	*LOW*
	2303	.020	.94	LOW	*26*	*LOW*	.027	1.3	LOW	*35*	*LOW*

The results of this table demonstrate the effect of choosing a C value of 0.45 (which denotes a zero ground cover which is commensurate with the blading off of snig tracks) and a C value of 0.003 which probably more realistically reflects the actual conditions of snig tracks to be used in the proposed forestry operations.

Table 12 provides indicative results of erosion hazard assessments for different levels of soil erodibility (K), rainfall erosivity (R) and slope steepness (S) for two different levels of cover (C). The variables used in the SEMGL for K, R and S have been used here to compare the effect of a C value of 0.45 to a C value of 0.1 which equates to a groundcover of 40% without any allowance being made for canopy cover. The resultant erosion hazards for these two different values of C are shown to illustrate the sensitivity of the method to the selection of particular values. The selection of standard C and P values by CaLM has been a somewhat subjective exercise and is therefore a current weakness in the method.

TABLE 12: Calculation of erosion hazard for each erodibility class - a comparison between the SEMGL's Appendix 2 ('C' = 0.45 [bare ground]) and a new value ('C' = 0.10) which allows for a 40% ground cover

	SEMGL Appendix 2 (C = 0.45)						Recalculated (C = 0.10)					
Erodibility - LOW (<0.02)												
Erosivity	Slope (degrees / [%])						Slope (degrees / [%])					
	10 [17.6]	15 [26.8]	20 [36.4]	25 [46.6]	30 [57.7]	35 [70.0]	10 [17.6]	15 [26.8]	20 [36.4]	25 [46.6]	30 [57.7]	35 [70.0]
<2000	L	M	M	M	M	M	L	L	L	L	M	M
<4000	M	M	M	M	M	H	L	L	M	M	M	M
<6000	M	M	M	H	H	H	L	M	M	M	M	M
<8000	M	M	H	H	E	E	L	M	M	M	M	M
Erodibility - MODERATE (<0.04)												
Erosivity	Slope (degrees / [%])						Slope (degrees / [%])					
	10 [17.6]	15 [26.8]	20 [36.4]	25 [46.6]	30 [57.7]	35 [70.0]	10 [17.6]	15 [26.8]	20 [36.4]	25 [46.6]	30 [57.7]	35 [70.0]
<2000	M	M	M	M	H	H	L	L	M	M	M	M
<4000	M	M	H	H	E	E	L	M	M	M	M	M
<6000	M	H	H	E	E	E	M	M	M	M	M	M
<8000	M	H	E	E	E	E	M	M	M	M	M	H
Erodibility - HIGH (<0.06)												
Erosivity	Slope (degrees / [%])						Slope (degrees / [%])					
	10 [17.6]	15 [26.8]	20 [36.4]	25 [46.6]	30 [57.7]	35 [70.0]	10 [17.6]	15 [26.8]	20 [36.4]	25 [46.6]	30 [57.7]	35 [70.0]
<2000	M	M	M	H	H	H	L	M	M	M	M	M
<4000	M	H	H	E	E	E	M	M	M	M	M	H
<6000	M	H	E	E	E	E	M	M	M	M	H	H
<8000	H	E	E	E	E	E	M	M	M	H	H	H

4.3 COMMENTS ON EROSION HAZARD METHODOLOGY

4.3.1 Soil Loss Estimates

The technique of applying SOILOSS to determine erosion hazard necessarily generates a value of soil loss. To some readers, the implied values of a high (>400 tonnes/ha/year) or extreme (>800 t/ha/yr) erosion hazard may be quite alarming. However, it must be stressed that these figures are used merely to obtain an objective indication of relative erosion hazard given certain site factors. There are many reasons why the actual soil loss would be much less than that predicted by SOILOSS. Even more importantly, the predicted soil loss does not imply 'lost from the logging area'; it simply implies 'moved from point A to point B'. Point A and point B may be quite close or quite distant. This is to say that the USLE, on which SOILOSS is based, has no transport function. However, research on erosion in logged forests indicates that transport distances are relatively small (see Lacey, 1993). Reasons why the soil loss estimates are less than would actually occur are as follows:

- the version of SOILOSS used is known to significantly overestimate erosion on slopes greater than 9%. This is one of the most significant revisions to the new version of SOILOSS which is based on RUSLE (the Revised Universal Soil Loss Equation) rather than the USLE (Rosewell, 1993). On slopes steeper than about 35% snig tracks are often benched to allow safe machinery operation. This means that the erodible surface has a much lesser slope than the natural slope but in addition there is a cut batter, which is not handled by SOILOSS.

- the P factor assumed is 1.0. This is the value used for soil cultivated up and down the slope. The level of disturbance assumed, i.e. bare soil snig tracks, does not parallel that of soil cultivated up and down the slope. The main difference is that cultivation disrupts internal soil cohesiveness and provides ready formed channels for rill initiation once overland flow commences. Snig tracks retain internal cohesiveness and contain few if any ready formed channels.

- the soil loss figures generated are assumed to be for a long-term situation. This implies that the long-term rainfall erosivity (R) is received by the soil surface which is maintained at average values of P and C as selected. This long-term or average R value is dependent on the range of rainfall intensities with both short and long return intervals being received. The problem is that P and C values are not stable in forest situations. C in particular declines rapidly as vegetation and litter layers recover.

  The probability of the average R value being received during that window of elevated C value is therefore quite low due to the dependence on some low probability high intensity rainfall being received. There is no doubt that, in the long-term, some compartments will receive the average or above average R but they will be in the minority.

- the USLE was derived principally for arable land and therefore may not take into account factors important in erosion processes on forest soil. One of these is the high level of gravels commonly found in forest soils. High gravel tends to act as a cover across the soil surface lowering the potential for particle detachment.

4.3.2 Erosion Hazard Classes

The above comments about the methodology are intended simply to point out that the soil loss figures should not be taken literally.

Of greater concern is that whilst the numbers generated by SOILOSS may be reasonably objective, the same does not apply to the erosion hazard class boundaries.

The authors do not believe that CaLM has adequately justified the choice of the particular erosion hazard class boundaries with any evidence of how the predicted numbers relate to reality. The classes are not consistent with other erosion hazard assessment methodology based on the USLE. For example, Morse & Rosewell (1993) presented a similar method for assessing erosion hazard for urban land. In their method, the erosion hazard classes are defined as Class 1: computed soil loss <300 t/ha/yr (regular erosion and sediment control plans are able to ensure sediment pollution remains at acceptable levels), Class 2: computed soil loss 300 - 900 t/ha/yr (special measures may be needed), and Class 3: computed soil loss >900 t/ha/yr (very stringent controls needed which may render work uneconomic). There are two reasons why the upper limit of 900 t/ha/yr for urban land makes the 800 t/ha/yr for forest land seem much too low. i) The efficiency of transport to receiving waters will be much greater in urban development so less sediment pollution will occur from forest areas for the same computed soil loss. ii) The area of contiguous disturbed land is much greater in urban development than in native forest logging and so the total amount of sediment generated will also be much greater.

There is a need for the erosion hazard classes to be demonstrably related to a definition of erosion hazard such as that of Houghton & Charman (1986). In conducting extensive fieldwork and API for this report, the authors never observed erosion of a severity that would match the extreme or high erosion hazard definition of Houghton & Charman (1986). It is maintained that the reason for this is the nature of the land use. Certainly, if the land was cleared and put to a more intensive use such as agriculture or urban development, then the manifestations of a high or extreme hazard might eventuate. Indeed such examples were observed in agricultural lands adjacent to forest land in the study area. In conclusion, the definition of erosion hazard should be framed with a particular land use in mind.

5.0 IMPACT MITIGATION

All of the soils within the study area are stable, under their current land use and land management regime. It should be appreciated that even a stable soil can erode if inappropriate land management is practised. The results of this can be observed on some eroded farmlands adjacent to the State forest lands within the study area.

To remain stable, the soils within the study area should be protected through vegetative cover and sound land management practices such as those which result from, and are consistent with, the current land use and land management to which these soils are subjected within the state forest regime. Thus, within the study area, the current forestry land management and land use strategies help to ensure the stability of the soil resource. This is principally due to the relatively undisturbed nature of the area and more particularly because of the good basal vegetative ground cover that is retained. To combat the onset of erosion on areas of disturbance occurring during harvesting/roading operations, a number of specific conditions are adhered to. These are discussed below in this Section.

5.1 GENERAL COMMENT

The Standard Erosion Mitigation Conditions (SEMC) were drawn up a number of years ago by the then Soil Conservation Service of NSW and the NSW Forestry Commission. Designed to minimise soil erosion and maintain water quality, these conditions allowed for a number of measures to be installed during and after logging and roading activities.

At the time that this study was first undertaken in 1992, the SEMC's were in operation. However, the more recently developed Standard Erosion Mitigation Guidelines for Logging (SEMGL), released in March 1993, now direct forestry operation activities in New South Wales on a day-to-day basis.

In a memorandum of understanding between CaLM and State Forests, it has been deemed that while the SEMC constituted a guide rather than prescriptive standards, the SEMGL are to be adapted and form the basis to produce enforceable conditions.

5.2 THE CONDITIONS

The following section of this report discusses the effectiveness of the SEMGL conditions in respect of limiting any accelerated erosion or land degradation during forest harvesting or roading activities, within the study area. These conditions are designed to be a minimum guideline, intended to mitigate against erosion which might lead to soil movement and water turbidity and sedimentation in excess of natural levels. Briefly, these conditions are organised around the following activities:

- construction of road and snig tracks
- retention of filter and protection strips
- snigging and timber extraction
- groundcover management
- felling operations
- log dumps

Each of these activities will be taken in turn and the relevance of their associated conditions, as they relate to the study area, will be briefly discussed.

5.2.1 Roading

A distinction is made in the conditions between "roads" and "snig and timber extraction tracks".

The roading conditions relate to the planning, location, formation, engineering constraints, batter stabilisation and drainage of roads as well as to clearing, crossing of drainage lines, and the rehabilitation of borrow pits, construction of bridges and culverts, repairing damaged roads and ongoing grading maintenance. Providing these conditions are adhered to, the construction and maintenance of roads should not present any long-term or significant erosion threat.

In respect of the construction and use of tracks and snig tracks, these conditions become more specific regarding their drainage, stabilisation and maintenance. There is adequate scope within these conditions for appropriate specifications to be applied to tracks within the study area to ensure erosion and land degradation does not occur. These will be dealt with later in Section 5.2.5

While the soil materials occurring within the study area are deemed to be relatively stable, the slope gradients occurring on the "minor" roads dictate that attention must be given to the proper construction of cross bank drains and the incorporation of seed and fertiliser where appropriate. The conditions cater for this and also dictate the proper disposal of road drainage water.

The flexibility contained within the SEMGL allows detailed conditions to be applied to specific situations. This is adequate to ensure that any normal roading operation that is carried out within the study area will not result in any significant erosion, providing specific instances are recognised and addressed. Obviously, this means that attention must be given to incorporating specific conditions in the case of minor roads being constructed on steep slopes. In this respect, roads can only be constructed where ground slopes exceed 30 degrees if engineering design and stabilisation techniques ensure road and batter stability.

Also of importance is the need for regular maintenance, especially that involving the desilting of table drains and especially culverts. A few areas were observed during the fieldwork period where maintenance was required. These were: a short 200 metre section on the steep downgrade on Paw Paw Skids Road (Richmond Range S.F.), two kilometres east of the intersection with Peacock Creek Road, where rilling up to 50 cm deep had developed; and in Camira S.F., Benders Rails Road requires the construction of culverts and / or cross drains at both ends. Other, non-erosion related instances of maintenance requirements were observed, such as the need for the reconstruction of culverts / bridges which have been destroyed by recent fires. (It is appreciated that the inclement weather conditions experienced during the fieldwork period for this study could well account for the above road surface grading maintenance works not being undertaken at that time.) Interestingly enough, there appears to be no such maintenance requirement contained within the SEMGL conditions.

5.2.2 Groundcover Management

The conditions recognise that groundcover management techniques are necessary to minimise soil erosion and sedimentation for operations associated with such activities as roading, snig tracks and log dumps.

These conditions call for minimising ground cover disturbance and destruction during logging operations and aim at achieving at least 70% groundcover. Apart from staff training in these matters, these conditions also outline effective groundcover management and re-establishment procedures.

Such procedures should be adequate to maintain a good basal groundcover within the areas disturbed by forestry operations.

5.2.3 Retention of Filter and Protection Strips

The conditions call for the retention of filter strips, of dimensions to be specified, on watercourses generally having catchment areas of 100 hectares or more or 40 hectares where erosion hazard is high. Protection strips are more generally applicable and are to be at least 10 metres wide on each side of specified drainage features.

It is considered that the operation of this condition within the study area is adequate and appropriate to prevent the sedimentation of flowlines, given the relative stable nature of the study area's soils.

5.2.4 Felling Operations

Felling activities within or into filter or protection strips or drainage lines are subject to a number of conditions. Adherence to these should ensure that erosion in proximity to streams is prevented and that filter strips function effectively at trapping any sediment mobilised from upslope disturbances.

5.2.5 Snigging and Timber Extraction

These conditions provide for uphill snigging, the drainage of snigging and extraction tracks and the retention of soil material and vegetative matter.

In areas of high erosion hazard, snigging and timber extraction is not permitted from areas with slopes over 25 degrees if track construction is required. For areas of low or moderate erosion hazard, snigging and timber extraction is not permitted from areas with slopes greater than 30 degrees if track construction is necessary.

Snig track and timber extraction activities in areas of extreme erosion hazard will only be permitted in specified circumstances relating to months of low erosivity, timing of soil and groundcover handling, and the limitation to slopes less than 30 degrees.

Where snig and extraction tracks are constructed, proper drainage is required through the installation of cross banks at a specified spacing and size. Providing due care is taken to install this required cross bank drainage at the specified spacing, no unacceptable erosion should occur as a result of forestry operations.

Snig tracks are not permitted to be bladed-off (i.e. the removal of muddy surface layers to provide better traction) and the retention of groundcover in the form of logging slash and existing vegetation is required as far as practicable.

5.2.6 Log Dumps

These conditions relate to the uphill location of log dumps, as well as their construction, drainage and subsequent rehabilitation. They allow for the removal, storage and respreading of topsoil as well as the ripping of specified areas to overcome the effects of compaction. Uphill locations minimise disturbance near streams and lead to snig track patterns which diverge rather than converge down the slope which reduces concentration of overland flow. Adherence to the safeguards allowed for in these conditions should ensure against any significant erosion.

5.3 INTERACTION WITH FORESTRY OPERATIONS

Given the low to moderate erodibility classification of the soils throughout the study area, and the appropriateness of the existing (SEMGL) erosion mitigation conditions, the impact of forestry operations on this soil resource should be negligible, providing the Standard Erosion Mitigation Guidelines for Logging conditions are adhered to. The guidelines adequately provide protection of the soil resource and receiving waters from the range of forestry operation activities. Based on current observation of the effects of past logging and forest operations within the study area, the implementation of similar conditions (under SEMC) has helped maintain the stability and proper management of the study area's soil resource.

6.0 RECOMMENDATIONS

A number of issues have become evident during the compilation of this soils report which could be acted upon to improve and enhance the protection of the soil resource within the study area. These issues are treated separately below.

6.1 RELIANCE ON SEMGL VALUES

While the procedures contained within the SEMGL are considered appropriate guidelines for forestry operation activities, the basis on which soil erodibility and erosion hazard are classified should be subject to review and amendment based on improved scientific knowledge and understanding. This is especially important given that, according to the Memorandum of Understanding between CaLM and State Forests, the interpretation of erosion hazard, erosivity and erodibility parameters "will be consistent with standards established by CaLM in Appendix 1, 2 and 3 of the SEMGL or as subsequently amended as a consequence of scientifically-based review and consultation".

It has been demonstrated in Section 4 of this report that such standards as set out in the SEMGL appendices require urgent review and amendment.

The emphasis of the SEMGL on snig tracks with zero ground cover is a major concern. Whilst this may serve as a convenient reference condition, it overlooks the very powerful sediment trapping role of undisturbed forest floor (Lacey, 1993). This sediment trapping efficiency may be less on steep slopes so there is a need to investigate the role of undisturbed forest floor and filter strips in interrupting sediment transport. This should be built into the erosion hazard assessment procedure.

Therefore, it is recommended that:

- a series of erosion hazard tables be drawn up for snig tracks of varying degrees of ground cover to enable the use of a prescriptive value which is closer to reality

- more realistic erosion hazard values be calculated for various forestry operations outside the construction of snig tracks and that these more generally applicable values be used, rather than those currently listed in the SEMGL, to determine whether forestry operations can, or cannot, be undertaken

- urgent emphasis be placed on the investigation of the role and mechanics of soil movement in the forest situation

6.2 DETERMINATION OF ERODIBILITY

Appendix 1 in the SEMGL presents a table whereby soil erodibility classification can be easily determined. In light of the non-applicability of this table to the forest soils that were examined in this soils report, it is recommended that:

- the table in Appendix 1 (ii) of the SEMGL's be replaced by an erodibility classification system whereby the soil characteristics peculiar to forest soils are recognised since forest soils are very different from, and behave differently to, agricultural soils from which the SEMGL table is derived

6.3 USE OF USLE TECHNOLOGY

Some of the shortcomings of current USLE technology, referred to in this report, relate to the inappropriate choice of soil structure categories, the biased weighting of a 'C' factor of 0.45, the inadequate levels of organic matter (and the need to identify the effects of having "high" forest organic matter levels), and the emphasis that the USLE places on soil loss and not soil movement.

Therefore, it is recommended that:

- as the values chosen for input to SOILOSS, particularly C and P, along with the overprediction on steeper land, are almost certainly overstating erosion hazard on forest land, the inputs to SOILOSS should be modified to reflect the forest situation and erosion hazard classes which should more reliably reflect real risks

- a better measure of soil movement, rather than soil loss, be developed as the basis of forestry operations. In time, this will mean either replacing, or substantially modifying the USLE. Until that time, USLE technology should only serve the purpose of a guideline rather than that of a prescription

- any such measure deals with realistic forest soil characteristics

6.4 ROLE OF THE HARVESTING PLAN

While it has not been discussed specifically in this report, the Harvesting Plan, prepared on an individual compartment basis, plays an important role in assessing specific soil characteristics and the impact that proposed forestry operations have on them.

To date, the Harvesting Plan has realistically dealt in "broad brush" terms. However, a greater emphasis is being placed on this instrument which runs the very real risk of falling victim to its own complexity. A proposal to group a number of compartments together to widen the area covered at this more detailed level of planning has been discussed between State Forests and CaLM. This has occurred within the context of preparing a draft framework for Erosion Hazard and Sediment Control Strategies (EH&SCS). This development is seen as a vital link between the generalised level of information that must necessarily be contained within an EIS study and the detailed level that is required if meaningful day-to-day management decisions are to be made from an informed position.

Therefore, it is recommended that:

- the proposed Erosion Hazard and Sedimentation Control Strategy approach be adopted

- in light of the above recommendations, the role that the USLE is to play in the EH&SCS be reviewed

6.5 FURTHER SOIL DATA COLLECTION

The data base of soils information compiled for this and the many other forestry EIS studies is extensive. This information ought to be capitalised upon by collecting further data from similar, adjacent lands within the same soil mapping units but which are under a land use, such as farming and/or grazing activities.

By examining these geographically and pedologically related soils, the real difference between forest soils and agricultural soils, primarily resulting from the effects of each land use, can be documented and fully appreciated. This especially relates to factors dealing with soil structure, bioturbation, organic matter, nutrient status, compaction, permeability, erodibility and ultimately erosion hazard.

Therefore, it is recommended that:

- the acquisition of soil data from agricultural lands immediately adjacent to State forest lands be undertaken and the results used to derive realistic expectations on the behaviour of forest soils

7.0 CONCLUSION

The various geological units occurring, and the soils derived on them within the study area have been examined and described. Nine main soil mapping units have been delineated. The soils' erodibility has been assessed and discussed. It has been found that, at the scale of mapping undertaken, the soils throughout the study area are quite stable, with a low to moderate erodibility classification. Based on observation of the results of past forestry operations within the study area, the stable nature of these soils is largely maintained under the existing forestry land use and land management practices.

Erosion hazard has been assessed across the study area and mitigation measures, primarily through the existing Standard Erosion Mitigation Guidelines for Logging conditions have been discussed. Providing the safeguards contained in the SEMGL are implemented and adhered to, it is concluded that there should be little, if any, significant detrimental erosion or sedimentation within the study area as a result of the proposed forestry operations.

With respect to the SEMGL method of assessing erosion hazard, it is concluded that the soil erodibility and erosion hazard classifications resulting from the use of this approach do not accurately reflect the behaviour of these soils. Consequently, the use of soil loss models in forest situations should be reviewed to reflect on–going research, operational experience and subsequent improved scientific knowledge and understanding.

J.A. Veness R.A. Veness
(Directors)
VENESS & ASSOCIATES Pty Limited
12th May, 1994

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APPENDIX 1

Soil Data Cards

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1302

spot Qa BRAEMAR Stoack Rd

4979ØØ 67869 2Ø

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Moisture	pH
1	A	.25	7.5 YR 3/1 [illegible]			SI	
2	[illegible]	.36	7.5 YR 5/3 [illegible]			MI	
3	[illegible]	.55	7.5 YR [illegible] 4/2			WI	
4							
5							
6							

Alluvial flat

SOIL PROPERTIES RECORD 'B'

BOUNDARY
DISTINCTNESS
SHAPE

TEXTURE
SAND FRACTION
GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY
CRACK SIZE

STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY

ROOTS
AMOUNT
ROOT DISTRIBUTION

PANS
CHARACTER

CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

661 - Grafton / Casino / Murwillumbah

Dj 5.31

SITE No. 1304

spot Qa GIBBERAGEE track off Lookout Rd.

5Ø55ØØ 67593ØØ

Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottle	Moisture	pH
1	A1	.07	7.5 YR 3/2				5.5	
2	A2	.18	[illegible]				5.7	
3	B2	.39	[illegible]			[illegible]	[illegible]	
4								
5								
6								

Flat.

SURFACE CONDITION

Crust
Hard set
Not hard set

BOUNDARY
DISTINCTNESS
SHAPE

TEXTURE
SAND FRACTION
GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

CONSISTENCE

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY
CRACK SIZE

STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY

ROOTS
AMOUNT
ROOT DISTRIBUTION

PANS
CHARACTER

CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1202

spot   Ra   BRAEMAR   Sandy Creek Trail

502380 6790280

Slowly permeable plastic clay

uf 0.23

SOIL PROPERTIES RECORD 'A'

Record Type	Same as Site No.	Total No. of Layers
0 0 0 4		

Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Texture	pH
1	A	·10	7.5YR 3/2		7.5YR 7/2	L	
2	B	·36	7.5YR 4/1		[illegible]	SL	
3	B	·60	7.5YR 5/3			M	
4							
5							
6							

Alluvial flat

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST

STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES · AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION

STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS · AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 ~~GRAFTON~~/CASINO/~~MURWILL'H~~

SITE No. 301

Soil   Ra   BUNGAWALBIN   Quarry Rd

515500 6792200

SOIL PROPERTIES RECORD 'A'

Record Type	Same as Site No.	Total No. of Layers
0 0 0 4		

Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Texture	pH
1	A	·03	7.5YR 4/2			SL	5.5
2	B	·05	7.5YR 3/2			SL	5.0
3	B2	·23	5YR 6/1			SL	5.0
4	D	·50	5YR 7/1			ML	5.6
5							
6							

SOIL PROPERTIES RECORD 'B'

Sn 3.41

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST

STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES · AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION

water repellant

STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS · AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

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Environmental and Natural Resource Consultants

SITE No. 1305

661 – Grafton / Casino / Murwillumbah

6n 3·74

Just   Da   DOUBLEDUKE   track off Lodleys Rd.

516980 6769940

	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottle Characteristics	Texture
1	1·A11	·11	[illegible] 2/2				W
2	2·A12	·35	[illegible]				W
3	3·A2	·46	[illegible]				W
5	4·[illegible]	·53	[illegible]				W
	5·						
	6·						

Da version of last site 071?

SURFACE CONDITION   Flat ~0%

Crust
Hard set
Not hard set X

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
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SITE No. 1306

661 – Grafton / Casino / Murwillumbah

5n 3·74

Full   Da   DOUBLEDUKE   Range Rd

516420 6766100

	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottle Characteristics	Texture
1	1·A1	·17	[illegible]				W 5·6
3	2·A2	·42	[illegible]				W 4·5
5	3·B2	·80	[illegible]				W 6·5
	4·						
	5·						
	6·						

SURFACE CONDITION   Flat 0%

Crust
Hard set
Not hard set X

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

STRUCT. PLASTIC CLAY

SITE No. 1302

661 – ~~Grafton~~ / Casino / ~~Murwillumbah~~ Uf 6·33

spot Da MORORO

unnamed, paperbarks, water.

5208306756500

Horizon	Lower Average Depth (m)	Moist	Dry	Mottle Characteristics	Tests
1 A	·24	7.5YR 3/2			W 4·5
2 B1	·43	7.5YR 4/2			W 5·0
3 B2	·51	10YR 5/3		O D D 20	W 6·5
4					
5					
6					

SURFACE CONDITION

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

probably not too far from this

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

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SITE No. 1307

661 – Grafton / Casino / Murwillumbah

spot Da SOUTH PULPIT

? nr. swamp

5233606762700

Horizon	Lower Average Depth (m)	Moist	Dry	Mottle Characteristics	Tests
1 A1	·10	10YR 4/3			M
2 A2	·36	10YR 5/2	10YR 7/2		M
3 B2	·42+	10YR 5/2		M R D D 15	M
4					
5					
6					

SURFACE CONDITION

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1310

661 - ~~Grafton~~ / Casino / ~~[illegible]~~

Gn 3·11

Qa MYRTLE Robinsons Rd

4995ØØ 67714 5Ø

Horizon	Lower Average Depth (m)	Moist	Dry	Mottle	Texture
A	·12	7.5 YR 3/2			M 5·0
B	·27	10 YR 3/2			M 6·0
B2	·54	7.5 YR 4/2		10 YR ·2D	M 5·5

SURFACE CONDITION

Flat 0% or non draining

Crust
Hard set
Non hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

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Environmental and Natural Resource Consultants

Dy 5·41

SITE No. 1306

661 - ~~Grafton~~ / Casino / ~~[illegible]~~

Spot

Qa WHIPORIE unnamed off Ningero Rd (30h) 5½ hr

5Ø266Ø 676563Ø

Horizon	Lower Average Depth (m)	Moist	Dry	Mottle	Texture
A1	·12	7.5 YR 5/3			W 6·0
A2	·23	7.5 YR 6/3	7.5 YR 8/4		W 6·0
B2	·50	7.5 YR 5/4		0 D D 1 D	M 5·5

SURFACE CONDITION

alluvial flat 2%

Crust
Hard set
Non hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

fine (much)

GRADE

L1·2 Thixotropic

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

COHERENCE

SHEARING TEST

L2?

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

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Environmental and Natural Resource Consultants

SITE No. 1802 661 MURWILLUMBAH Gn 4·51

Lot T11 MEBBIN Tank Rd. Bog hole area

5153706853580

Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry	Mottle Characteristics	Texture	pH
1	A11	·12	10YR 3/2			M	5·5
2	A12	·34	10YR 5/2			M	5·0
5	B2	+·60	10YR 7/5		Y P F 1	W	4·5

slightly thin

Dark grey fine grained basalt with …

SURFACE CONDITION

Crust
Hard set
Not hard set X

Lower slope - 8% gentle …

Locally is wet - … good … particularly … Soggy mud tracks up to 40 cm deep

scars but does not cause or result in erosion

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE DISRUPTIVE TEST · SHEARING TEST · STRUCTURE GRADE · PED SIZES · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · FANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. C104 661 MURWILLUMBAH Df 4·21

spot T1b MEBBIN Cedell Rd.

5156106848080

Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry	Mottle Characteristics	Texture	pH
1	A1	·45	7.5YR 2/2			S	5·5
3	A2	·28	7.5YR 3/2			S	5·0
5	B2	·65	7.5YR 4/6			S	5·0
7	C	+·84	7.5YR 5/6			S	5·6

Sample of … rock

SURFACE CONDITION

Crust
Hard set
Not hard set X litter/…

Lowerslope 10%

L1 … abundant

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE DISRUPTIVE TEST · SHEARING TEST · STRUCTURE GRADE · PED SIZES · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · FANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1701 — 661 MURWILLUMBAH — Gn 3.14

FULL — Two (unknown?) — TOLLUMGIN (?) — Caldera Fa

524260 6960030

Horizon	Lower Average Depth (m)	Moist	Dry	Field pH
1 A1	.24	7.5YR 2/3		5.7
2 A2	.43	7.5YR 3/4		5.7
3 B1	1.90	5YR 3/4		5.5
4 B2	1.35	2.5YR 3/4		5.5

Upper slope 35%

SURFACE CONDITION
Crust
Hard set
Not hard set — self mulching

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE — SAND FRACTION — GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE — DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES — AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1801 — 661 MURWILLUMBAH — UF 5.3

FULL — TII — MEBBIN — Merinda Rd

5138400 6857220

Horizon	Lower Average Depth (m)	Moist	Dry	Field pH
1 A	.12	5YR 2/2		M 7.6
2 B	.57	5YR 2/3		M 7.8
3 B2	+.90	5YR 3/2		M 7.6

Lower slope - steep ~ 10%

SURFACE CONDITION
Crust
Hard set
Not hard set — self-mulching

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE — SAND FRACTION — GRADE

PLASTICITY TYPE — slightly subplastic

STICKINESS

WATER-TABLE

CONSISTENCE — DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY — thinly porous

CRACK SIZE

STONES — AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0103

SPOT

BOORABEE Tlb

506820 6831420

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Mottle Characteristics	Tests
1	A	.22	5YR3/3			S
2	B2	.62	5YR2/3			S
3						
4						
5						
6						

Midslope – gully

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION (crystals of ?)

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY (slowly)

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0101

SPOT

BUNGABBEE S.F. Tlb.

511120 6821120

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Mottle Characteristics	Tests
1	A	.11	5YR2/1			S
2	B2	.64	5YR2/4			S
3	C					
4						
5						
6						

Ridgetop. Very steep + stony. 35°

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION none

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY L1 slightly porous

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0102

FULL

BUNGABBEE S.F. Tlb

51Ø38Ø 6821660

Gn 3·11

SOIL PROPERTIES RECORD 'A'

Record Type 0 0 0 4

Layer No	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Moisture	pH
1	A	·45	5YR 2/1		/	S	7·0
5 2	B2	+·90	5YR 4/4		/	M	6·5
3		·	/		/		·
4		·	/		/		·
5		·	/		/		·
6		·	/		/		·

13% Midslope - gentle - below break of slope betw. very steep upper & more gentle lower slope.

L1 could be further subdivided as it shows a very gradual change from L1 to L2 soil colours with much ... the middle section shows ABL ... particular. 5YR 2/2 pH 6.5 SiC

SOIL PROPERTIES RECORD 'B'

Record Type 0 3 0 1

BOUNDARY
DISTINCTNESS
SHAPE
TEXTURE
SAND FRACTION
GRADE
PLASTICITY TYPE
STICKINESS
WATER-TABLE
CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY
CRACK SIZE
STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY
ROOTS
AMOUNT
ROOT DISTRIBUTION
PANS
CHARACTER
CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

L2 Bioturbated

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

PRAIRIE SOIL (CHECK STATE)

SITE No. 0201

FULL

EDEN CREEK S.F. Tml

49Ø43Ø 684686Ø

Gn 3.22

SOIL PROPERTIES RECORD 'A'

Record Type 0 0 0 4

Layer No	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Moisture	pH
1 1	A1	·12	7·5YR 3/2		/	S	5·5
2 2	A12	·40	7·5YR 2/2		/	M	6·0
5 3	B2	·94	7·5YR 4/4		/	M	6·5
6 4	B3	1·30	10YR 5/3		/	M	7·0
5		·	/		/		·
6		·	/		/		·

Upper slope relatively steep 30%

SOIL PROPERTIES RECORD 'B'

Record Type 0 3 0 1

BOUNDARY
DISTINCTNESS
SHAPE
TEXTURE
SAND FRACTION
GRADE
PLASTICITY TYPE
STICKINESS
WATER-TABLE
CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY (slowly)
CRACK SIZE
STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY
ROOTS
AMOUNT
ROOT DISTRIBUTION
PANS
CHARACTER
CONCRETIONS & INCLUSIONS ?
FORM
AMOUNT
SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0502
spot

RICHMOND RANGE Tmb
476240 6827520

Dr 2·11

SOIL PROPERTIES RECORD 'A'

Record Type 0 0 0 4

	Layer No.	Horizon	Lower Average Depth (m)	Moist	Moisture
1	1	A	·05	7.5YR 2/2	S
4	2	B1	·18	2.5YR 3/3	S
5	3	B2	+1·0	2.5YR 3/4	S

136 Upper slope - gentle. 500m past Pawpaw Skids Rd

SOIL PROPERTIES RECORD 'B'

Record Type 0 0 0 5

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

L1 water repellent

L2 slowly porous

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0501
spot

RICHMOND RANGE Tmb.
471330 6831970

Dr 2·21

for Urbenville

SOIL PROPERTIES RECORD 'A'

Record Type 0 0 0 4

	Layer No.	Horizon	Lower Average Depth (m)	Moist	Moisture
1	1	A1	·05	5YR 2/2	S
3	2	A2	·22	5YR 2/4	S
5	3	B2	·50	5YR 3/6	S
6	4	B3	+75	5YR 3/4	S

Upper slope - steep. 327

SOIL PROPERTIES RECORD 'B'

Record Type 0 0 0 5

BOUNDARY DISTINCTNESS

L1 Separate L2 Bist.

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

L1 Nutty structure

PED SHAPE

FABRIC

CUTANS

PED POROSITY

(slowly)

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0503
FULL

RICHMOND RANGE Tmb Gorge Ck Rd.

475170 6822210

Gr 3-5?

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Moisture	pH
1	1	A	·03	7.5YR 2/2		S	6.5
4	2	B1	·27	7.5YR 2/2		S	6.0
5	3	B2	·52	7.5YR 4/3		M	6.5
6	4	B3	·90	10YR 3/3		M	7.0
	5						
	6						

Midslope bench. 10%

Brown variety

SOIL PROPERTIES RECORD 'B'

BOUNDARY
DISTINCTNESS
SHAPE
TEXTURE
SAND FRACTION
GRADE
silty
PLASTICITY TYPE (slight)
STICKINESS
WATER-TABLE
CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY Sandy 2-4
CRACK SIZE
STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY
ROOTS
AMOUNT
ROOT DISTRIBUTION
PANS
CHARACTER
CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0504
spot

RICHMOND RANGE Tmb Weston Boundary Rd

475040 6817520

as 0503
- earlier
yellow
variation

Class?
Dr 4-11

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Moisture	pH
1	1	A	·09	7.5YR 2/2		D	
5	2	B2	·86	7.5YR 3/3		S	
	3	C					
	4						
	5						
	6						

Upper to midslope - moderate 16%

SOIL PROPERTIES RECORD 'B'

BOUNDARY
DISTINCTNESS
SHAPE
TEXTURE
SAND FRACTION
GRADE
silty
PLASTICITY TYPE
STICKINESS
WATER-TABLE
CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY
CRACK SIZE
STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY
ROOTS
AMOUNT
ROOT DISTRIBUTION
PANS
CHARACTER
CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0505

Spot

RICHMOND RANGE Tmb Cambridge Plateau Forest Drive

4746ØØ 681263Ø

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Moisture
1	1	A	.03	5YR 2/2		/	S
5	2	B2	.62	5YR 3/2		/	M
6	3	B3	+ .82	5YR 3/3		/	MW
	4					/	
	5					/	
	6					/	

Upper nail. moderately steep. 27

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0506

spot

CHERRY TREE NORTH. Jk Hogarth Range Rd

Uf 5.3

4764ØØ 68Ø1Ø7Ø

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Moisture
1	1	A	.22	7.5YR 2/1		/	M
5	2	B2	+ .78	7.5YR 3/4		/	M
	3					/	
	4					/	
	5					/	
	6					/	

Disturbed - exp. 1/2 Boundary area

Upper slope - gentle. 12

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 2011

FULL Tp Wyan Ck Rd. INTERMORE / volcanic rock

4739006770970

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry	Mottle Characteristics	Tests
1	A	.07	[illegible]	[illegible]		M 7.0
2	B2	.5	[illegible]			M 5.5
3	B2	[illegible]	5 YR 4/4			5.5
4						
5						
6						

Upper slope - gentle. 16%.

Cracking

Gn 3.11

.3 - stickier ... [illegible]

SOIL PROPERTIES RECORD 'B'

BOUNDARY

DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE

GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1L01 — Full

661 MURWILLUMBAH

Struct. plastic clay

Pzn — MOOBALL — 5453606860600 — Palmvale Spur Rd — Uf 6.33

Horizon	Lower Average Depth (m)	Colour Moist	Texture
1 A	.22	10YR 4/2	S 6.0
2 B2	.65	10YR 5/4	H 6.0
3 C	1.40		5.5
4 R			
5			
6			

weathered

SURFACE CONDITION

Crust

Hard set

Not hard set — self mulch

Lower slope 25%

Rocky — on ridge

Thin stony along ridgeline

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE — SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE — DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY — slow

CRACK SIZE

STONES — AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS — AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1402 — Spot

661 MURWILLUMBAH

Struct. plastic cl

Pzn — NULLUM — 539670695410 — North Chowan Rd — Uf 6.21

Horizon	Lower Average Depth (m)	Colour Moist	Texture
1 A	.08	2.5YR 3/3	S
2 B2	.44	2.5YR 4/8	M
3 C	1.20		
4			
5			
6			

SURFACE CONDITION

Crust

Hard set

Not hard set

Ridgeline 10%

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE — SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE — DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY — slow, water repellent

CRACK SIZE

STONES — AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS — AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

661 - ~~Grafton~~ / Casino / ~~Murwillumbah~~

UF 6.3

SITE No. 2201

9-S EWINGBAR Lionsville Rd

44753067692400

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Texture
1 A	0.10		
2 B	0.40		
3 BC	0.73		
4			
5			
6			

SURFACE CONDITION

Upper slope

Crust
Hard set
Not hard set

BOUNDARY
DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

SHEARING TEST

STRUCTURE
GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

661 - ~~Grafton~~ / Casino / ~~Murwillumbah~~

KRAS

UF 5.22

SITE No. 2202

9-S WARNBOO Woolpool Rd

44440067628200

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Texture
1			
2			
3			
4			
5			
6			

SURFACE CONDITION

No 2202 Upper slope 22

Crust
Hard set
Not hard set

BOUNDARY
DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

SHEARING TEST

STRUCTURE
GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 2202

661 – ~~Grafton~~ / Casino / ~~Murwillumbah~~

UF 5.22

Paddy's Ck Rd

8-5

WASHPOOL

4452106759120

Similar to 220

SURFACE CONDITION

Crust
Hard set
Not hard set

Lower slope 6%

BOUNDARY
DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE
GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

BIOTIC ACTIVITY

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 2201

661 – ~~Grafton~~ / Casino / ~~Murwillumbah~~

Maculata Rd.

UF 5.21

or

UF 5.22

1 small sample

8-5

WASHPOOL

4418506754810

SURFACE CONDITION

Crust
Hard set
Not hard set

Upper slope – 10%

BOUNDARY
DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE
GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

BIOTIC ACTIVITY

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

?

661 - Grafton / Casino / Murwillumbah

Gn 3.14

SITE No. 2501

FULL

Pab (Porph rdm)

BILLILIMBRA

Malara Ck F.T.

439 776 6769 540

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Mottle Characteristics	Tests
1	1 A1	.3	7.5YR 2/2			M 4.5
3	2 A2	.4	7.5YR 3/3			M 4.0
5	3 B	.7	5YR 5/6			M 5.2
6	4 C	.9	5YR [illegible]			M 5.6
8	5	1.50				

SURFACE CONDITION

Upper slope 10% above steep sideslope

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

STRUCTURE GRADE

STONE SIZE

SHAPE

PED SIZES

STONE WEATHERING

STONE LITHOLOGY

feldspar crystals

TEXTURE SAND FRACTION

PED SHAPE

ROOTS AMOUNT

GRADE

ROOT DISTRIBUTION

FABRIC

PANS

CUTANS

CHARACTER

PLASTICITY TYPE

PED POROSITY

(slowly porous)

STICKINESS

CRACK SIZE

CONCRETIONS & INCLUSIONS

WATER-TABLE

STONES AMOUNT OF STONES

FORM

CONSISTENCE DISRUPTIVE TEST

COHERENCE

SHAPE

AMOUNT

SHEARING TEST

STONE DISTRIBUTION

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

STRUCT. SUSPLAT. CU

HF 5.11

661 - Grafton / Casino / Murwillumbah

SITE No. 2401

Spot

Pas (adam)

BILLINMBRA

Malara Ck F.T.

441 500 676 9400

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Mottle Characteristics	Tests
1	1 A	.19	5YR 2/2			M 5.5
6	2 B2	.30	5YR [illegible]			M 6.4
7	3 B/C	.40				M [illegible]
8	4 C	.0?				

Upper slope 12%

SURFACE CONDITION

Crust
Hard set
Not hard set — loose, some gravel, litter

BOUNDARY DISTINCTNESS

STRUCTURE GRADE

STONE SIZE

SHAPE

PED SIZES

STONE WEATHERING

STONE LITHOLOGY

TEXTURE SAND FRACTION

PED SHAPE

ROOTS AMOUNT

GRADE

ROOT DISTRIBUTION

FABRIC

PANS

CUTANS

CHARACTER

PLASTICITY TYPE

PED POROSITY

STICKINESS

CRACK SIZE

CONCRETIONS & INCLUSIONS

WATER-TABLE

STONES AMOUNT OF STONES

FORM

CONSISTENCE DISRUPTIVE TEST

COHERENCE

SHAPE

AMOUNT

SHEARING TEST

STONE DISTRIBUTION

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

STRUCT. PLASTIC CLAY

SITE No. 2402

661 – Grafton / Casino / Murwillumbah

UF 6·2(a)

Spot

Pas

BILLILIMBRA

4401706765680

Berry Rd

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Mottle Characteristics	Field pH
1	A11	.12	[illegible]			[illegible]
2	A12	.30	[illegible]			[illegible]
5	B1	.38	[illegible]			[illegible]
6	[illegible]	.70	[illegible]			[illegible]

SURFACE CONDITION

Lower slope, mid-slope 12%

Crust
Hard set
Not hard set — cf. mulchy

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

?

UF 4·43

SITE No. 2403

661 – Grafton / Casino / Murwillumbah

Spot

Pas

EWINGAR

4437406774950

North Ewingar Rd

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Mottle Characteristics	Field pH
1	A1	.17	5YR 4/4			M 5.5
3	A2	.29	5YR 4/4			M 5.5
6	B2	.75	5YR 5/4			M 5.5
8	C					

SURFACE CONDITION

Upper slope 3%

Crust
Hard set
Not hard set — [illegible]

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 2101

661 - ~~Grafton~~ / Casino / ~~Murwillumbah~~

Gn 3.14

FULL Pgdw EWINGBAR Track to Colfoino

450010677080 0

SURFACE CONDITION

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

COHERENCE

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

SAMPLING SECTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 2024

661 - Grafton / Casino / Murwillumbah

mPS

Dy 4.11

FULL Pas EWINGAR Bulldog P.S.

4439506781830

SURFACE CONDITION

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

COHERENCE

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

SAMPLING SECTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

4PS

SITE No. 1121

661 - ~~Grafton~~ / Casino / ~~Murwillumbah~~

Dy 5·11

spot Kg BANYABBA Olgilvie Trail

4999166749800

Horizon	Lower Average Depth (m)	Moist	Dry	Mottle	Texture
1 A	·19	7.5 YR 4/3			S·5·p
2 B2	·30	7.5 YR 5/2		D:DIF:15	M 4.5
3 B3	·83	7.5 YR 5/2		D:DIF:7	M 4.5
4 C					

dark

SURFACE CONDITION

Crust
Hard set
Not hard set

Lower slope 6%

Slaty siltstone

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

COHERENCE

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

SITE No. 1123

661 - ~~Grafton~~ / Casino / ~~Murwillumbah~~

spot Kg GIBBERAGEE Cahills Rd

5110606762926

Horizon	Lower Average Depth (m)	Moist	Dry	Mottle	Texture
1					
2		16/3			
3		6/3			
7 B2		5/4			
9				D:P F	

Mid slope 5%

SURFACE CONDITION

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

COHERENCE

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1122

661 - ~~Grafton~~ / Casino / Murwillumbah   Dr 3.11

Spot   Kg.   GIBBERAGEE   Cahills Rd

5Ø873Ø6758Ø6Ø

Farming

	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Mottles	Moisture
1	A1	.05	[illegible]		S
3	A2	.11	[illegible]		[illegible]
7	B2	.39	[illegible]		[illegible]
9	B3	.50	[illegible]	[illegible]	M

SURFACE CONDITION

Crust
Hard set
Not hard set X litter

Ridge line 12%

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER TABLE

CONSISTENCE DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1120

661 - ~~Grafton~~ / Casino / Murwillumbah   Dy 5.41

Spot   Kg   GIBBERAGEE   unnamed, thin' tick gate

5Ø28ØØ675473Ø

Gardens abundant

	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Mottles	Moisture
1	A1	.37	5YR4/3		W
3	A2	.61	5YR6/4		W
7	B2	.73	7.5YR4/0/2.2	10 D P 25	M

61
72

SURFACE CONDITION

Crust
Hard set
Not hard set X mainly over litter layer

7.5YR5/8

M slope 5%

Lower A1 very clay

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER TABLE

CONSISTENCE DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1117

Spot

Kg CAMIRA Camira Rd – [illegible]

494100 6760930

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Moisture
1	1	A	.19	5YR 3/4			S1
7	2	B2	.47	2.5YR 3/6			M1
9	3	B3	.62	2.5YR 3/6			M1
10	4	C	.70				

Not [illegible] [illegible]

Upper slope ~6%

Dr 4·11

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

Water repellence

(Finely porous along [illegible])

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

(rounded) from rock (pebbles in [illegible])

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1110

Spot

Kg CAMIRA Camira Rd, just west of [illegible] Rd.

491630 6763910

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottles
1	1	A1	.02	7.5YR 3/3			
3	2	A2	.10	7.5YR 4/3		7.5YR 7/3	
7	3	B2	.21	5YR 4/6			[illegible]
9	4	B3	.58	2.5YR 3/6			[illegible]
10	5	BC	.65	10YR [illegible]			

Hilltop – gentle [illegible]

Dr 5·[illegible]

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

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661 - Grafton / Casino / Murwillumbah

Dy 3.1

SITE No. 1124

FULL   Kg   BANYABBA   Back Forest Rd

4963006755430

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottle Primary	Mottle Secondary	Moisture	pH
1	1A1	.05	[illegible]					M	[illegible]
3	2[illegible]	.32	[illegible]		[illegible]			A	5.0
7	3[illegible]	.75	6/3			7.5YR 6/5		M	5.5
	4								
	5								
	6								

On upper slopes

SURFACE CONDITION

Crust
Hard set
Not hard set — sandy

BOUNDARY
DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE
GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB No 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1107

Spot   Kg   BUNGAWALBIN   Main Camp Rd.

509500677800600

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottle Primary	Mottle Secondary	Moisture	pH
1	1A11	.03	7.5YR 3/2					S	
2	2A12	[illegible]	7.5YR 3/4		7.5YR 5/3			S	
3	3A2	[illegible]	7.5YR 4/3		10YR 6/2			S	
7	4B2	.55	7.5YR 4/[illegible]					M	
	5								
	6								

firm surface - bit litter

Upper slope

Dg
Gn 3.24

SOIL PROPERTIES RECORD 'B'

BOUNDARY
DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

SHEARING TEST

STRUCTURE
GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

Mineral prairie soil

661 - ~~Grafton~~ / Casino / ~~Murwillumbah~~

SITE No. 1119

Gn 3.94

soot   Kg   WHIPORIE   off Harpers Rd

0 0 0 4 1

5Ø328Ø 6768366

Layer No	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Texture	pH
1	A1	0.05	5YR 3/2				5 6.0
2	A2	.15	5YR 5/2				5 6.5
3	B2	+ .44	7.5YR 5/2			Y D F 15	M 5.0
4							
5							
6							

Brown wombat

SURFACE CONDITION

Crust
Hard set
Not hard set

[illegible] 47

BOUNDARY

DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

Hardsetting

STRUCTURE

GRADE

PED SIZE

PED SHAPE

FABRIC

slickensides

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB No 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1113

soot   Jy ?   Fullers Rd   [illegible]

484570 6773730

0 0 0 4

SOIL PROPERTIES RECORD 'A'

Layer No	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	pH
1	A1	.10	YR 3/2			
2	A2	.45	7.5YR 6/6		5YR 5/6	
3	B1	.61	5YR 5/6		5YR 6/6	
4	B2	.82	7.5YR 6/6 15			
5	C					
6						

[illegible]

Dr 4.11

0 0 0 1

SOIL PROPERTIES RECORD 'B'

BOUNDARY

DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE

GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1115

soot Kj CAMIRA Greens Rd.

4915906761070

Dr 1:11 or Dr 5:11 KPS (both suspect codes)

SOIL PROPERTIES RECORD 'A'

	Layer No	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry	Mottle Characteristics	Moisture
1	1						S
2	2	A1	.11	7.5YR 4/6	7.5YR 6/6		S
6	3	B	.26	5YR 4/6			S
7	4	B	.48	5YR 3/6		WIPIFI?O	M
9	5	B	+.65	7.5YR 7/2		KIDIPI2O	M

[illegible] degraded, [illegible], curving.

Midslope [illegible] 7%

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE QUALITATIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY (sloughing aside)

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

661 - ~~Grafton~~/ Casino / ~~Murwillumbah~~

SITE No. 1118

spot Kg MYRTLE Clearfield Rd. Gn 2:11

4986206776000

SOIL PROPERTIES RECORD 'A'

	Layer No	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry	Mottle Characteristics	Moisture
1	1	A	.24	7.5YR 3/2			S
7	2	B2	.55	2.5Y 4/6.5		WPIF 8	M
9	3	B3	+.54	2.5Y 4/1		WPID 5	M

SURFACE CONDITION

Crust
Hard set
Not hard set

V. gentle hilltop 4%

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE QUALITATIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 112

Spot Kg FULLERS. Fullers Rd

484450 6769820

SOIL PROPERTIES RECORD 'A'

Wide hilltop - gentle, undulating 5%

Gn 3.91

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST

STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION

STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 114

Full Kg CAMIRA McDonalds Waterholes Rd

489150 6768750

SOIL PROPERTIES RECORD 'A'

21 water repellent

4% gully line - no evidence of any gullies on this drainage system in 1977

Gn 3

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST

STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION

STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1108

spot Kg BUNGAWALBIN One Man Rd. Dr 4.41

50158067830S0

SOIL PROPERTIES RECORD 'A'

	Layer No. / Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dominant Colour Dry	Texture
1	1 A1 1	.07	7.5YR 2/1		H
2	2 A1	.14	7.5YR 4/3		S
3	3 A2 1	.41	7.5YR 4/4	7.5YR 6/6	S
4	4 B2 2	.69	10YR 5/6	7.5YR 7/6	S
7	B/C 2	+.73	5YR 4/8		S

Good tree, organic

Hilltop - gentle terrain <1%

21-3

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

13/3/92

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 110-

spot Kg BUNGAWALBIN Number One Rd/Tuckurimba Rd.

51454067868400

Bullants

SOIL PROPERTIES RECORD 'A'

	Layer No. / Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dominant Colour Dry	Texture
1	1 1A	.01	7.5YR 2/2		3
5	2 1A	.13	7.5YR 3/2		
7	3 1B	+.69	7.5YR 5/4		
	4				
	8				
	8				

YELLOW EAR

Upper slope - very gentle (2%)

Gn 2.21

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

coarse sand

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 106

spot Kg BUNGAWALBIN Mill Rd ?

Db 3.51

5144266778146

SOIL PROPERTIES RECORD 'A'

Record Type	Same as Site No.	Total No. of Layers
0 0 0 4		

	Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	V/C	Dry	Mottle Primary	Mottle Secondary	Moisture	pH	Ag NO3	Sample
1	1	A1	·06	7.5YR 4/1					S			
2	2	A2	1.0	7.5YR 6/2					S			
6	3	B	·32	10YR 5/4					S			
7	4	B2	+·60	2.5Y 4/8					S			

Sidecinge - mottle ~5%

Highly ... mottled ...

SOIL PROPERTIES RECORD 'B'

Record Type	Same as Site No.
0 0 0 3 1	

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE DISRUPTIVE TEST · SHEARING TEST

STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION

U water repellent

STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 135

spot Kg BUNGAWALBIN Track linking Quarry ... Rd. ...

5135506781480

SOIL PROPERTIES RECORD 'A'

Record Type	Same as Site No.	Total No. of Layers
0 0 0 4		

	Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	V/C	Dry	Mottle Primary	Mottle Secondary	Moisture	pH	Ag NO3	Sample
1	1	A	·03	7.5YR 3/1								
2	2	A2	··	7.5YR 3/2								
6	3	B	·35	7.5YR 3/4		4/4						
7	4	B2	·55	7.5YR 4/6		5/6						

Upper ... mottle ~5%

Yellow-brown mottle

Gn 2.21

Distinct top 2 layers U-much ... organic matter

SOIL PROPERTIES RECORD 'B'

Record Type	Same as Site No.
0 0 0 3 1	

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE DISRUPTIVE TEST · SHEARING TEST

STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION

U1,2 water repellent

STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1109

FULL

Kg Ellangowan road. BRAEMAR EUCHROZEM

50100067830000

Gn 3.16

(with slope concretions)

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Boundary / pH
1	A1	.04	7.5YR 3/2		D1 6.5
3	A2	.20	7.5YR 4/4	10YR 6/4	D1 5.5
7	B2	.??	5YR 4/8		S1 5.5
9	B3	.67	2.5Y 6/4		S1 5.5
10	C				

Ridgetop 3%

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DEFORMATIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1110

spot

Kg. BRAEMAR Ridge Rd. Ancient

49948067860600

?

Gn 3.11

(with slope concretions)

SOIL PROPERTIES RECORD 'A'

Same as Site No. 1109

Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry
1	A1	.[illegible]	7.5YR 2/2	
2	A2	.14	7.5YR 3/4	7.5YR 6/4
7	B2	.64	5YR 4/8	
9	B3	.91	10YR 5/8	
10	C			

Midslope 13%

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DEFORMATIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1107

Spot

Kg Pabong Rice Rd ROMAL CANO ?

48854Ø 679Ø46Ø

Dy 1.41

SOIL PROPERTIES RECORD 'A'

1	1 1A 1	·03	[illegible]		SI
3	2 1A 2	·25	[illegible]		MI
7	3 1B 2	·35	[illegible]	101 ND 135	MI
9	4 1B 3	·65	[illegible]	P/ADIPIRO	MI

Midslope 1½

Porosity

Powder

Midslope - 3 Frog 5/6

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1111

Spot

Kg CARWONG Borroganda Rd

4947ØØ 67861ØØ

SOIL PROPERTIES RECORD 'A'

1	1 1A 1	·02	[illegible]		SI
3	2 1A 2	·07	7.5 YR 4/2		SI
7	3 1B 2	·44	5 YR 6/8		MI
9	4 1B 3	·56	[illegible]		WI

Hilltop - gentle ½

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
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JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1101 ?

500C Kg. Red Hill Rd ROYAL CAMP Dr 1.11

484680 678988O

Record Type	Same as Site No.	Total No. of Layers
0004		

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottle Primary	Mottle Secondary	Test
1	1A	.02	7.5YR 4/4	7.5	YR 5/4			S
7	2B2	.30	5YR 4/6					S
9	2B3	.75	7.5YR 6/3			10 D P 5		M

Mid-slope - to - upper slope. 2? ?

SOIL PROPERTIES RECORD 'B'

Record Type	Same as Site No.
00051	

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST · STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1102 ?

Ka Barragunda Road ROYAL CAMP. - (far Eastern end.) Gn 3.21

494880 679381O

Record Type	Same as Site No.	Total No. of Layers
0004		

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottle Primary	Mottle Secondary	Test
1	1A	.04	7.5YR 4/3					M 6.0
2	2A2e	.12	7.5YR 5/3		8/4			M 5.5
7	2B21	.25	7.5YR 4/3					M 5.0
8	2B22	.50	7.5YR 4/2			M D P 5		W 5.0

SOIL PROPERTIES RECORD 'B'

Record Type	Same as Site No.
00051	

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST · STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

SITE No. 0716

661 - ~~Grafton~~ / Casino / ~~Murwillumbah~~

Spot

GIBBERAGEE

Oil Rig Rd.

Dy 4·11

5067006750640

Horizon	Lower Average Depth (m)	Moist	Dry	Texture
1 A	·20	7.5YR 2/2	7.5YR 5/6	S
6 B	·45	7.5YR 5/4		
8 C	·61	7.5YR 6/6		MI
9 C				

SURFACE CONDITION

Crust

Hard set

Not hard set

impd - 10YR 4/6

imped - 10YR 5/6

Upper slope 15%

BOUNDARY

DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

CONSISTENCE

STRUCTURE

GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

SITE No. 0717

661 - ~~Grafton~~ / Casino / ~~Murwillumbah~~

Db 3·41

Spot

JK

GIBBERAGEE

Mangrove Creek Rd

5082606754960

Horizon	Lower Average Depth (m)	Moist	Dry	Texture
1 A1	·11	10YR 4/2		S -·0
3 A2	·30	10YR 5/3	10YR 7/2	S 5·0
5 B1	·39	7.5YR 5/6		MS 5·5
6 B2	·51	7.5YR 5/8		MC 4·5

SURFACE CONDITION

Crust

Hard set

Not hard set

Upper slope on ridge line 18% down ridge

BOUNDARY

DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

CONSISTENCE

STRUCTURE

GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

Site no. 0715

661 - ~~Grafton~~ / Casino / ~~Murwillumbah~~

Dy 5.31

Spot Jk OUTSIDE GIBBERAGEE PT. unnamed.

5161806756590

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Mottle Characteristics	Texture / pH
1	1 A1	.05	10YR 4/2			5.5
3	2 A2	.31	10YR 6/4+5/4		C P F 1	6.0
5	3 B1	.47	10YR 6/6		0 D F 1	M 5.5
6	4 B2	.62	10YR 5/6		R D F 1	M 4.5

sporadic

acar derived by badly gullied farm + washed out erosion (circled on management acp)

c/.0417

SURFACE CONDITION

Crust
Hard set
Not hard set X loose

lower slope 17%

BOUNDARY

DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE

GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ironrick qtz not common gravel

ROOTS

AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

Site no. 0714

661 - Grafton / Casino / Murwillumbah

Dy 4.11

Spot Jk Joland Rd, just next to Tick Gate

DEVILS PULPIT

5199006762900

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Mottle Characteristics	Texture / pH
1	1 A11	.11	7.5YR 5/3			
2	2 A12	.28	7.5YR 3/6			
6	3 B21	.71	7.5YR 6/6			MW
7	4 B22	.94	7.5YR 6/8			W
10						

SURFACE CONDITION

Crust
Hard set
Not hard set X

Upper slope 15%

BOUNDARY

DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE

GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

SITE No. 0713

661 - Grafton / Casino / Murwillumbah

spot   Jk   BANMABBA   Fire Trail off ...

4946206755520

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Mottle Characteristics	Texture
1 A	.15	... 5/6			S
3 B2	.60	... 5/6			

Typical soil ... concretions ... lateritic ... gravelly ...

SURFACE CONDITION

Crust / Hard set / Not hard set — sandy, ... silty, ... organic

Upper slope - 2%

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

CONSISTENCE

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

SITE No. 8713

661 - Grafton / Casino / Murwillumbah

Gn 2-31

spot   Jk   DOUGLEOUNE   Glencoe Rd

5183306773760

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Mottle Characteristics	Texture
1 A	.35	7.5YR 2/2			S
5 B1	.60	7.5YR 4/4			S
6 B2	+1.00	7.5YR 5/8			S1

SURFACE CONDITION

Crust / Hard set / Not hard set

footslope - 3%

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

CONSISTENCE

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY — porous ... pellet

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
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JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0703

Full   JK   MT BELMORE   Wyan Ck Rd   Jones

4768806775426   Uc 4.21

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	pH
1	A1	·15	7.5YR 3/2	[illegible]	5.5
3	A2	·63	7.5YR 4/4	[illegible]	6.5
5	B	·70	7.5YR 4/6	[illegible]	6.0
6	B	1·40	7.5YR 5/8	[illegible]	6.0

Ferrosols (depositional) 12b

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · SHEARING TEST · STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H.

SITE No. 0704

Soot   JL   Bennetts Rd.   MT BELMORE   ?   Dyn11

4767206773500

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	pH
1	A1	·22	[illegible]	[illegible]	[illegible]
2	A2	·14	7.5YR 4/4	[illegible]	[illegible]
4	A3	·43	7.5YR 4/6	[illegible]	[illegible]
6	B2	1·60	7.5YR 5/6	[illegible]	[illegible]

Ridgeline - crest   5L

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · SHEARING TEST · STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 77·2

spot Jk MT MARSH [illegible] from [illegible]

48722b676738ф

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Texture
1	1	A	·13	7.5YR 3/3		M
3	2	A2	·51	7.5YR 4/4		M
6	3	B2	+ ·74	7.5YR 5/6		M
	4					
	5					
	6					

lower slope 7°

RPS

Dy 4·21

SOIL PROPERTIES RECORD 'B'

[illegible]

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 77·11

Jk

MT MARSH

48254ф676824ф

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Mottles	Texture
[illegible] missing 2	1	A12	·07	7.5YR 2/2			K
4	2	B2	·13	7.5YR 3/4			
6	3	B2	+·40	2.5Y 6/6		C [illegible]	M
	4						
	5						
	6						

Rehm

Upper slope 11°

RPS

Dr 5·11

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1905 — 661 MURWILLUMBAH — Sn 3.71

Full — Tnr — Rummery Rd

WHIAN WHIAN 5339506836426

Layer	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Codes) Moist
1	A11	.06	7.5YR 2/2
2	A12	.21	7.5YR 3/2
3	A2	.37	7.5YR 4/6
4	B1	.53	5YR 5/6
6	B2	1.30	5YR 5/8
8	C	2.00	

SURFACE CONDITION

Crust / Hard set / Not hard set — litter layer

Lower slope just up from building bank

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · SHEARING TEST · STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1906 — 661 MURWILLUMBAH — Dy 4.11

Spot — Tnb — Gibberagee Range Rd

WHIAN WHIAN 5324406838380

Layer	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Codes) Moist
1	A1	.13	7.5YR 2/3
2	A1	.32	7.5YR 2/3
4	B1	.61	7.5YR 3/7.5
6	B2	.91	7.5YR 5/6
9	C		

SURFACE CONDITION

Crust / Hard set / Not hard set — slight litter layer

Midslope – undulating terrain

Sample – yellow weathered ...

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · SHEARING TEST · STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1305 — 661 MURWILLUMBAH — Gn 3.71

Spot — Tnr — WHIAN WHIAN — Peates Mtn Rd.

5353906839220

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Texture
1	A1	.07	7.1 YR 3/3	
2	A12	.20	7.5 YR 3/3	MI
6	B2	.47	10 YR 6/6	MI
9	C			

SURFACE CONDITION — Hill top - gentle slope

Crust / Hard set / Not hard set — litter layer

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE DISRUPTIVE TEST · SHEARING TEST

STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION

STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1907 — 661 MURWILLUMBAH — Gn 3.74

spot — Tnr — WHIAN WHIAN — Outfalls F.F.

5314366836800

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Texture
1	A11	.08	7.5 YR 3/2	M
2	A12	.27	7.5 YR 4/3	M
3	A2	.42	7.5 YR 5/4	M
4	B21	.60	7.5 YR 5/8	M
6	B22	1.9	5 YR 5/8	M

SURFACE CONDITION

Crust / Hard set / Not hard set

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE DISRUPTIVE TEST · SHEARING TEST

STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION

STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1929 | 661 MURWILLUMBAH | Gn 3·71

spot | Tnr | WHIAN WHIAN | Baldwin Rd

536266683496

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Texture
1 A1	·07	7.5YR 4/2	[illegible]
2 A12	·31	7.5YR 3/2	[illegible]
4 B1	·41	5YR 4/4	[illegible]
6 B2	+·63	5YR 6/3	M

SURFACE CONDITION

Crust
Hard set
Not hard set — litter/leaf litter

Upper slope ~4% short sideslope
rolling undulating terrain

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

Krasnozem

SITE No. 1501 | 661 MURWILLUMBAH | Gn 3·14

FULL | Rc | NULLUM Manns Rd

536590685087

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Texture
1 A1	·16	5YR 3/3	5·6·5
3 A2	·38	5YR 4/3	5·6·5
4 B1	·62	5YR 5/8	M 5·0
6 B2	+1·24	5YR 4/8/5	M

Stony, highly disturbed

SURFACE CONDITION

Crust
Hard set
Not hard set — self mulching with grass

Upper slope 17%

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1502 — 661 MURWILLUMBAH — 6n 4 81

Spot — Rc — NULLUM — Gilwah Rd

53235Ø685167Ø

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Texture
1	1 A	.13	7.5YR 3/2	M 6.0
6	2 B	.70	7.5YR 5/6	M 5.0
9	3 C			
	4			
	5			
	6			

Surface Condition — Lingelia / upper slope 35% steep topography

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION — med.

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

KRAJ

SITE No. 1503 — 661 MURWILLUMBAH — 6n 3

Spot — Rc — NULLUM — Rockface Rd

53338Ø684808Ø

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Texture
1	1 A 1	.11	7.5YR 2/2	SL
3	2 A 2	.52	5YR 3/4	MI
6	3 B 2	.99	2.5YR 3/4.5	MI
7	4 B 3	1.30	5YR 3/6	MI
	5			
	6			

Surface Condition — Upper slope 18%

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE — (light)

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

KRAS.

SITE No. 2302

FULL

~~Ptd~~/Plv

661 - Grafton / Casino / Murwillumbah

UF5·22

BILLILIMBRA

Perry Rd extension

4389706764540

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Texture
1 A	·15	[illegible]		M [illegible]
2 B21	·57	[illegible]		M [illegible]
3 B22	1+ 2·5	[illegible]		M [illegible]
4				
5				
6				

CODES

SURFACE CONDITION

Crust
Hard set
Not hard set — self mulching / litter

Upper slope 18%

BOUNDARY
DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE — slight

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE
GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY — slow — quick

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZES

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

RED EARTH

SITE No. [illegible]

Jk MT BELMORE - Wyan Ck Rd

Gn 2.14

4744806772760

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottles	Tests
1	1 A1	.15	7.5 YR 3/2		/		[illegible]
3	2 B2	.37	2.5 YR 3/2		/		[illegible]
6	3 B2	.53	2.5 YR 4/6		/		5
	4		/		/		
	5		/		/		
	6		/		/		

Moderate 10L

SOIL PROPERTIES RECORD 'B'

BOUNDARY
DISTINCTNESS
SHAPE
TEXTURE
SAND FRACTION
GRADE
PLASTICITY TYPE
STICKINESS
WATER-TABLE
CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY
CRACK SIZE
STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY
ROOTS
AMOUNT
ROOT DISTRIBUTION
PANS
CHARACTER
CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

VENESS & ASSOCIATES PTY LIMITED
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JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 07 10

Spot

Jk BUNGAVIALBIN Eastern boundary road. (sandy)

5177706786740

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottles	Tests
1	1 A	.14	7.5 YR 2/3		/		[illegible]
2	2 B	.26	7.5 YR 3/2		/		[illegible]
6	3 B	.75	[illegible]		/		[illegible]
	4		/		/		
	5		/		/		
	6		/		/		

drainage [illegible] 2/6

Dy [illegible]

SOIL PROPERTIES RECORD 'B'

BOUNDARY
DISTINCTNESS
SHAPE
TEXTURE
SAND FRACTION
GRADE
PLASTICITY TYPE
STICKINESS
WATER-TABLE
CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY
CRACK SIZE
STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY
ROOTS
AMOUNT
ROOT DISTRIBUTION
PANS
CHARACTER
CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

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JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0704

Spot

Jk Pacing Ridge Rd ROYAL CAMP

48377Φ6791376

SOIL PROPERTIES RECORD 'A'

Record Type 0 0 0 4 | Same as Site No. | Total No. of Layers

Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	V/C	Dry	Mottle Primary	Mottle Secondary	Moisture	pH	Ag NO3
1	[illegible]	[illegible]	[illegible]							
2	[illegible]	[illegible]	[illegible]			[illegible]				
3	[illegible]	[illegible]	[illegible]			WIFICHO		W		
4										
5										
6										

Hidramps 156

SOIL PROPERTIES RECORD 'B'

Record Type 0 3 4 5 | Same as Site No.

BOUNDARY
DISTINCTNESS: None; Sharp (<20 mm); Clear (20-50 mm); Gradual (50-100 mm); Diffuse (>100 mm)
SHAPE: Even; Wavy; Irregular; Broken

TEXTURE
SAND FRACTION: Fine; Coarse — mod
GRADE: Sand; Loamy Sand; Clayey Sand; Sandy Loam; Fine Sandy Loam; Light Sandy Clay Loam; Loam; Loam, Fine Sandy; Silt Loam; Sandy Clay Loam; Clay Loam; Silty Clay Loam; Fine Sandy Clay Loam; Sandy Clay; Silty Clay; Light Clay; Light Medium Clay; Medium Clay; Heavy Clay

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY
CRACK SIZE

STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY

ROOTS
AMOUNT
ROOT DISTRIBUTION

PANS
CHARACTER

CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. [illegible]

47929Φ6784Φ8d

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	V/C	Dry	Mottle Primary	Mottle Secondary	Moisture	pH	Ag NO3
1	1A	[illegible]	[illegible]					M		
3	[illegible]	[illegible]	[illegible]							
6	[illegible]	43	[illegible]			[illegible]				
8	[illegible]	[illegible]	[illegible]			[illegible]		W		

RFS

Dr 5:5

206

SOIL PROPERTIES RECORD 'B'

BOUNDARY
DISTINCTNESS
SHAPE

TEXTURE
SAND FRACTION — mod.
GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY
CRACK SIZE

STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY

ROOTS
AMOUNT
ROOT DISTRIBUTION

PANS
CHARACTER

CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

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JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0796

spot JK MT BELVIDERE Mt Belvidere rd. Qfg ?

4771506783560

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottle Characteristics	Texture
1	1	A1	[illegible]	10YR 2/3				[illegible]
2	2	A[illegible]	[illegible]	10YR 4/3		10YR 5/3		[illegible]
3	3	A2	[illegible]	10YR 5/4		10YR 7/3		[illegible]
6	4	B[illegible]	[illegible]	7.5YR 5/4			W P F 20 R D 11 0	W

Midslope ... ~25°

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

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JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0703

spot CHERRY TREE NORTH JK Track off Hogarth Range Rd. (bogg...)

477720580 0260

SOIL PROPERTIES RECORD 'A'

YPS

Dy 5.21

	Layer No.	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Mottle Characteristics	Texture
1	1	A1	.13	7.5YR 3/2				M
3	2	A2	.34	7.5YR 4/3		7.5YR 6/2		M
6	3	B2	.64	7.5YR 5/3			R 6 M D 3 0	W

Upper slope ~20°

Coarse-grained ...

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
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JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0701

Spot

RICHMOND RANGE Jk Qtz/felds sst. Uc 4.21

Ecotly [illegible]

468910683275Ø

SOIL PROPERTIES RECORD 'A'

Layer No	Horizon	Lower Average Depth (m)	Moist	Dry
1	A1	.11	7.5YR 3/2	10YR 5/2
2	A2	.38	7.5YR 4/4	10YR 6/3
3	B2	.68	10YR 5/6	10YR 7/4
4	C	1.00	7.5YR 5/8	7.5YR 5/8
5				
6				

Midslope - mod steep, [illegible] 11%

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0702

Spot

RICHMOND RANGE Jk qtz/felds sst. Uc 6.4.

[illegible]

4704006828200

SOIL PROPERTIES RECORD 'A'

Layer No	Horizon	Lower Average Depth (m)	Moist	Dry
1	A	.11	7.5YR 3/3	
2	R2	.38	7.5YR 3/4	
3	R			
4				
5				
6				

Midslope [illegible]

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

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Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0301

Spot

EDEN CREEK S.F. JS

486600 6838200

Gn 3.11

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry	Moisture
1	1	A	.11	5YR 3/3		D
6	2	B.L	.50	5YR 3/4		S
9	3	C				
	4					
	5					
	6					

Lower Midslope - very gentle 13%

SOIL PROPERTIES RECORD 'B'

BOUNDARY · STRUCTURE · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · TEXTURE · ROOTS · FABRIC · FANS · CUTANS · CHARACTER · PLASTICITY TYPE · PED POROSITY · STICKINESS · CRACK SIZE · CONCRETIONS & INCLUSIONS · WATER-TABLE · STONES · FORM · CONSISTENCE · AMOUNT · SIZE · STONE DISTRIBUTION

pale, stony within 1st

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JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0602

Spot

RICHMOND RANGE JS - Fine qtz / felds ssl

Uc 4.24

469020 6834970

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry	Moisture
1	1	A1	.06	10YR 2/2		
3	2	A2	.35	10YR 4/3	10YR 6/3	
6	3	B21	.79	7.5YR 6/6		
7	4	B22	1.23	7.5YR 5/6		
8	5	B3		10YR 6/4		
	6					

Upper slope 27%

100m down road
0-10 cm A1 LS
10-20 cm A2 LS
20-28 cm B1 LS
28 - 90+ B2 LC

This soil is a cross between 01 & 02 & little should be expected in the JS unit

SOIL PROPERTIES RECORD 'B'

BOUNDARY · STRUCTURE · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · TEXTURE · ROOTS · FABRIC · FANS · CUTANS · CHARACTER · PLASTICITY TYPE · PED POROSITY · STICKINESS · CRACK SIZE · CONCRETIONS & INCLUSIONS · WATER-TABLE · STONES · FORM · CONSISTENCE · AMOUNT · SIZE · STONE DISTRIBUTION

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JOB Nº 661 GRAFTON/CASINO/MURWILL'H

?

Gn 3·21

SITE No. 0601

Full

RICHMOND RANGE Js qtz - med to coarse feldspar

46833Ø68345ØØ

SOIL PROPERTIES RECORD 'A'

	Horizon	Lower Average Depth (m)	Moist	Dry	pH
1	A11	·07	7.5YR2/1		6·0
2	A12	·16	7.5YR3/3	7.5YR6/2	5·5
5	B1	·33	7.5YR3/3		5·5
6	B21	·80	7.5YR3/4		5·5
7	B22	·95	7.5YR4/4		5·0
8	B3		10YR5/2		5·0

Upper slope - moderately steep. ? 76

SOIL PROPERTIES RECORD 'B'

BOUNDARY
DISTINCTNESS
SHAPE

TEXTURE
SAND FRACTION
GRADE

Sandy Clay (just)

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE

L4

FABRIC
CUTANS
PED POROSITY

L1 water repellent

stable porous

CRACK SIZE

STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY

ROOTS
AMOUNT
ROOT DISTRIBUTION

PANS
CHARACTER

CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

base of L5 seems to be zone where movement over L6. i.e. for landslip erosion hazard in cleared land - grass :

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4PS

SITE No. 0418

661 - ~~Grafton~~/ Casino / ~~[illegible]~~

Dy 5.21

spot   JW   MOUNT MARSH   unnamed track

Record Type	Same as Site No	Total No. of Layers
0 0 0 4 1		

47636Ø6764/3Ø

	Horizon	Lower Average Depth (m)	Moist	Dry	Mottle Characteristics	Field pH
1	1 A1	.14	10YR 3/2			M 5.0
3	2 A2	.29	10YR 5/4			M 5.5
5	3 B2	.59	10YR 6/6		R D P 10	M 5.0
	4					
	5					
	6					

coarse qtz/lithic rot.

SURFACE CONDITION

Midslope 7%

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

rounded pebbles

ROOTS
AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

Struct. plastic clays

SITE No. 1003

661 - ~~Grafton~~/ Casino / ~~[illegible]~~

Uf 6.34

spot   JW   MOUNT MARSH   Mount Marsh Rd

Record Type	Same as Site No	Total No. of Layers
0 0 0 4 1		

48288Ø675966Ø

	Horizon	Lower Average Depth (m)	Moist	Dry	Mottle Characteristics	Field pH
1	1 A	.05	7.5YR 2/2			M 6.5
4	2 B1	.28	7.5YR 4/4			M 6.5
5	3 B2	.69	7.5YR 5/6			M 6.0
9	4 C					
	5					
	6					

check sample against ...

fine-grained, ... Pisa massive felspar ... qtz ...

SURFACE CONDITION

just off midslope - 8%

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

mod clays

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

Porous (slow)

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 0415

661 - Grafton / Casino / Murwillumbah

Gn 3·74

FULL JW TABBIMOBLE 1·3km off Dartyo Rd.

52456067706820

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Mottles	Texture / pH
1 A1	·27	10YR 4/2			5·5
3 A2	·53	10YR 5/3	10YR 7/2		5·5
5 B2	+·76	5YR 5/6		10YR 6/8	5·5

looks like duplex but features suit part to gradational

SURFACE CONDITION

Upper slope - very gentle terrain 8%-10%

Crust
Hard set
Not hard set X 1cm litter layer

BOUNDARY
DISTINCTNESS
SHAPE
TEXTURE
SAND FRACTION
GRADE
(thick)
PLASTICITY TYPE
STICKINESS
WATER-TABLE
CONSISTENCE
CONSISTENCE
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY
Porous (thick dense)
CRACK SIZE
STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY
(siliceous pebbles)
ROOTS
AMOUNT
ROOT DISTRIBUTION
PANS
CHARACTER
CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 046

661 - Grafton / Casino / Murwillumbah

Gn 3·74

SPOT JN TABBIMOBLE Macjoydens Rd

52183067671800

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Dry	Mottles	Texture / pH
1 A1	·05	10YR 4/3			
3 A2	·14	10YR 5/3	10YR 6/4		
4 B1	·35	10YR 5/4			
5 B2	+·43	10YR 7/3			

SURFACE CONDITION

Lower slope 5%

Crust
Hard set
Not hard set

BOUNDARY
DISTINCTNESS
SHAPE
TEXTURE
SAND FRACTION
GRADE
PLASTICITY TYPE
STICKINESS
WATER-TABLE
CONSISTENCE
CONSISTENCE
SHEARING TEST

STRUCTURE
GRADE
PED SIZE
PED SHAPE
FABRIC
CUTANS
PED POROSITY
CRACK SIZE
STONES
AMOUNT OF STONES
SHAPE
STONE DISTRIBUTION

STONE SIZE
STONE WEATHERING
STONE LITHOLOGY
ROOTS
AMOUNT
ROOT DISTRIBUTION
PANS
CHARACTER
CONCRETIONS & INCLUSIONS
FORM
AMOUNT
SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1002

FULL JWS MT PIKAPENE .. Track off main road thru' plantation

4746306789580

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry	Moisture	pH
1	A1	.05	5YR 2/1			
2	A12	.12	5YR 3/2	7.5YR 5/4		
3	A2	.57				
5	B2	.95	5YR 4/6			
9						
10						

APS Dec 21

lower slope moderate 20%

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST · STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES · AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

Coarse medium

rock pits

slowly in …

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 1301

Spot JWS Forestry … Rd. …

Mt BELMORE 4734306785660

SOIL PROPERTIES RECORD 'A'

Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry	Moisture	pH
1	A	.25	7.5YR 2/2			
5	B	.52	7.5YR 3/4			
7	B3	1.2	7.5YR 4/4			

lower slope - gentle 4%

UF 6.21

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST · STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES · AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0510

spot

JW Smalls Road

bagged for slipping when wet.

MT PIKAPENE 4760206787340

SOIL PROPERTIES RECORD 'A'

Struct. plastic clay

Uf 6.33

Gentle Upper slope - steep, long. 15L

SOIL PROPERTIES RECORD 'B'

BOUNDARY

DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE

GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

JW - erosion - Total clearing is the farming land in good shape mainly in landslip e.g. near tank + Old Lawrence + at the Mt Pikapene S.F. and also near sth. eastern of Richmond Range Rd near Bungawa Hwy

landslip outside of [illegible]

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Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. [illegible]

spot

JW Old Lawrence Rd.

MT PIKAPENE 4748706791270

Struct. plastic clay

UF 6.31

SOIL PROPERTIES RECORD 'A'

upper slope, moist, steep 32L

SOIL PROPERTIES RECORD 'B'

BOUNDARY

DISTINCTNESS

SHAPE

TEXTURE

SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

DISRUPTIVE TEST

SHEARING TEST

STRUCTURE

GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES

AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS

AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0403

Full SUGARLOAF SW? Sugarloaf Fire Trail

MOUNT PIKAPENE 46152006789260 JF 6.33

SOIL PROPERTIES RECORD 'A'

Record Type	Same as Site No.	Total No. of Layers
0 0 0 4		

	Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	V/C	Dry	Mottle Characteristics Primary	Secondary	Tests Moisture	pH	Ag NO3	Sample
1	1	1	.09	10YR 4/3					M	6.8		
5	2	2	.47	10YR 4/4					M	6.3		
7	3	3		7.5YR 5/6 16/4					M	6.3		
	4											
	5											
	6											

Ridgeline 33 rising ridge with minor ...

Record Type	Same as Site No.
0 3 0 1	

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY (stones)

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY sandstone

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0404

Spot CHERRY TREE JW coarse-sand to gravel size qtz/feldspathic sst

476600679572 KPS Dr 2.21

SOIL PROPERTIES RECORD 'A'

Record Type	Same as Site No.	Total No. of Layers
0 0 0 4		

	Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	V/C	Dry	Mottle Characteristics Primary	Secondary	Tests Moisture	pH	Ag NO3	Sample
Dry sclerophyll	1	A1	.06	5YR 3/2					M			
3	2	A2	.28	5YR 3/6					M			
8	3	K	.60	2.5YR 3/6					M			
	4											
	5											
	6											

surface - gravelly, firm sheraserry

96 Upper slope, gentle Rocky knob above site on most of tree area

Record Type	Same as Site No.
0 3 0 1	

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT distributed in L1,2

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

Structured subplastic clay

SITE No. 0403

Full

CHERRY TREE WEST

JW

UF 5.31

474950 6797870

SOIL PROPERTIES RECORD 'A'

	Layer/Horizon	Lower Average Depth (m)	Moist	Dry		pH
1	11A	·03	7.5YR 3/2			M18.0
5	21B2	·19	5YR 4/6 ← F/bedrock)			M15.5
7	31B3	·43	10YR 6/6			M15.5
9	4C					

RH mulching wih ironstones

Ridge line upper slope adjacent side of ridge 4%

Ironstone Stone line ~ overlying L2/3

L3 with white ... frag ... further ...

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST

STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES · AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION

STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

slight

slight

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants
JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0405

spot

RICHMOND RANGE . JW off Upper Cudmoran Ck Rd

472660 6805930

?

SOIL PROPERTIES RECORD 'A'

Gn :·41

	Layer/Horizon	Lower Average Depth (m)	Moist	Dry		pH
1	11A 1	·06	7.5YR 2/2	5/2.3		
2	21A 12	·21	7.5YR 4/2			
5	31B2	·52	7.5YR 5/2/2			
9	41C					

Lower slope - gentle 13%

SOIL PROPERTIES RECORD 'B'

L1 Very top 1cm is many layers of leaves, dense leaves ... ~ ... cm

L2 dist.

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST

STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES · AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION

STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0404

FULL

RICHMOND RANGE Jw. Culmaran Ck Rd

474130680938Ø

DR5.11

SOIL PROPERTIES RECORD 'A'

	Layer No	Horizon	Lower Average Depth (m)	Colour Moist	Colour Dry	Mottle Characteristics	Moisture	pH
1	1	A1	.10	7.5YR 4/3	7.5YR 5/3		S	5.5
2	2	A2	.25	7.5YR 4/4			S	5.8
5	3	B2	.33	7.5YR 4/6			M	5.0
7	4	B3	.60	7.5YR 5/8		G P D 45	M	5.0
10	5	R						
	6							

5.Ø or 4.5 4.5 4.5

9% Lower slope - moderately gentle

increases with depth

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE QUALITATIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

slowly

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

Fe nodules

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 0414

661 MURWILLUMBAH

spot

Jw MEBBIN Cadell Rd

516640684993Ø

c dark grey clay st. ovr. coarl bau

SOIL PROPERTIES RECORD 'A'

	Layer No	Horizon	Lower Average Depth (m)	Colour Moist	Colour Dry	Moisture	pH
1	1	A	.14	10YR 3/2		M	4.4
4	2	B1	.23	10YR	3/4	M	5.5
5	3	B2	.70	10YR	4/4	M	5.6
4	4	C	.90				

STRUCT. PLASTIC Cutn

Uf 6.3.

Upper slope 23%

SURFACE CONDITION

Crust

Hard set

Not hard set X

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE QUALITATIVE TEST

CONSISTENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

[illegible]
Uf 5·22

SITE No. 2413

661 MURWILLUMBAH

Fulls

JW

[illegible] Rd

MEBBIN

5168306854436

Layer	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Mottle Characteristics	Moisture
1	[illegible]	·16	5YR 3/2		M
2	[illegible]	·32	5YR 3/4		M
3	B2	·46	5YR 3/6		[illegible]
4	B3	+·78	2.5YR 3/4	[illegible]	M

Midslope ~7 %

SURFACE CONDITION

Crust
Hard set
Not hard set

BOUNDARY
DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
QUALITATIVE TEST

SHEARING TEST

STRUCTURE
GRADE

PED SIZES

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

[illegible]
Uf 6·34

SITE No. 2412

661 MURWILLUMBAH

Vot

JW

[illegible]

[illegible] Rd

5192306855366

Layer	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Mottle Characteristics	Moisture
1	A	·06	7.5YR [illegible]		S
2	B1	·17	7.5YR 5/4		M
3	B2	·37	7.5YR 5/6		M
4	B3	·52	7.5YR [illegible]		M
5	C	·57		[illegible]	

Ridgeline ~5%

SURFACE CONDITION

Crust
Hard set
Not hard set

BOUNDARY
DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
QUALITATIVE TEST

SHEARING TEST

STRUCTURE
GRADE

PED SIZES

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 0411

661 MURWILLUMBAH

Gn 3·14

spot JW

WOLLUMBIN Tondowni Rd

5 2213Ø6856726

	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Texture	pH
1	1 A1	·06	7.5YR 2/2			S	5.5
2	2 A2	·9	7.5YR 3/4			Ch	5.5
4	3 B1	·9	7.5YR 4/4			M	5.5
5	4 B2	·56	10YR 4/10			M	5.5
9	5 C	9					

SURFACE CONDITION
Crust
Hard set
Not hard set

Upper slope 15%

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST · STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES · AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

lithic cont.

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

* POSS. SITE FOR PLASTICIT TEST - L4

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0403

spot

RICHMOND RANGE JW Cabyi Ck Rd

475680682385Ø

SOIL PROPERTIES RECORD 'A'

	Horizon	Lower Average Depth (m)	Moist	V/C	Dry / Mottle col	Texture
1	1 A	·11	5YR 3/2			D
5	2 B21	·70	5YR 4/4			S
6	3 B22	·90	7.5YR 5/6		10YR 6/4	S
7	4 B3	1·20	10YR 4/2			S

<3 MOTTLE

Midslope - moderate 20%

SOIL PROPERTIES RECORD 'B'

Slightly harsh clays

BOUNDARY DISTINCTNESS · SHAPE · TEXTURE · SAND FRACTION · GRADE · PLASTICITY TYPE · STICKINESS · WATER-TABLE · CONSISTENCE · DISRUPTIVE TEST · SHEARING TEST · STRUCTURE GRADE · PED SIZE · PED SHAPE · FABRIC · CUTANS · PED POROSITY · CRACK SIZE · STONES · AMOUNT OF STONES · SHAPE · STONE DISTRIBUTION · STONE SIZE · STONE WEATHERING · STONE LITHOLOGY · ROOTS AMOUNT · ROOT DISTRIBUTION · PANS · CHARACTER · CONCRETIONS & INCLUSIONS · FORM · AMOUNT · SIZE

floater

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0402

spot

RICHMOND RANGE JW

477660 6828640

UF 6.31

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Mottles	Texture
1	1	A	.17	5YR3/2			SI
5	2	B2	.55	5YR4/?			MI
7	3	B3	+.90				MI
	4						
	5						
	6						

patches o' colour.

Upper slope 11%

SOIL PROPERTIES RECORD 'B'

BOUNDARY

STRUCTURE

STONE SIZE

TEXTURE

ROOTS

FANS

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

STONES

CONCRETIONS & INCLUSIONS

slowly

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0401

SPOT

RICHMOND RANGE - JW

477200 6831600

Structured plastic

UF 6.31

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Mottles	Texture
1	1	A	.18	M.5YR3/4			DIS
5	2	B2	.37	5YR4/?			M
7	3	B3	.80	7.5YR6/6			MI
9	4	C	+.65				
	5						
	6						

Ridgeline - gentle 3%

SOIL PROPERTIES RECORD 'B'

BOUNDARY

STRUCTURE

STONE SIZE

TEXTURE

ROOTS

FANS

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

STONES

CONCRETIONS & INCLUSIONS

slowly (tiny pores)

4 very light both with bright mottles

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 0417

661 - ~~Grafton~~ / Casino / ~~Murwillumbah~~ ?

Db 0.41

spot JW MORORO unnamed

523976757400

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Texture
1 A11	0.05	10YR 5/2	S 6.5
2 A12	0.38	10YR 4/6	M 6.0
3 A2	0.60	10YR 7/4	M 6.6
5 B2	0.70	7.5YR 4/6.5	M 5

SURFACE CONDITION

Crust X
Hard set
Not hard set

Upper slope ~ 5% very gentle slope.

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

SHEARING TEST

STRUCTURE GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 1101

661 MURWILLUMBAH

Dy – 1

FULL

K-Jb

WOLLUMBIN

North Wollumbin Rd

5233 ø6 686 ø73ø

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Mottle Characteristics	Texture
1	.12	10YR 3/2	5	M
3	.35	10YR 6/4		M
4	.60	10YR 6/4		M
7				

SURFACE CONDITION

Crust
Hard set
Not hard set X loose, friable, litter

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

COHERENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZES

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 2001

661 – Grafton / Casino / Murwillumbah

Dy 5.41

FULL

RJm

TABBIMOBLE

unnamed track, 1 km S of Tick Station

5295 7ø 677 213ø

Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Mottle Characteristics	Texture	
1 A1	.13	10YR 3/2		W	5.0 4.5
2 A2	.84	10YR 6/2		W	5.5 4.5
3 B1	.54	10YR 5/4	W P F .. 0	VA	5.0 4.5
4 B2	.92	10YR 6/6	N P D 1 5	W	5.0 4.5

Lower slope – very gentle terrain 5%

SURFACE CONDITION

Crust
Hard set
Not hard set X loose, friable with litter (10YR 7/1) – organic stain

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE

COHERENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZES

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

PANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 0903

661 – ~~Grafton~~ / Casino / ~~Murwillumbah~~

Kiasonzen

Soot   Jmr   Pt MOUNT MARSH   unnamed track   Gn 3·11

Record Type	Same as Site No.	Total No. of Layers
0 0 0 4 1		

4739φφ676299φ

	Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	V/C	Dry	Mottle Characteristics	Texture / pH
1	1	A	·03	7·5YR 2/3				M 6.0
3	2	B1	·32	7·5YR 2/4				M 6.5
4	3	B2	·56	7·5YR 3/6				M 5.0
	4							
	5							
	6							

coarse gravel
hillock

SURFACE CONDITION
Crust
Hard set
Not hard set X

Midslope ~12%

L? point
hillock

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

COHESIVENESS

SHEARING TEST

STRUCTURE
GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

JOB No 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0902

FULL   KEYBARBIN   Jmr   Keybarbin Rd

Dy 5·21

Record Type	Same as Site No.	Total No. of Layers
0 0 0 4 1		

465426676834φ

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	V/C	Dry	Mottle Characteristics	Texture / pH
1	1	A1	·05	7·5YR 2/2				S 5.5
2	2	A2	·22	7·5YR 5/4		6/4		S 5.6
4	3	B2	·48	5YR 7/8			W P D 2 φ	M 5.5
6	4	B3	·96	7·5YR 5/6			W P P 2 5	M 5.5
8	5	R		5/Y				
	6							

Upper slope – steep 23%

Record Type	Same as Site No.
0 0 0 5 1	

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE
SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE
DISRUPTIVE TEST

SHEARING TEST

STRUCTURE
GRADE

PED SIZE

PED SHAPE

FABRIC

CUTANS

PED POROSITY

Water repellent

CRACK SIZE

STONES
AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS
AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0901

spot KEMBARBIN Jmr Med to corse grained felds/qtz sst.

* Clare weaked with MINOR [illegible] oding, cutting or length of [illegible] between con bank; hide drain.

465216678197d

SOIL PROPERTIES RECORD 'A'

Layer No	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Moisture
1	A	·03	10YR5/4		10YR6/4	S
3	B21	·31	7.5YR5/6			M
4	B22	+·50	10YR5/6	4		M

Yellow earth

Gn2·21

Cristy

Hilltop flat - wet 32

SOIL PROPERTIES RECORD 'B'

BOUNDARY DISTINCTNESS — SHAPE — TEXTURE SAND FRACTION — med. — GRADE — PLASTICITY TYPE — STICKINESS — WATER-TABLE — CONSISTENCE — SHEARING TEST

STRUCTURE GRADE — very [illegible] — PED SIZE — PED SHAPE — FABRIC — CUTANS — PED POROSITY — CRACK SIZE — STONES AMOUNT OF STONES — SHAPE — STONE DISTRIBUTION

STONE SIZE — STONE WEATHERING — STONE LITHOLOGY — (ironrich sst) — ROOTS AMOUNT — ROOT DISTRIBUTION — PANS — CHARACTER — CONCRETIONS & INCLUSIONS — FORM — AMOUNT — SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0903

snot SUGARLOAF. Jmr? very wet - [illegible]

[illegible] HOLE

Sh

465400671163b

SOIL PROPERTIES RECORD 'A'

Layer No	Horizon	Lower Average Depth (m)	Moist	V/C	Dry	Moisture
1	A	·14	10YR4/2			N
4	B21	·41	10YR4/2			N
5	B22	+1·40	10YR5/4		5/2	M

Uf5·[illegible]

4·06 Ridgeline (gritty)

Same soil all the way [illegible] towards change line

SOIL PROPERTIES RECORD 'B'

slickensides

BOUNDARY DISTINCTNESS — SHAPE — TEXTURE SAND FRACTION — (coarse - med) — GRADE — PLASTICITY TYPE — STICKINESS — WATER-TABLE — CONSISTENCE — SHEARING TEST

STRUCTURE GRADE — PED SIZE — PED SHAPE — FABRIC — CUTANS — PED POROSITY — CRACK SIZE — STONES AMOUNT OF STONES — SHAPE — STONE DISTRIBUTION

STONE SIZE — STONE WEATHERING — STONE LITHOLOGY — ROOTS AMOUNT — ROOT DISTRIBUTION — PANS — CHARACTER — CONCRETIONS & INCLUSIONS — FORM — AMOUNT — SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0802

FULL SUGARLOAF JLm (Hildo:est)

Gn 3.11

4628306797180

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Mottle Characteristics	Test
1	1	A	.25	5YR 3/3			S16.0
4	2	B2	1.0	5YR 3/4			S15.2
6	3	B3	.72	7.5YR 5/8	5YR 4/8	WP/P 30	S15.0
7	4	C					

Lower slope (straight slope) 92

SOIL PROPERTIES RECORD 'B'

BOUNDARY / DISTINCTNESS / SHAPE

TEXTURE / SAND FRACTION / GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE / DISRUPTIVE TEST / SHEARING TEST

STRUCTURE / GRADE / PED SIZE / PED SHAPE

FABRIC

CUTANS

PED POROSITY slow

CRACK SIZE

STONES / AMOUNT OF STONES / SHAPE / STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS / AMOUNT / ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS / FORM / AMOUNT / SIZE

VENESS & ASSOCIATES PTY LIMITED

Environmental and Natural Resource Consultants

JOB Nº 661 GRAFTON/CASINO/MURWILL'H

SITE No. 0801

spot SUGARLOAF JLm

Gn 3.11

4607307680019

SOIL PROPERTIES RECORD 'A'

	Layer No.	Horizon	Lower Average Depth (m)	Moist	Dry	Mottle Characteristics	Test
1	1	A	.12	7.5YR 4/4			H
4	2	B2	.31	5YR 4/8	7.5YR 4/9		H
6	3	B3	.58	2.5Y 5 6/8		W/P/P 40	H
7	4	C					

Upper slope 20%

SOIL PROPERTIES RECORD 'B'

BOUNDARY / DISTINCTNESS / SHAPE

TEXTURE / SAND FRACTION / GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE / DISRUPTIVE TEST / SHEARING TEST

STRUCTURE / GRADE / PED SIZE / PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES / AMOUNT OF STONES / SHAPE / STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS / AMOUNT / ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS / FORM / AMOUNT / SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

K.A.C.
Sx 3·11

SITE No. 2301

661 - ~~Grafton~~/ Casino / ~~Murwillumbah~~

Spot Pld EWINGBAR Lionsville Rd.

44542b67710ø0ø

	Horizon	Lower Average Depth (m)	Moist	Dry
1	A	·19	2.5YR 2/2	
2	A	·34	2.5YR 2/3	
6	B	1·10	2.5YR 2/2.5	

Sample No.

SURFACE CONDITION

· Upper slope on ridge 12%.

Crust
Hard set
Not hard set ☒ Self-mulching / litter < 1cm

BOUNDARY DISTINCTNESS

STRUCTURE GRADE

STONE SIZE

PED SIZE

STONE WEATHERING

STONE LITHOLOGY

SHAPE

TEXTURE

SAND FRACTION

GRADE

PED SHAPE

ROOTS AMOUNT

FABRIC

ROOT DISTRIBUTION

CUTANS

PANS

PLASTICITY TYPE

PED POROSITY slow

CHARACTER

STICKINESS

CRACK SIZE

CONCRETIONS & INCLUSIONS

WATER-TABLE

STONES AMOUNT OF STONES

FORM

CONSISTENCE DISRUPTIVE TEST

COHERENCE

AMOUNT

SHAPE

SIZE

SHEARING TEST

STONE DISTRIBUTION

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

STRUCT. PLASTIC CLAY
UF 6·31

SITE No. 2304

661 - Grafton / Casino / Murwillumbah

Spot Pld EWINGBAR Bulldog Rd, 1st past Bulldog Rd

44647ø6786øøø

	Horizon	Lower Average Depth (m)	Moist	Dry
1	A	·25		
6	B		7.5YR 4/4	
9	C			

SURFACE CONDITION

Ridgeline - narrow. 4% downslope

Crust
Hard set
Not hard set ☒

BOUNDARY DISTINCTNESS

STRUCTURE GRADE

STONE SIZE

PED SIZE

STONE WEATHERING

STONE LITHOLOGY

SHAPE

TEXTURE

SAND FRACTION

GRADE

PED SHAPE

ROOTS AMOUNT

FABRIC

ROOT DISTRIBUTION

CUTANS

PANS

PLASTICITY TYPE

PED POROSITY

CHARACTER

STICKINESS

CRACK SIZE

CONCRETIONS & INCLUSIONS

WATER-TABLE

STONES AMOUNT OF STONES

FORM

CONSISTENCE DISRUPTIVE TEST

COHERENCE

AMOUNT

SHAPE

SIZE

SHEARING TEST

STONE DISTRIBUTION

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

STRUCT. SUSPLAST. CLAY
UF5.23

SITE No. 2303

661 – Grafton / Casino / Murwillumbah

Hill P/d. EWINGAR North Ewingar Rd.

4483406778420

Record Type | Same as Site No | Total No. of Layers

Layer Status | Dominant Colour (Munsell Code) | Mottle Characteristics | Tests

Horizon | Lower Average Depth (m) | Moist | V/C | Dry | Primary | Secondary | pH

Ridgeline, ... – 14%

SURFACE CONDITION

Crust
Hard set
Not hard set organic ...

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZES

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

SITE No. 2305

661 ~~Murwillumbah~~ ~~Graf~~/Cas

Spot Pld (interbedded mix) EWINGAR PT Bulldog Rd RPS

4503906789040

Dr 4.41

Record Type | Same as Site No | Total No. of Layers

Layer Status | Dominant Colour (Munsell Code) | Mottle Characteristics | Tests

Horizon | Lower Average Depth (m) | Moist | V/C | Dry | Primary | Secondary | pH

Ridgeline 9% along slope

SURFACE CONDITION

Crust
Hard set
Not hard set

BOUNDARY DISTINCTNESS

SHAPE

TEXTURE SAND FRACTION

GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE DISRUPTIVE TEST

COHERENCE

SHEARING TEST

STRUCTURE GRADE

PED SIZES

PED SHAPE

FABRIC

CUTANS

PED POROSITY

CRACK SIZE

STONES AMOUNT OF STONES

SHAPE

STONE DISTRIBUTION

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

ROOTS AMOUNT

ROOT DISTRIBUTION

FANS

CHARACTER

CONCRETIONS & INCLUSIONS

FORM

AMOUNT

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

STRUCT. PLAST. CLAY

UF2

SITE No. 1903 — 661 MURWILLUMBAH

Full — Tnr — NULLUM — Koonyum Range Rd / Teeks lookout road

5406006841100

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Texture / Tests
1	1 A 1	.16	10YR 3/4	5.0
3	2 A 2	.35	7.5YR 7/6	5.0
6	3 Bt	.87	7.5YR 6/8	5.5
7	4 B3	+1.17	7.5YR 7/8	5.5

Hollows

SURFACE CONDITION

Upper slope ~15%

Crust / Hard set / Not hard set — 2 with litter

STRUCTURE

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

BOUNDARY

DISTINCTNESS

SHAPE

PED SIZE

TEXTURE

SAND FRACTION

GRADE

PED SHAPE

ROOTS

AMOUNT

ROOT DISTRIBUTION

FABRIC (opaque glaze)

CUTANS

PANS

CHARACTER

PED POROSITY

PLASTICITY TYPE

STICKINESS

CRACK SIZE

CONCRETIONS & INCLUSIONS

WATER-TABLE

STONES

AMOUNT OF STONES

FORM

CONSISTENCE

DISRUPTIVE TEST

SHAPE

AMOUNT

SHEARING TEST

STONE DISTRIBUTION

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

STRUCT. PLASTIC CLAY

SITE No. 1902 — 661 MURWILLUMBAH

Spot — Tnr — NULLUM — Nordaby Rd

Uf 2 or Uf 4.43

5393406843190

	Horizon	Lower Average Depth (m)	Dominant Colour (Munsell Code) Moist	Mottles	Tests
1	1 A 1	.07	10YR 3/3		
2	2 A 1 2	.14	10YR 5/4		
3	3 A 2	.38	10YR 6/6		5.5
6	4 B 2	+.85	7.5YR 7/8	R D P 51	5.5

SURFACE CONDITION

10L Upper slope on basalt volcanic plateau above escarpment

Crust / Hard set / Not hard set — 2 litter

BOUNDARY

DISTINCTNESS

SHAPE

STRUCTURE

GRADE

PED SIZE

STONE SIZE

STONE WEATHERING

STONE LITHOLOGY

TEXTURE

SAND FRACTION

GRADE

PED SHAPE

ROOTS

AMOUNT

ROOT DISTRIBUTION

FABRIC (coarse glaze)

CUTANS

PANS

CHARACTER

PLASTICITY TYPE

PED POROSITY

STICKINESS

CRACK SIZE

CONCRETIONS & INCLUSIONS

WATER-TABLE

STONES

AMOUNT OF STONES

FORM

CONSISTENCE

DISRUPTIVE TEST

SHAPE

AMOUNT

SHEARING TEST

STONE DISTRIBUTION

SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

STRUCT. PLASTIC CLAY

SITE No. 1904 — 661 MURWILLUMBAH — Uf6·31

Spot

Tnr

GOONENGARRY

5399∅∅68382 5∅

Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry	Texture
1 A	·19	7·5YR 2/3		
2 A	·42	2·5YR 4/?		
3 B 2	+95	2·5YR 3/5		

Same red soils ?throughout this profile

Lines as samples from 1992

SURFACE CONDITION

Crust / Hard set / Not hard set

Microslope ~12%

BOUNDARY / DISTINCTNESS / SHAPE

TEXTURE / SAND FRACTION / GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE / DISRUPTIVE TEST / SHEARING TEST / CONSISTENCE

STRUCTURE GRADE / PED SIZE / PED SHAPE

FABRIC / CUTANS / PED POROSITY / CRACK SIZE

STONES / AMOUNT OF STONES / SHAPE / STONE DISTRIBUTION

STONE SIZE / STONE WEATHERING / STONE LITHOLOGY

ROOTS AMOUNT / ROOT DISTRIBUTION / SAMPLE DEPTHS

PANS / CHARACTER

CONCRETIONS & INCLUSIONS / FORM / AMOUNT / SIZE

VENESS & ASSOCIATES PTY LIMITED
Environmental and Natural Resource Consultants

STRUCT. PLASTIC CLAY

SITE No. 1901 — 661 MURWILLUMBAH — Uf6·21

Spot

Tnr

NULLUM

5334∅∅68437∅∅

Jerusalem Mtn Rd.

Horizon	Lower Average Depth (m)	Dominant Colour Moist	Dry
1 A	·13	5YR 3/4	
3 A 2	·36	5YR 3/4	
4 B 1	·73	2·5YR 4/6	
6 B 2	+1·0	2·5YR 4/6	

Tnr or Tnb (be careful)

Late afternoon

SURFACE CONDITION

Crust / Hard set / Not hard set

32% Ridgeline - narrow above steep sideslopes on either side

BOUNDARY / DISTINCTNESS / SHAPE

TEXTURE / SAND FRACTION / GRADE

PLASTICITY TYPE

STICKINESS

WATER-TABLE

CONSISTENCE / DISRUPTIVE TEST / SHEARING TEST / CONSISTENCE

STRUCTURE GRADE / PED SIZE / PED SHAPE

FABRIC / CUTANS / PED POROSITY / CRACK SIZE

STONES / AMOUNT OF STONES / SHAPE / STONE DISTRIBUTION

STONE SIZE / STONE WEATHERING / STONE LITHOLOGY

ROOTS AMOUNT / ROOT DISTRIBUTION / SAMPLE DEPTHS

PANS / CHARACTER

CONCRETIONS & INCLUSIONS / FORM / AMOUNT / SIZE

APPENDIX 2

SEMGL based Soil Erodibility Classification

CASINO / MURWILLUMBAH EIS SOILS

Soil Erodibility based on Appendix 1 (ii) of the SEMGL's

SOIL MAPPING UNIT A – (soils formed on alluvials)

CHARACTERISTIC	TOPSOIL	CLASS	SUBSOIL	CLASS
ORGANIC MATTER	Range 1.39 – 20.5%; (av. 10.95%); >3%	LOW		n.a.
TEXTURE	L1 – SiCL/SLC/FSCL/SCL/Lfsy/SCL⁻/SL (A,A11 – always)* L2 SCL–/SiLC (A12 – uncommon) L3 – SCL/FSCL/CS (A2 – common; usually bleached)	 LOW MOD?	L4 – LC (B1 – sometimes) L5 – LC TO LMC (B2,B21 – always) L6 – LMC (B22 – rare) L7 – LC (D1 – rare)	LOW – MOD MOD?
STRUCTURE	moderately well structured / non–dispersive	LOW	well structured	LOW – MOD
EAT	A1 – 8; A11 – 8; A12 – 8 A2 – 2(1)	LOW MOD	B2 – 2(1), 3(2)	MOD
NORTHCOTE	Uf 6.2*, 6.3*; Gn 2.9*, 3.0, 3.1, 3.4, 3.7 Dy 4.1*, 5.3*, 5.4*	LOW MOD?		
GSG	Structured plastic clays*, Yellow podzolic soil	MOD		
GEOLOGY	alluvial mud, silt, sand, gravel	HIGH		

* = not catered for in the table in Appendix 1 (ii)

CONCLUSION: According to the table in Appendix 1 (ii) of the SEMGL's, the soils represented by this soil mapping unit have a generally low to moderate soil erodibility classification.

CASINO / MURWILLUMBAH EIS SOILS

Soil Erodibility based on Appendix 1 (ii) of the SEMGL's

SOIL MAPPING UNIT B - (soils formed on basalts)

CHARACTERISTIC	TOPSOIL	CLASS	SUBSOIL	CLASS
ORGANIC MATTER	Range 4.41 - 9.39%; (av.6.69); >3%	LOW		n.a.
TEXTURE	L1 - CL/SiCL (A,A1,A11 - always) L2 - FSCL/SiC (A12 - rare) L3 - LC/SiLC (A2 - uncommon; unbleached)	LOW LOW MOD?	L4 - LC/LMC/MC (B1 - uncommon) L5 - LMC/SiLC/HC (B2 - always) L6 - LMC/MC/LC (B3 - uncommon) L7 - LMC (BC - rare)	LOW LOW - MOD
STRUCTURE	well structured / non-dispersive	LOW	well structured	MOD
EAT	A,A1 - 8, 8, 3(2), 8, 8, 2(1) A12 - 3(3); A2 - 3(1)	LOW - MOD	B1 - 3(2), 5. 2(1) B2 - 6, 3(1), 3(1), 2(1), 5, 2(1) B3 - 3(3), 3(3), 3(3)	LOW - MOD LOW-MOD-HIGH MOD
NORTHCOTE	Uf 5.3; Gn 3.1, 3.2, 4.5; Dr 4.1, 4.2	LOW		
GSG	Structured plastic clays*, Krasnozems Chocolate soils	LOW LOW		
GEOLOGY	trachyte, basalt, tuff*, agglomerate*	MOD - LOW		

* = not catered for in the table in Appendix 1 (ii)

CONCLUSION: According to the table in Appendix 1 (ii) of the SEMGL's, the soils represented by this soil mapping unit have a generally low, but sometimes moderate, soil erodibility classification. The topsoil layers generally have a low classification, while the subsoils have a low to moderate classification.

CASINO / MURWILLUMBAH EIS SOILS

Soil Erodibility based on Appendix 1 (ii) of the SEMGL's

SOIL MAPPING UNIT D – (soils formed on granitoids)

CHARACTERISTIC	TOPSOIL	CLASS	SUBSOIL	CLASS
ORGANIC MATTER	Range 3.3 – 8.82%; (av. 6.06%); >3%	LOW		n.a.
TEXTURE	L1 – SiLC/LC (A,A1,A11 – always) L2 – LC/LMC/SCL⁻ (A12 – sometimes) L3 – SCL/LC/SiCL (A2 – common; unbleached) L4 – SCL (A3 – rare)	 LOW LOW	L5 – LC/LMC/MC (B1 – common) L6 – LC/LMC (B2 – always) L7 – LC (BC – rare)	LOW – MOD?
STRUCTURE	well structured / non–dispersive	LOW	well structured	LOW – MOD
EAT	A1,A11,A12 – 8, 8 A2 – 2(1), 8; A3 – 8	LOW LOW – MOD	B1 – 3(2), 2(1) B2 – 2(1), 3(1), 2(1)	MOD – HIGH
NORTHCOTE	Gn 3.1; Dr 4.1; Uf 4.4*, 5.1, 6.2*	LOW		
GSG	Structured plastic & sub–plastic clays*, Krasnozems Yellow podzolic soils	LOW MOD		
GEOLOGY	granodiorite, porphyritic adamellite*	HIGH		

* = not catered for in the table in Appendix 1 (ii)

CONCLUSION: According to the table in Appendix 1 (ii) of the SEMGL's, the soils represented by this soil mapping unit have a generally low to moderate soil erodibility classification.

CASINO / MURWILLUMBAH EIS SOILS

Soil Erodibility based on Appendix 1 (ii) of the SEMGL's

SOIL MAPPING UNIT C - (soils formed on metasediments)

CHARACTERISTIC	TOPSOIL	CLASS	SUBSOIL	CLASS
ORGANIC MATTER	Range 7.11 - 15.3%; (av. 11.1%); >3%	LOW		n.a.
TEXTURE	L1 - SiLC/LC (A - always)	LOW	L2 - LC/LMC (B1,B11 - usually) L3 - LMC (B12 - sometimes) L4 - LC/LMC (B2 - always) L5 - LMC (B3,BC - sometimes)	LOW - MOD?
STRUCTURE	well structured / non-dispersive	LOW	well structured	LOW
EAT	A - 8	LOW	B11 - 3(2); B12 - 3(1); B2 - 2(1), 2(2)	MOD
NORTHCOTE	Uf 5.2, 6.2*, 6.3*	LOW		
GSG	Structured plastic clays* Krasnozems	LOW		
GEOLOGY	argillite*, phyllite, slate, greywacke intermediate volcanics*, quartz*	MOD		

* = not catered for in the table in Appendix 1 (ii)

CONCLUSION: According to the table in Appendix 1 (ii) of the SEMGL's, the soils represented by this soil mapping unit have a generally low but sometimes moderate soil erodibility classification. The topsoil layers have a low classification, while the subsoils have a low to moderate classification.

CASINO / MURWILLUMBAH EIS SOILS

Soil Erodibility based on Appendix 1 (ii) of the SEMGL's

SOIL MAPPING UNIT E - (soils formed on Grafton Formation)

CHARACTERISTIC	TOPSOIL	CLASS	SUBSOIL	CLASS
ORGANIC MATTER	Range 3.38 - 13%; (av. 7.06%); >3%	LOW		n.a.
TEXTURE	L1 - SL - FSCL (FSL/SCL/SiCL) (A,A1,A11 - always) *		L6 - SCL/FSL/LC (B1 - rare)	
	L2 - FSCL/SCL/LC (A12 - common)	MOD -	L7 - LMC/LC/HC(CSL/FSL/SCL⁻/FSCL/SLC)(B2-always)	MOD
	L3 - LC/SLC⁻(S-HC)(A2,A21-common;bleached/unbleached)	HIGH	L8 - LMC (B22 - rare)	MOD
	L4 - FSL (A22 - rare)	MOD	L9 - LMC/HC (B3 - common)	HIGH?
	L5 - LS (A3 - rare)	MOD		
STRUCTURE	weak to well structured / non-dispersive	LOW	well structured	LOW - MOD
EAT	A1,A11, - 2(1), 8, 2(1)	LOW	B2 - 2(1), 2(1), 2(1)	MOD -
	A12 - 2(1); A2 - 2(1), 2(3), 2(1)	MOD	B3 - 2(1), 2(3)	HIGH
NORTHCOTE	Gn 2.2*, 2.4*, 3.0, 3.1, 3.2, 3.9	LOW		
	Dr 1.1*, 4.1, 4.4, 5.1*, 5.4*	LOW - MOD		
	Dy 1.4*, 5.1*, 5.4*	MOD?		
GSG	Chocolate soils, Euchrozems	LOW -		
	Yellow podzolic soils, Yellow-brown earths	MOD		
	Red and Yellow podzolic soils	MOD		
	Lateritic podzolic soils*, Minimal prairie soils*			
GEOLOGY	lithic sandstone,	HIGH		
	siltstone, claystone?	MOD		
	minor coal	LOW		

* = not catered for in the table in Appendix 1 (ii)

CONCLUSION: According to the table in Appendix 1 (ii) of the SEMGL's, the soils represented by this soil mapping unit have a low to moderate soil erodibility classification. The topsoil layers generally have a low to moderate classification, while the subsoils have a moderate classification.

CASINO / MURWILLUMBAH EIS SOILS

Soil Erodibility based on Appendix 1 (ii) of the SEMGL's

SOIL MAPPING UNIT F – (soils formed on Kangaroo Creek sandstones)

CHARACTERISTIC	TOPSOIL	CLASS	SUBSOIL	CLASS
ORGANIC MATTER	Range 2.02 – 8.26%; (av. 5.14%); >3%	LOW		n.a.
TEXTURE	L1 – LS/SL/FSCL (A,A1,A11 – always) L2 – CS/LS/SCL⁻/Lfsy (A12 – occasional) L3 – LS/CS/SCL⁻(A2–common;bleached/unbleached) L4 – CS/SiLC (A3 – rare)	* * * MOD – * MOD?	L5 – CS/SCL/LC (B1 – sometimes) L6 – CS/SLC/LMC (B2/B21 – always) L7 – SLC/LS (B22 – rare) L8 – LMC/LS (B3 – occasional)	* * MOD? * LOW – MOD?
STRUCTURE	weak to moderately structured / non–dispersive	LOW – MOD	well structured	MOD?
EAT	A1,A11 – 8, 8 A2 – 3(2)	LOW MOD	B1 – 2(1); B21 – 2(2); B22 – 2(2); B3 – 2(2)	MOD
NORTHCOTE	Uc 4.2*, 6*, 6.1*; Gn 2.1*, 2.2*, 3.1, 3.2 Dr 5.1*, 5.2*; Dy 1.1*, 4.1*, 4.2*, 5.2*, 5.3*, 5.4* Db 3.4	LOW MOD? LOW		
GSG	Krasnozems, Sands*, Structured sands* Red & Yellow podzolic soils; Yellow & Red earths	LOW MOD		
GEOLOGY	quartz sandstone*, feldspathic quartz sandstone siltstone	MOD		

* = not catered for in the table in Appendix 1 (ii)

CONCLUSION: According to the table in Appendix 1 (ii) of the SEMGL's, the soils represented by this soil mapping unit have a low to moderate soil erodibility classification. Both the topsoil and subsoil layers generally have a low to moderate classification.

CASINO / MURWILLUMBAH EIS SOILS

Soil Erodibility based on Appendix 1 (ii) of the SEMGL's

SOIL MAPPING UNIT G - (soils formed on Walloon Coal Measures)

CHARACTERISTIC	TOPSOIL	CLASS	SUBSOIL	CLASS
ORGANIC MATTER	Range 2.83 - 7.06%; (av. 5.36%); >3%	LOW		n.a.
TEXTURE	L1 - LC/SCL⁻/CL/SiLC (A,A1,A11 - always) L2 - SCL⁻/CL/LC (A12 - rare) L3 - SCL⁻/SCL/LC (A2 - sometimes; bleached)	LOW - MOD MOD MOD-HIGH	L4 - LMC/LC/SCL⁻ (B1 - sometimes) L5 - LC/LMC (B2,B21 - always) L6 - LC/LMC (B22 - rare) L7 - LC/LMC (B3 - common)	LOW LOW - MOD
STRUCTURE	moderately structured	LOW - MOD	well structured	MOD
EAT	A,A1,A11 - 8, 2(2), 2(1), 3(2), 8, 8 A12 - 3(2), 2(1); A2 - 2(1), 2(2)	LOW - MOD MOD	B1 - 2(1) B21 - 2(1) B22,B2 - 3(3), 5, 2(1), 2(1), 2(2), 2(2)	LOW - MOD - HIGH
NORTHCOTE	Uf 5.2, 5.3, 6.3* Gn 3.1, 3.8, 3.9 Dr 2.2*, 4.1, 4.2, 5.1*, 5.2* Db 0.4	LOW LOW LOW MOD?		
GSG	Structured plastic and sub-plastic clays* Krasnozems, Xanthozems, Chocolate soils Yellow and Red podzolic soils	 LOW MOD		
GEOLOGY	sandstone*, shale*, coal siltstone	LOW MOD		

* = not catered for in the table in Appendix 1 (ii)

CONCLUSION: According to the table in Appendix 1 (ii) of the SEMGL's, the soils represented by this soil mapping unit have a low to moderate soil erodibility classification.

CASINO / MURWILLUMBAH EIS SOILS

Soil Erodibility based on Appendix 1 (ii) of the SEMGL's

SOIL MAPPING UNIT H - (soils formed on Marburg Sediments)

CHARACTERISTIC	TOPSOIL	CLASS	SUBSOIL	CLASS
ORGANIC MATTER	Range 3.94 - 7.37%; (av. 5.79%); >3%	LOW		n.a.
TEXTURE	L1 - LStoLC(SL/SCL⁻/Lfsy/SiCL/FSCL)(A,A1, - always) * L2 - SCL⁻/SCL (A2 - sometimes; bleached)	* MOD?	L3 - FSCL/SiLC/MC (B1 - common) L4 - LC - LMC (SL/SiLC/MC) (B2,B21 - always) L5 - LMC (B22 - rare) L6 - LMC (B3 - sometimes)	LOW MOD MOD
STRUCTURE	weak to well structured / non- to slight dispersive	LOW - MOD	well structured	LOW - MOD
EAT	A,A1 - 2(1), 3(2), 8, 2(1) A2 - 2(1)	LOW - MOD MOD	B2 - 3(3), 2(2), 2(1), 2(2) B3 - 3(2), 2(2)	MOD MOD
NORTHCOTE	Uf 5.3; Gn 2.2*, 3.1 Dy 4.1*, 5.2*, 5.4*	LOW - MOD?		
GSG	Krasnozems Yellow podzolic soils; Yellow earths	LOW MOD		
GEOLOGY	sandstone*, shale* conglomerate*	* MOD?		

* = not catered for in the table in Appendix 1 (ii)

CONCLUSION: According to the table in Appendix 1 (ii) of the SEMGL's, the soils represented by this soil mapping unit have a generally low to moderate soil erodibility classification. The topsoil and subsoil layers generally have a low to moderate classification.

CASINO / MURWILLUMBAH EIS SOILS

Soil Erodibility based on Appendix 1 (ii) of the SEMGL's

SOIL MAPPING UNIT I – (soils formed on volcanics)

CHARACTERISTIC	TOPSOIL	CLASS	SUBSOIL	CLASS
ORGANIC MATTER	Range 5.04 – 16.4%; (av. 10.1%); >3%	LOW		n.a.
TEXTURE	L1 – SiCL/SiLC/SCL/LC (A,A1,A11 – always)	LOW	L4 – LC/LMC/SiLC (B1,B11 – sometimes)	LOW – MOD
	L2 – SiLC/LC (SCL) (A12 – uncommon)	LOW	L5 – LMC (B12 – rare)	LOW
	L3 – SiLC/LC/SCL/LMC (A2–sometimes;bleached/unbleached)	MOD	L6 – LC/LMC/(SLC/SiLC) (B2 – always)	LOW – MOD
			L7 – LC/LMC (B3 – rare)	MOD
STRUCTURE	well structured / non–dispersive	LOW	well structured	LOW -MOD
EAT	A,A1,A11 – 8, 8, 8, 8, 3(2)	LOW – MOD	B1,B11 – 2(1), 2(1), 8, 3(1)	LOW – MOD
	A12 – 8	LOW	B12 – 6; B2 – 5, 5, 2(1), 3(3), 2(1)	LOW – MOD
	A2 – 2(1), 3(1), 2(1)	MOD	B3 – 5	MOD
NORTHCOTE	Uf 2*, 5.2, 6.2*, 6.3*	LOW		
	Gn 3.1, 3.7, 4.8; Dr 4.4	LOW		
	Dy 4.1*	MOD?		
GSG	Structured plastic and sub–plastic clays*	*		
	Krasnozems	LOW		
	Red and Yellow podzolic soils	MOD		
GEOLOGY	rhyolite*, tuff*, claystone*, obsidian*, pitchstone*	*		
	basalt, agglomerate*, andesite*	LOW		

* = not catered for in the table in Appendix 1 (ii)

CONCLUSION: According to the table in Appendix 1 (ii) of the SEMGL's, the soils represented by this soil mapping unit have low, but sometimes moderate, soil erodibility classification. Both the topsoil and subsoil layers generally have a low to sometimes moderate classification.

APPENDIX 3

SEMGL based Erosion Hazard Classification

CASINO / MURWILLUMBAH EIS SOILS STUDY
Soil Erosion Hazard based on Appendix 2 (ii) of the SEMGL's

SOIL MAPPING UNIT A – (soils formed on alluvials)

Erodibility (SEMGL App 1)	SEMGL Appendix 2 Erosivities	State Forest	Maximum Slope (degrees)	Erosion Hazard Class
low to moderate*	<4000	pt Eden Creek	<1	Moderate
		SF north of Royal Camp	<1	Moderate
		Royal Camp	<1	Moderate
		Mount Marsh	6	Moderate
		Carwong	2	Moderate
		Braemar	<1	Moderate
		Ellangowan	<1	Moderate
		Myrtle	<1	Moderate
		Whiporie	<1	Moderate
		Camira	3	Moderate
		Banyabba	1	Moderate
		Gibberagee	<1	Moderate
		Mount Belmore	6	Moderate
		Bungawalbin	<1	Moderate
		Doubleduke	1	Moderate
		Tabbimoble	<1	Moderate
		Devils Pulpit	1	Moderate
		Mororo	5	Moderate
		pt Gibberagee	1	Moderate

*while the soil erodibility for this unit is low to moderate, the "worst case" moderate class has been used for this table

CONCLUSION: According to the table in Appendix 2 (ii) of the SEMGL's, the soils represented by this soil mapping unit have a moderate "maximum" erosion hazard class.

CASINO / MURWILLUMBAH EIS SOILS STUDY

Soil Erosion Hazard based on Appendix 2 (ii) of the SEMGL's

SOIL MAPPING UNIT B – (soils formed on basalts)

Erodibility (SEMGL App 1)	SEMGL Appendix 2 Erosivities	State Forest	Maximum Slope (degrees)	Erosion Hazard Class
low, sometimes moderate	<4000	Richmond Range	18	Moderate
		Eden Creek	14	Moderate
		pt Eden Creek	22	Moderate
		Boorabee	39	High
		Bungabee	26	High
		Cherry Tree North	26	High
		Mount Belmore	12	Moderate
		Mount Marsh	15	Moderate
		pt Gibberagee	10	Moderate
	<6000	Boorabee	32	Extreme
		Mebbin	45	Extreme
	<8000	Wollumbin	30	Extreme
		Nullum	21	High
		Goonengarry	17	High
		Whian Whian	32	Extreme

CONCLUSION: According to the table in Appendix 2 (ii) of the SEMGL's, the soils represented by this soil mapping unit have "maximum" erosion hazard classes ranging from moderate to extreme.

CASINO / MURWILLUMBAH EIS SOILS STUDY

Soil Erosion Hazard based on Appendix 2 (ii) of the SEMGL's

SOIL MAPPING UNIT C - (soils formed on metasediments)

Erodibility (SEMGL App 1)	SEMGL Appendix 2 Erosivities	State Forest	Maximum Slope (degrees)	Erosion Hazard Class
low, sometimes moderate	<2000	Ewingar	25	Moderate
	<4000	Ewingar	29	High
		Billilimbra	18	Moderate
		Washpool	31	High
		pt Washpool	23	Moderate
	<8000	Mooball	29	Extreme
		Burringbar	34	Extreme
		Nullum	39	Extreme

CONCLUSION: According to the table in Appendix 2 (ii) of the SEMGL's, the soils represented by this soil mapping unit have "maximum" erosion hazard classes ranging from moderate to extreme.

CASINO / MURWILLUMBAH EIS SOILS STUDY

Soil Erosion Hazard based on Appendix 2 (ii) of the SEMGL's

SOIL MAPPING UNIT D – (soils formed on granitoids)

Erodibility (SEMGL App 1)	SEMGL Appendix 2 Erosivities	State Forest	Maximum Slope (degrees)	Erosion Hazard Class
low to moderate*	<2000	Ewingar	28 - 37	High
		Billilimbra	24	Moderate
	<4000	Ewingar	27	Extreme
		Billilimbra	27	Extreme

* while the soil erodibility for this unit is low to moderate, the "worst case" moderate class has been used for this table

CONCLUSION: According to the table in Appendix 2 (ii) of the SEMGL's, the soils represented by this soil mapping unit have "maximum" erosion hazard classes ranging from moderate to extreme.

CASINO / MURWILLUMBAH EIS SOILS STUDY

Soil Erosion Hazard based on Appendix 2 (ii) of the SEMGL's

SOIL MAPPING UNIT E – (soils formed on Grafton Formation)

Erodibility (SEMGL App 1)	**SEMGL Appendix 2 Erosivities**	**State Forest**	**Maximum Slope (degrees)**	**Erosion Hazard Class**
low to moderate*	<4000	Royal Camp	4	Moderate
		Fullers	6	Moderate
		Carwong	7	Moderate
		Braemar	14	Moderate
		Ellangowan	9	Moderate
		Myrtle	7	Moderate
		Whiporie	1.5	Moderate
		Camira	10	Moderate
		Banyabba	9	Moderate
		Gibberagee	17	High
		Bungawalbin	6	Moderate
		Doubleduke	2	Moderate
		Devils Pulpit	14	Moderate

* while the soil erodibility for this unit is low to moderate, the "worst case" moderate class has been used for this table

CONCLUSION: According to the table in Appendix 2 (ii) of the SEMGL's, the soils represented by this soil mapping unit have "maximum" erosion hazard classes ranging from moderate to high.

CASINO / MURWILLUMBAH EIS SOILS STUDY

Soil Erosion Hazard based on Appendix 2 (ii) of the SEMGL's

SOIL MAPPING UNIT F - (soils formed on Kangaroo Creek Sandstone)

Erodibility (SEMGL App 1)	SEMGL Appendix 2 Erosivities	State Forest	Maximum Slope (degrees)	Erosion Hazard Class
low to moderate*	<4000	Richmond Range	25	High to Extreme
		pt Richmond Range	41	Extreme
		Cherry Tree/Cherry Tree W	22	High
		Mount Belmore	36	Extreme
		pt Mount Belmore	30	Extreme
		pt Royal Camp	18	High
		Fullers	19	High
		Mount Marsh	23	High
		Banyabba	22	High
		Camira	5	Moderate
		Gibberagee	22	High
		pt Gibberagee	22	High
		Devils Pulpit	27	Extreme
		Doubleduke	24	High
		Bungawalbin	3	Moderate
		pt Eden Creek	8	Moderate
		Eden Creek	16	High

* while the soil erodibility for this unit is low to moderate, the "worst case" moderate class has been used for this table

CONCLUSION: According to the table in Appendix 2 (ii) of the SEMGL's, the soils represented by this soil mapping unit have "maximum" erosion hazard classes ranging from moderate to extreme.

CASINO / MURWILLUMBAH EIS SOILS STUDY

Soil Erosion Hazard based on Appendix 2 (ii) of the SEMGL's

SOIL MAPPING UNIT G - (soils formed on Walloon Coal Measures)

Erodibility (SEMGL App 1)	SEMGL Appendix 2 Erosivities	State Forest	Maximum Slope (degrees)	Erosion Hazard Class
low to moderate*	<4000	Richmond Range	16	High
		Cherry Tree North	19	High
		Cherry Tree	21	High
		Cherry Tree West	22	High
		Mount Pikapene	25	High to Extreme
		Mount Belmore	17	High
		pt Mount Belmore	21	High
*while the soil erodibility for this unit is low to moderate, the "worst case" moderate class has been used for this table		Mount Marsh	20	High
		pt Mount Marsh	15	Moderate to High
		Doubleduke	9	Moderate
		Sugarloaf	24	High
		Tabbimoble	6	Moderate
		Devils Pulpit	27	Extreme
		Mororo	3	Moderate
	<6000	Mebbin	17	High
		Wollumbin	22	Extreme
	<8000	Wollumbin	27	Extreme

CONCLUSION: According to the table in Appendix 2 (ii) of the SEMGL's, the soils represented by this soil mapping unit have "maximum" erosion hazard classes ranging from moderate to extreme.

CASINO / MURWILLUMBAH EIS SOILS STUDY

Soil Erosion Hazard based on Appendix 2 (ii) of the SEMGL's

SOIL MAPPING UNIT H – (soils formed on Marburg Sediments)

Erodibility (SEMGL App 1)	SEMGL Appendix 2 Erosivities	State Forest	Maximum Slope (degrees)	Erosion Hazard Class
low to moderate*	<2000	Sugarloaf	17	Moderate
		Keybarbin	22	Moderate
	<4000	Sugarloaf	13	Moderate
		Keybarbin	22	High
		pt Mount Marsh	11	Moderate
		Doubleduke	3	Moderate
	<8000	Wollumbin	25	Extreme
		Nullum	32	Extreme

* while the soil erodibility for this unit is low to moderate, the "worst case" moderate class has been used for this table

CONCLUSION: According to the table in Appendix 2 (ii) of the SEMGL's, the soils represented by this soil mapping unit have "maximum" erosion hazard classes ranging from moderate to extreme.

CASINO / MURWILLUMBAH EIS SOILS STUDY

Soil Erosion Hazard based on Appendix 2 (ii) of the SEMGL's

SOIL MAPPING UNIT I – (soils formed on extrusive volcanics)

Erodibility (SEMGL App 1)	SEMGL Appendix 2 Erosivities	State Forest	Maximum Slope (degrees)	Erosion Hazard Class
low, sometimes moderate	<2000	Ewingar	24	Moderate
		Billilimbra	26	Moderate
	<4000	Billilimbra	16 – 32	Moderate to High
		Washpool	30	High
		Ewingar	23	Moderate
	<8000	Nullum	32 – 42	Extreme
		Goonengerry	16 – 42	High to Extreme
		Whian Whian East	28	Extreme
		Whian Whian	35	Extreme

CONCLUSION: According to the table in Appendix 2 (ii) of the SEMGL's, the soils represented by this soil mapping unit have "maximum" erosion hazard classes ranging from moderate to extreme.

APPENDIX 4

Erodibility (K) values

Unit	Site	Layer	Zone	R	Structure	Permeab.	K
A	1301	A11	1	3000	3	2	.008
		B2			3	3	.015
	1306	A1	1	3100	3	1	.017
		B2			3	1	.014
B	0102	A	1	3250	2	2	.020
		B2			2	3	.006
	0201	A11	2	3100	3	3	.031
		B1			2	5	.038
	0503	A	2	3100	3	2	.016
		B1			3	3	.027
	1201	A	2	3050	3	3	.015
		B2			3	3	.012
	1701	A1	1	6300	3	2	.006
		B1			3	3	.008
	1801	A	1	5500	3	3	.025
		B1			3	5	.041
	1801	A	1	5500	3	3	.025
		B1			3	5	.047
C	1401	A	1	7000	3	3	.023
		B2			3	3	.044
	2202	A	2	2200	2	3	.006
		B11			3	3	.009
D	2101	A1	2	2000	2	2	.022
		B2			3	3	.036
	2404	A11/12	2	2100	2	1	.010
		B1			3	5	.023
	2501	A1	2	2000	3	2	.009
		B1			3	6	.033
E	1109	A1	1	3100	3	2	.011
		B2			3	3	.019
	1114	A11	2	3000	3	2	.029
		B2			3	3	.016
	1124	A1	2	3100	3	3	.026
		B2			3	5	.023
F	0601	A11	2	2700	3	2	.012
		B1			3	3	.018
	0707	A1	2	3100	2	2	.012
		B1			2	2	.018
G	0404	A11	2	3100	2	2	.032
		B2			3	5	.034
	0407	A	2	3100	3	6	.026
		B2			3	5	.024
	0408	A	2	2500	3	3	.018
		B2			3	3	.019

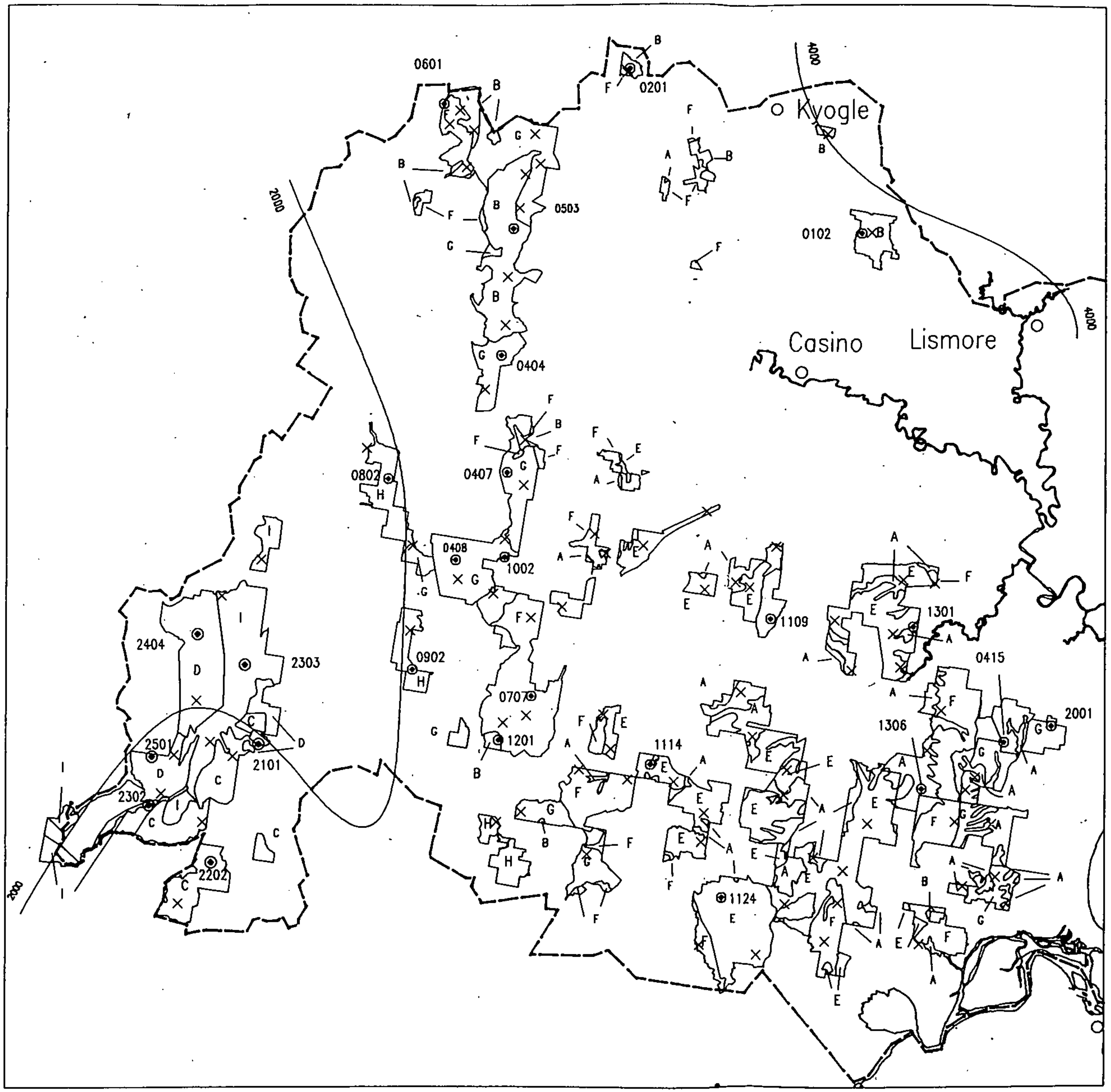
(cont'd next page)

Unit	Site	Layer	Zone	R	Structure	Permeab.	K
G	0413	A	1	5500	3	3	.023
		B1			3	3	.023
	0415	A1	1	3100	3	2	.044
					3	3	.013
	1002	A11	2	3050	2	2	.017
					3	3	.016
H	0802	A	2	2000	3	2	.029
					3	3	.022
	0902	A1	2	2100	3	1	.014
		B2			3	4	.042
	1601	A	1	6200	3	1	.011
		B1			4	2	.039
	2001	A1	1	3100	3	2	.026
		B1			3	3	.014
I	1501	A1	1	8500	2	2	.004
		B1			2	3	.025
	1903	A1	1	8600	2	3	.016
		B2			2	3	.015
	1908	A11	1	8000	2	2	.004
		B1			2	3	.020
	2302	A	1	2100	2	3	.008
		B1			2	3	.007
	2303	A	2	2200	2	3	.020
		B11			2	3	.027

APPENDIX 4: **Values used to determine the erodibility (K) factor**

APPENDIX 5

Figures



Note : Also refer to Figure 8.1 and Maps 5 and 6 inVolume A of the Casino Management Area EIS

CASINO MANAGEMENT AREA

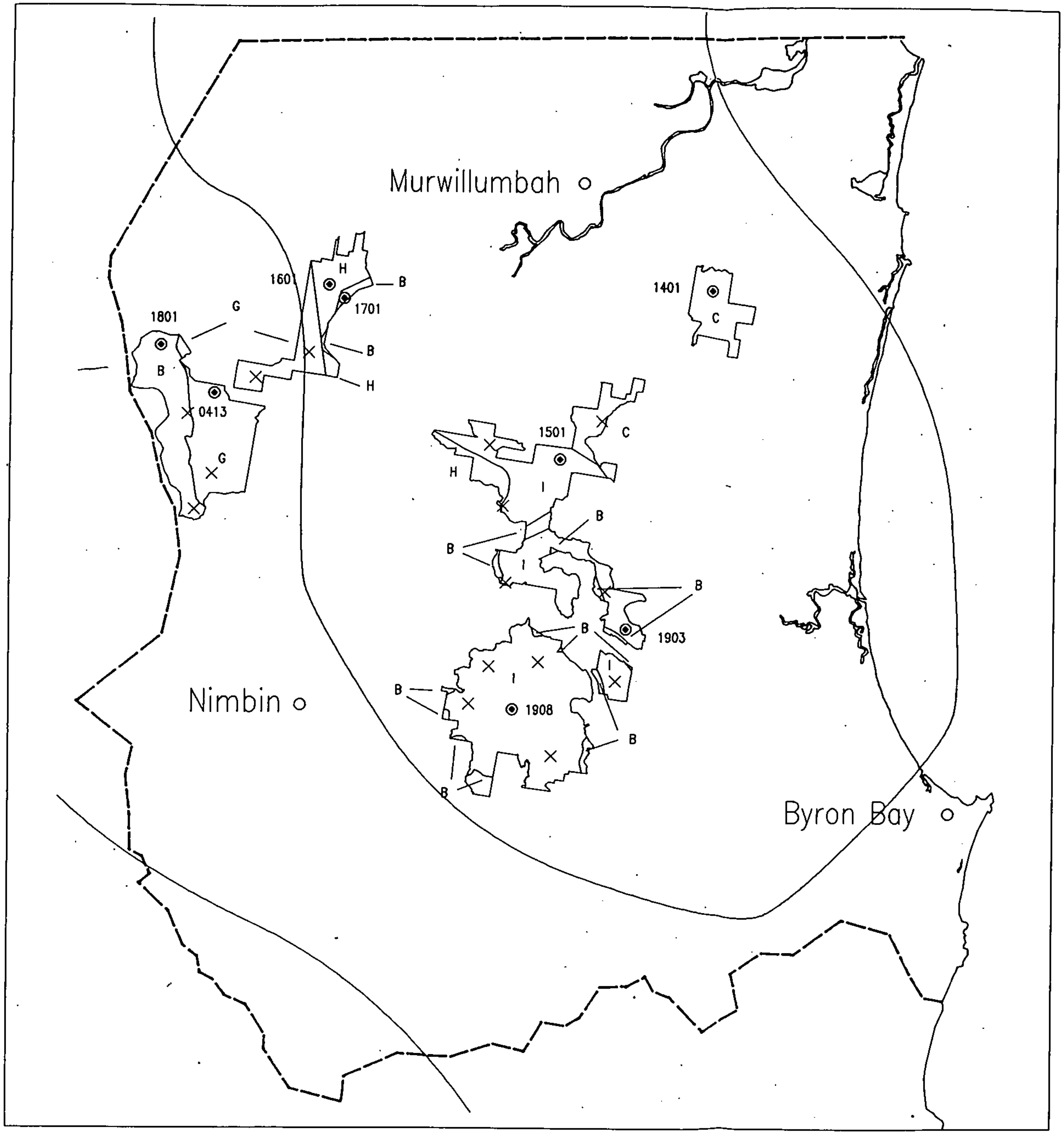
LEGEND

A	ALLUVIAL
B	BASALTS OF PLUGS AND FLOWS
C	METASEDIMENTS
D	GRANITOIDS
E	GRAFTON FORMATION
F	KANGAROO CREEK SANDSTONES
G	WALLOON COAL MEASURES
H	MARBURG SEDIMENTS
I	EXTRUSIVE VOLCANICS
	MANAGEMENT BOUNDARY.
2000	SOIL EROSIVITY TYPE
1000	SAMPLED SOIL DESCRIPTION SITE
	SOIL DESCRIPTION SITE
	TOWNS
	RIVERS

0 20km N

SOILS
Casino Management Area

FIGURE 1a



MURWILLUMBAH
MANAGEMENT AREA

LEGEND

B	BASALTS OF PLUGS AND FLOWS
C	METASEDIMENTS
G	WALLOON COAL MEASURES
H	MARBURG SEDIMENTS
I	ERUPTIVE VOLCANICS

MANAGEMENT BOUNDARY

4000 SOIL EROSIVITY TYPE

1000 SAMPLED SOIL DESCRIPTION POI

SOIL DESCRIPTION SITE

TOWNS

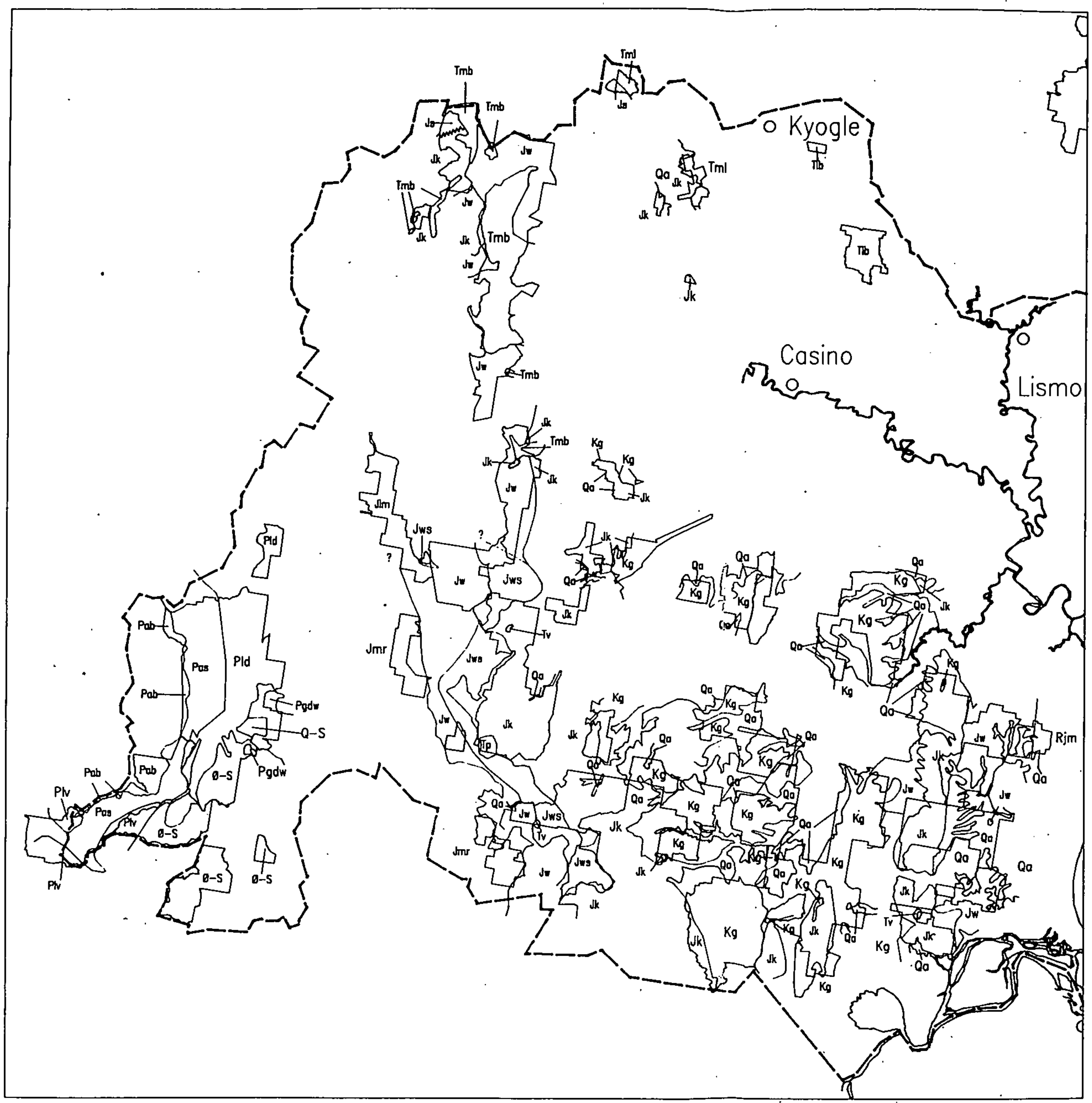
RIVERS

0 10km N

SOILS
Murwillumbah
Management Area

FIGURE 1b

CASINO MANAGEMENT AREA



LEGEND

Jk	KANGAROO CREEK SANDSTONE
Jlm	MARBURG SANDSTONE
Jmr	KOUKANDOWIE SANDSTONE
Js	WOODENBONG BEDS
Jw	WALLON COAL MEASURES
Jws	MALLANGANEE COAL MEASURES
Kg	GRAFTON FORMATION
Pab	BUNGULLA PORPHYRITIC ADAMELLITE
Pas	STANTHORPE ADAMELLITE
Pgdw	DUMBUDGERY CREEK GRANODIORITE
Pld	DRAKE VOLCANICS
Plv	DRAKE VOLCANICS
Qa	SEDIMENTS
Ø–S	ORDIVICIAN–SILURIAN SEDIMENTS
Tlb	LISMORE BASALT
Tmb	LAMINGTON VOLCANICS, (basalt)
Tml	LAMINGTON VOLCANICS, (agglomerate)
Tp	TERTIARY VOLCANICS
Tv	TERTIARY EXTRUSIVE VOLCANICS

MANAGEMENT BOUNDARY

GEOLOGICAL FORMATION BOUNDARY

FACIES BOUNDARY

TOWNS

RIVERS

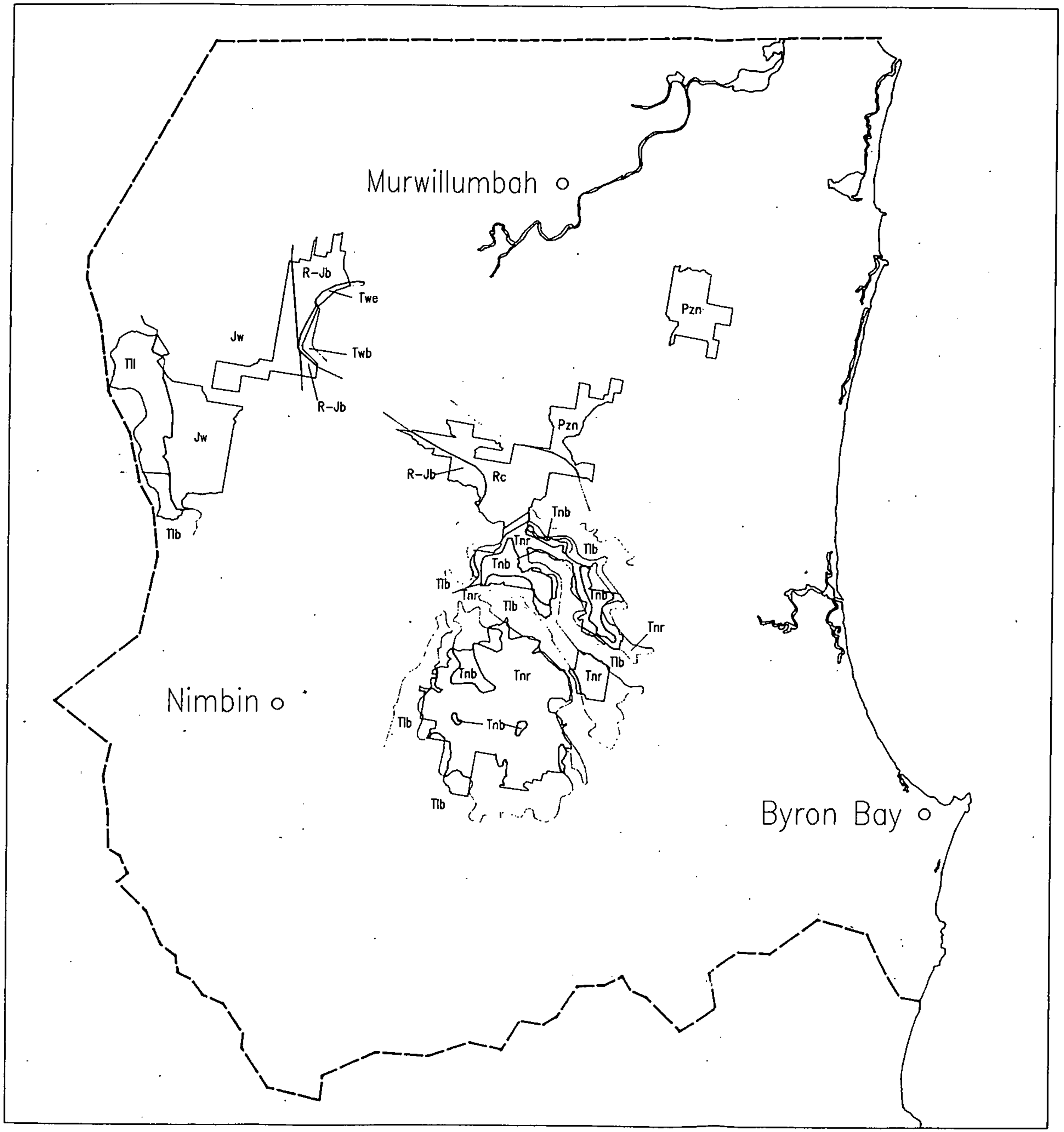
0 20km

N

GEOLOGY
Casino Management Area

FIGURE 2a

Note: Also refer to Figure 6.3 in Volume A of the Casino Management Area EIS



MURWILLUMBAH
MANAGEMENT AREA

LEGEND

Jw	WALLOON COAL MEASURES
Pzn	NERANLEIGH-FERNVALE GROUP
Rc	CHILLINGHAM VOLCANICS
R-Jb	BUNDAMBA GROUP
Tlb	LISMORE BASALT
Tll	LAMINGTON BASALTS
Tnb	BLUE KNOB BASALT
Twb	MT WARNING CENTRAL COMPLEX (basalt)
Twe	MT WARNING CENTRAL COMPLEX (trachyte)
	MANAGEMENT BOUNDARY
	GEOLOGICAL FORMATION BOUNDARY
	TOWNS
	RIVERS

0 10km N

GEOLOGY
Murwillumbah
Management Area

FIGURE 2b