

Investigation of Rehabilitation Areas and Proposal for Acceptance Criteria – Grazing Outcome

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**New Hope Coal-
Australia Pty Ltd**

NEW OAKLEIGH MINE



ACN 089 654 651 - ABN 86 089 654 651
P.O. Box 942 Beenleigh QLD 4207
Ph (07) 3382 0880
Fax (07) 3382 0885
www.bteq.com.au

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1.0 Introduction

BTEQ have been commissioned by New Hope Coal Australia to conduct an investigation of the status of current and historic mine rehabilitation and nearby unmined analogue sites at and near New Hope's New Oakleigh Coal Mine. The investigation is to provide background information which will be used to help develop a set of rehabilitation acceptance criteria for a grazing outcome following the eventual handover of the mine at the conclusion of mining operations.

The New Oakleigh operation is located near Rosewood, Qld and is approximately 20 kilometres Southwest of Ipswich. The location of the mine is depicted in **Figure 1**.

2.0 Aims

The aims of the investigation were to:

- Provide a “snapshot” of the current status of the historic mine rehabilitation works at New Oakleigh Mine,
- Provide an assessment of the state of pasture growth and productivity at the “Analogue” site Lot 566 on CH31740,
- Determine an effective comparative measure of grazing productivity for the analogue and mine rehabilitation sites,
- On the basis of the state of the analogue site, devise a set of acceptance criteria for a grazing outcome which would then be applied to the rehabilitation works at New Oakleigh Mine.

FIGURE 1 Site Location

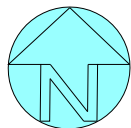
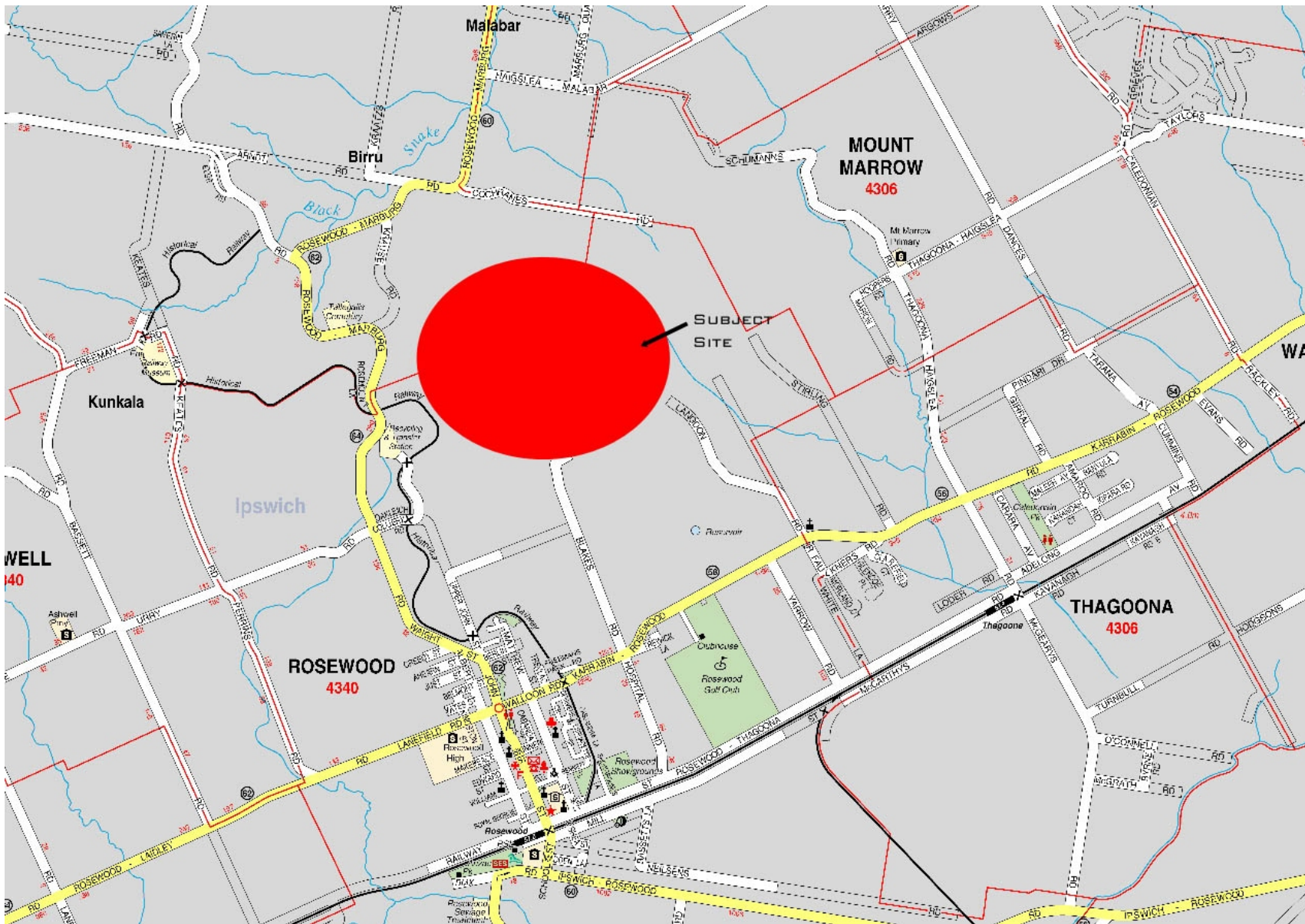


Figure 1
Site Location

Drawing Number:

Scale: 1:10000 Approx

Date: 30/8/04

Source : UBD 2002

Drawn By: JA

Checked By: KT

3.0 Methods

3.1 Literature Review

A review of relevant publications was conducted to determine best practice methods which could be applied to the vegetation sampling and selection of appropriate measures for assessing grazing productivity. The impacts of grazing on mine rehabilitation sites were also reviewed. A detailed list of references is attached.

As part of this desktop study the relevant site data required for input to the Revised Universal Soil Loss Equation (RUSLE) (Renard et al. 1994) was also acquired to allow comparison of erosion rates on the sites.

3.2 Field Assessment

Three areas were used in this investigation. Two areas of historic rehabilitation were sampled at the New Oakleigh mine site and an analogue site chosen previously in consultation with the EPA was also assessed. The location of these sites is depicted in **Figure 2**.

After an initial orientation inspection of the sites, a series of 20m x 20m plots were placed at random in the rehabilitation areas. Ten (10) plots were placed in the analogue site Lot 566 on CH31740 and ten (10) in the historic rehabilitation areas at New Oakleigh.

The aim of this was to establish a sampling pattern which would provide a representative example of the type and physical distribution of grazing land across the sites. Transects were measured using a 20m tapes. At each 20m x 20m plot the following measurements and information were recorded:

- **Plot location** – AMG eastings and northings measured with hand held GPS
- **Site orientation** – measured in degrees with hand held compass and verified with GPS
- **Slope** – measured in degrees with hand held clinometer
- **Photo** – a reference photo was taken of each plot from the intersection of the tapes used to measure the plot boundaries (**see Plates 1 – 4 for examples**)
- **Foliage Projective Cover (FPC)** – understorey FPC was measured at 0.5 metre intervals along a transect within the plot and vegetation was classified as either Live, Dead or, if no vegetation was present, Bare. The 40 FPC records taken at each site were then converted to a percentage figure to allow easy analysis and comparison with other sites. Only understorey FPC was recorded at each transect as the rehabilitation areas and the are largely devoid of shrubs and trees (**see Plates 1 - 4**).
- **Species list** – all flora species encountered were recorded. Most species were able to be identified in the field however any species not able to be identified on site were collected for later identification.

FIGURE 2 Rehabilitation Sites

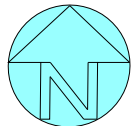
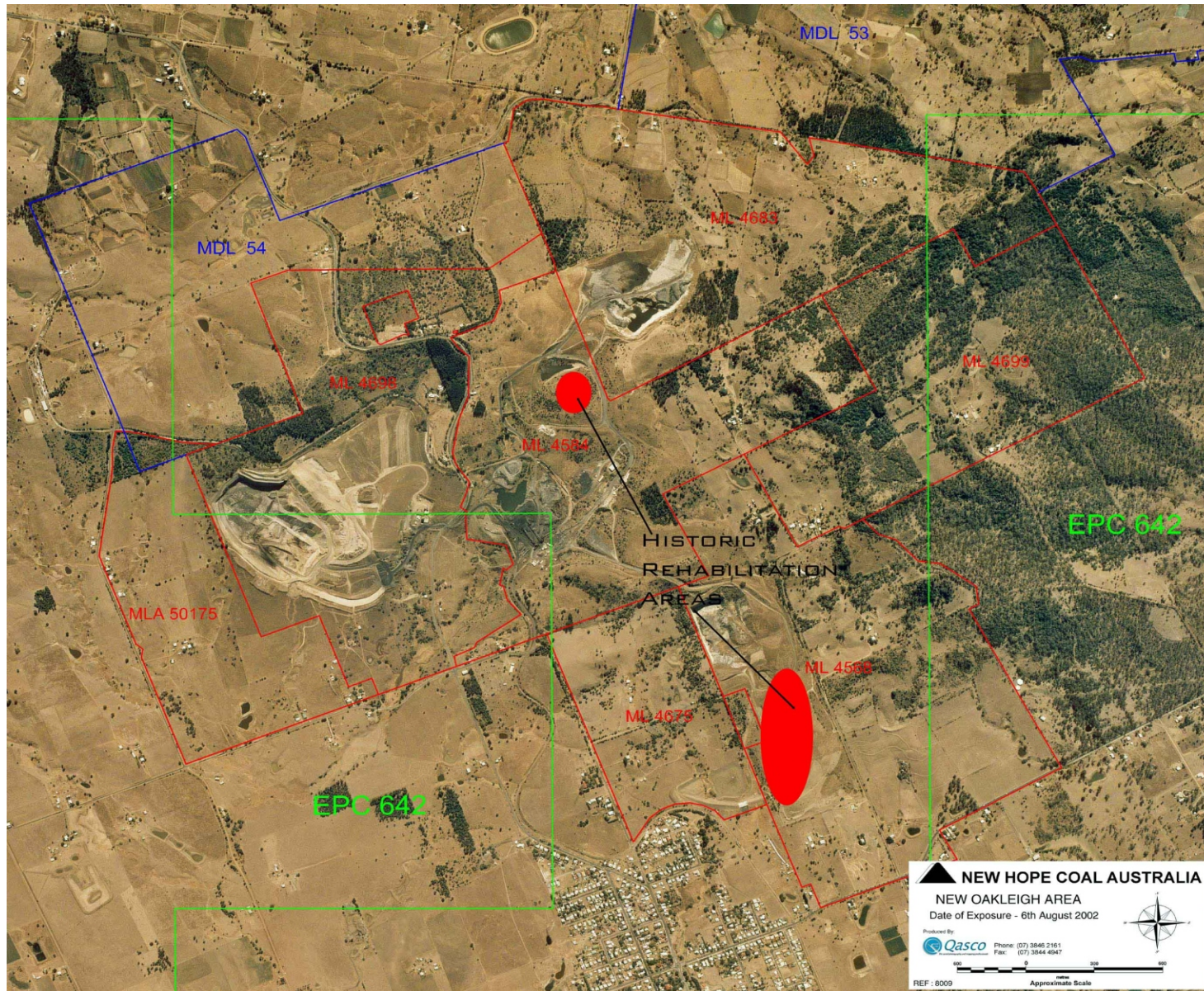


Figure 2
Rehabilitation Site Locations

Drawing Number:

Scale: As Above

Date: 30/08/04

Source: New Hope Coal

Drawn By: JA

Checked By: KT



Plate 1 – Plot 1 New Oakleigh Analogue (Lot 566 on CH31740)



Plate 2 – Plot 3 New Oakleigh Analogue (Lot 566 on CH31740)



Plate 3 – Plot 1 New Oakleigh Mine site (Near Normanton Pit)

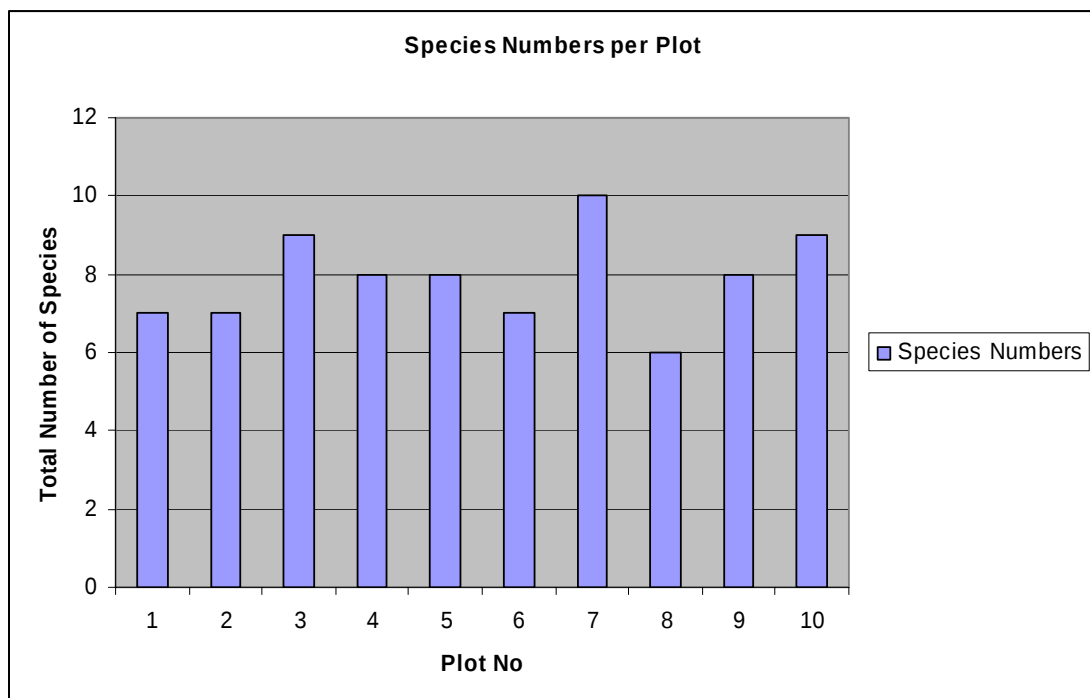
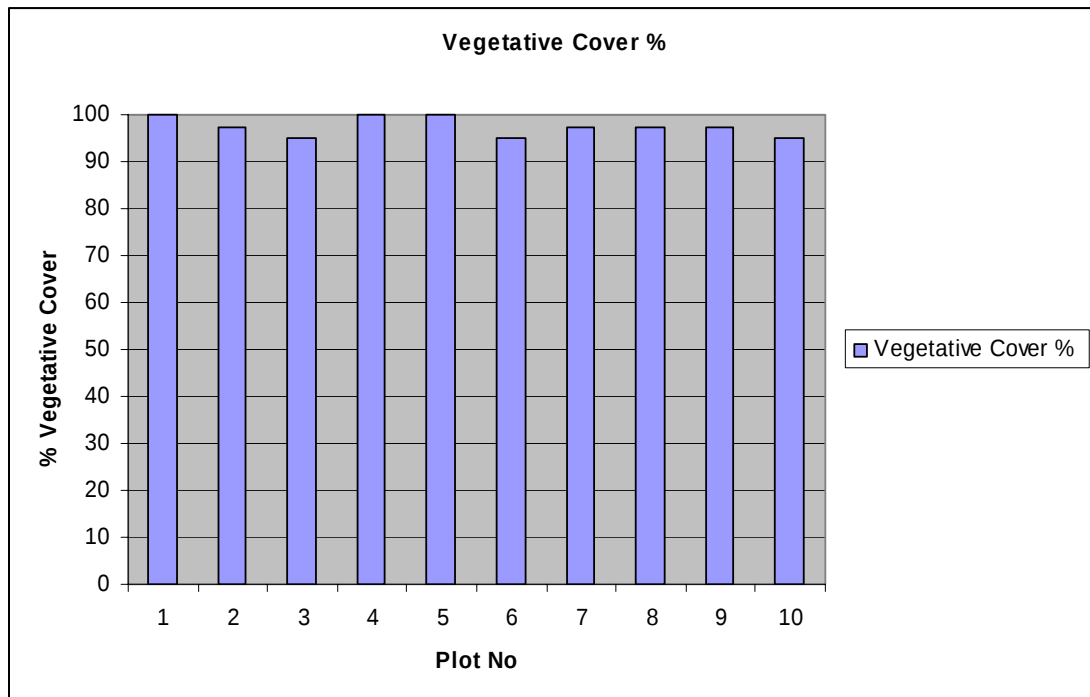


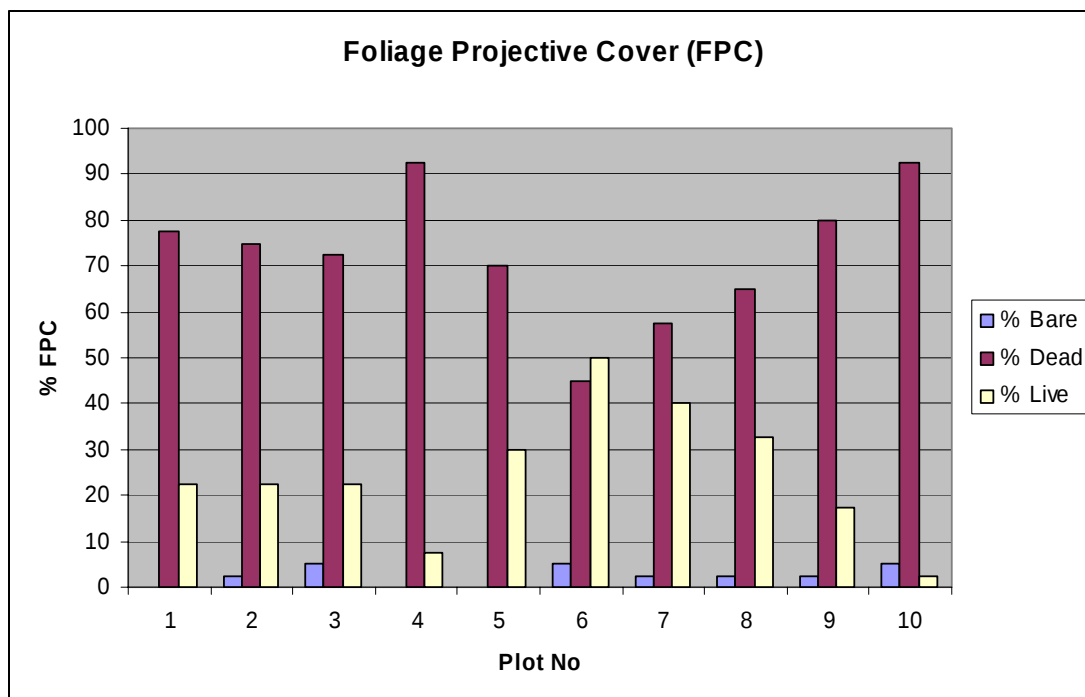
Plate 4 – Plot 5 New Oakleigh Mine site (Near Normanton Pit)

4.0 Results

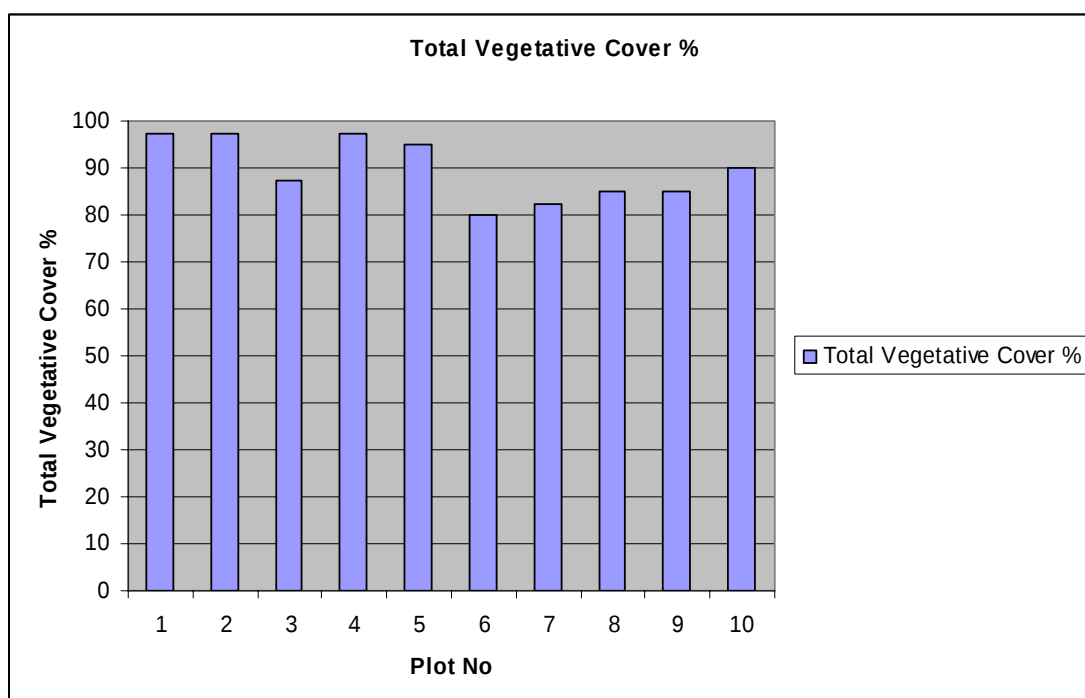
The results of the investigation are summarised in the following series of graphs.

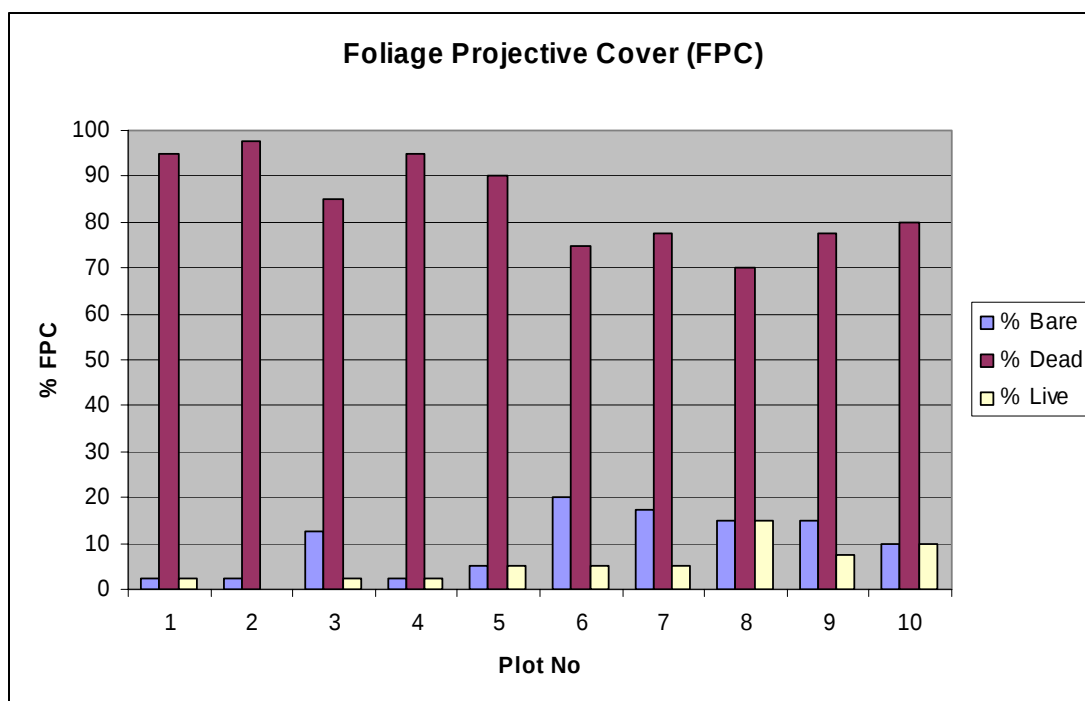
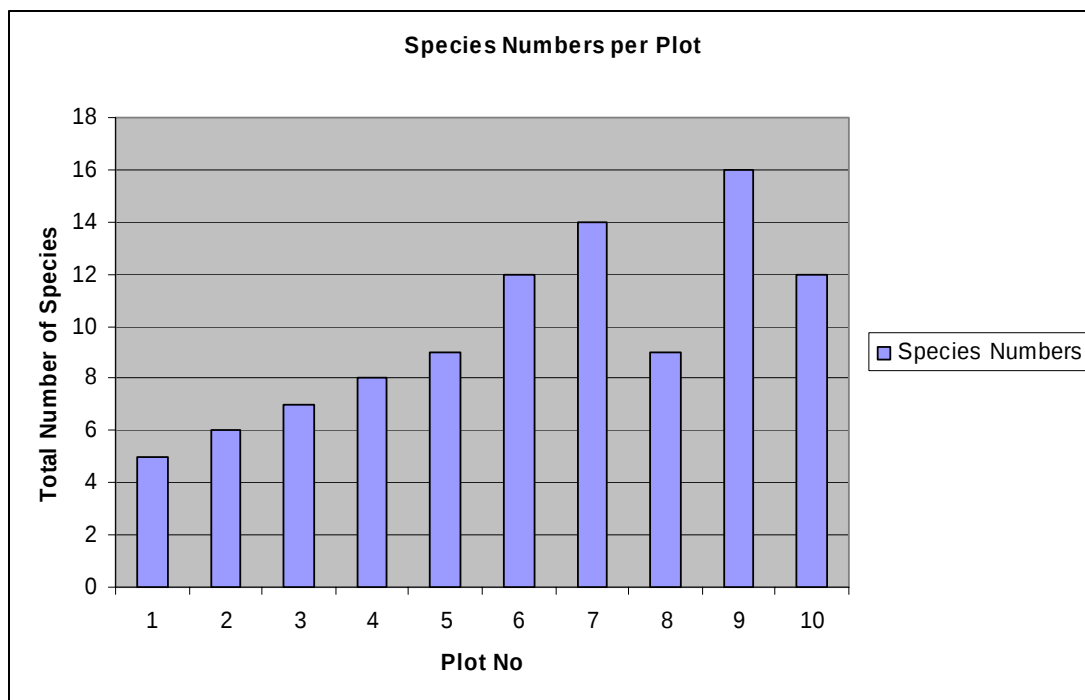
4.1 Analogue Site Results





4.2 New Oakleigh Mine Site Results





5.0 Comparison of Results

The results indicate that there was little variation between the Mine rehabilitation sites and the Analogue site.

Total vegetative cover was marginally higher on average at the analogue site than at the mine site however the mine site was being used for grazing at the time of the assessment whereas the analogue site has not been grazed for some time. This would undoubtedly have affected total vegetative cover.

Species numbers were on average higher on the mine rehabilitation site than at the analogue site.

Comparison of the nature of the foliage projective cover showed that whilst FPC was high at all sites in most cases the vegetation was dead. This is a reflection of the extremely dry conditions prevailing throughout the region at the time of sampling and the fact that the sampling was conducted at the end of winter.

Comparison of the data used as input data for the Revised Universal Soil Loss Equation (RUSLE) showed that input data for the two areas was identical (Brough et. al 2004). This is a reflection of the two sites close proximity to one another and similarity of landform, vegetative cover, soil type and land use. Erosion rates for the two sites would be shown to be similar if not identical with only variables such as Slope length and intensity of landuse having an impact on the RUSLE's results.

6.0 Discussion

Generally the results gained in this assessment suggest that the historic rehabilitation which has been undertaken at the site has produced a “grazing outcome” standard pasture which compares favourably with the current state of the analogue site.

Of the 20 plots measured across the two sites (analogue and mine rehabilitation) all had a total a total vegetative cover of 70% or greater. The 70% FPC total is a subjective limit applied in a number of vegetation classification schemes (eg Specht 1981) to describe “closed” plant communities. This means that once the plant community FPC has reach 70% or greater the “Canopy” of that community is effectively closed. In the case at the New Oakleigh sites the majority of the area would be classified as a “closed grassland” under the Specht classification referred to above. A large percentage of grazing lands in Qld would fall within this classification.

Research conducted on a number of mine sites throughout Queensland has shown that grazing is a viable land use on mine rehabilitation sites (Grigg, 2000, Grigg et.al. 2001). However, the ultimate success of this land use is often directly related to the intensity of grazing pressure (Grigg, 2000) and its relationship to the stage of the development of the rehabilitation site. Overly intense grazing at too early a stage of the rehabilitation will result in loss of pasture vigour and may lead to increase in erosion and landscape degradation.

After review of various methods of assessing grazing productivity it would appear that a measure such as standing dry matter production would provide an effective and appropriate indication of the status of grazing sustainability.

With these factors in mind a range of acceptance criteria are proposed in section 7.0.

7.0 Proposed Acceptance Criteria (Grazing Outcome)

The following acceptance criteria and associated monitoring practices are proposed for the New Oakleigh mine rehabilitation areas.

Acceptance Criteria 1

- ❖ FPC of Monitoring rehabilitation sites is at or above 70% understorey FPC

Monitoring

Biennial monitoring of randomly selected plots within mine rehabilitation areas proposed for the “grazing outcome” and the analogue site using methods described in section 3.

Acceptance Criteria 2

- ❖ Standing Dry Matter to be within +/- 10% of the analogue sites production rate over a period of 12 months

Monitoring

Biennial monitoring of randomly selected plots within mine rehabilitation areas proposed for the “grazing outcome” and the analogue site using methods described in Campbell and Hacker (2002).

Acceptance Criteria 3

- ❖ Grazing species diversity on the mine rehabilitation sites to be on average within +/- 20% of the analogue site.

Monitoring

Biennial monitoring of randomly selected plots within mine rehabilitation areas proposed for the “grazing outcome” and the analogue site using methods described in section 3.

Acceptance Criteria 4

- ❖ Erosion rates of the mine rehabilitation areas, as determined by the Revised Universal Soil Loss Equation (RUSLE) (Renard et. al. 1994), to be within +/- 10% of the rates of the analogue site.

Monitoring

Biennial monitoring of randomly selected plots within mine rehabilitation areas proposed for the “grazing outcome” and the analogue site using methods described in Renard et. al. 1994

8.0 References

Brough.D., Lawrence.P., Fraser.G., Rayner. D.and Le Grand .J. (2004) *Improved inputs of Regional Scale Soil Erosion potential for Queensland*. Proceedings of the 13th International Soil Conservation Organisation Conference – Brisbane, July 2004.

Cambell. T. and Hacker. R. (2002) *Tactical Grazing Management for the Semi - Arid Woodlands*. NSW Agriculture, Sydney

Grigg, A.H., Emmerton, B.R. and McCallum, N.J. (2001). The development of draft completion criteria for ungrazed rehabilitation pastures after open-cut coal mining in central Queensland. Australian Coal Association Research Program Project C8038. Final Report to ACARP, August 2001. Centre for Mined Land Rehabilitation, The University of Queensland.

Grigg, A.H., Shelton, M. and Mullen, B. (2000). The nature and management of rehabilitated pastures on open-cut coal mines in central Queensland. *Tropical Grasslands* 34, 242-250.

Hannan. J.C. (1995), *Mine Rehabilitation : A handbook for the Coal Mining Industry*. NSW Coal Association, Elisabeth St Sydney

Renard. K.G., Laflen, J.M., Foster.G.R.and McCool. D.K. (1994). *The Revised Universal Soil Loss Equation*. Soil Erosion Research Methods, 2nd edition, Soil and Water Conservation Society and St Lucie press, pp104-124, USA

Soilloss: A Program to Assist in the Selection of Management Practices to Reduce Erosion, by Colin J Rosewell. 2nd ed. Soil Conservation Service of NSW, Sydney, 1993.

Appendix 1

Cumulative Species List

Analogue Site

Pasture Species

Grasses

Species Name	Common Name
<i>Cynodon nlemfluensis</i>	African star grass
<i>Cynodon plectostachyus</i>	African star grass
<i>Dichanthium annulatum</i>	Angleton
<i>Panicum coloratu</i>	Bambatsi
<i>Cenchrus ciliaris</i>	Buffel
<i>Cynodon dactylon</i>	Couch, green
<i>Bothriochloa insculpta</i>	Creeping Bluegrass
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Panicum coloratum</i> var. <i>mararikariense</i>	Makarikari
<i>Panicum maximum</i> var. <i>trichoglume</i>	Green Panic, Gatton Panic
<i>Paspalum plicatulum</i>	Plicatulum
<i>Setaria incrassata</i>	Purple Pigeon
<i>Dichanthium sericum</i>	Queensland bluegrass
<i>Chloris gayana</i>	Rhodes grass
<i>Setaria sphacelata</i>	Setaria
<i>Themeda australis</i>	Kangaroo Grass

Legumes

Species Name	Common Name
<i>Desmanthus virgatus</i>	Desmanthus
<i>Lablab purpureus</i>	Lablab
<i>Leucaena leucocephala</i>	Leucaena

Medicago sativa	Lucerne
Medicago truncatula	Barrel Medic
Medicago polymorpha	Common Burr Medic
Medicago scutellata	Snail Medic
Macroptilium atropurpureum	Siratro
Vicia villosa	Woolly pod vetch

Other Species

Species Name	Common Name
Sida cunninghamii	Paddys Lucerne
Desmodium variens	
Desmodium brachypodium	Slender Treefoil
Crisium vulgare	Scotch Thistle
Sidgesbeckia orientalis	Sidgesbeckia
Lantana camara	Lantana
Lantana montevidensis	Lantana

Appendix 2

Cumulative Species List
Oakleigh Rehabilitation Sites

Pasture Species

Grasses

Species Name	Common Name
<i>Dichanthium annulatum</i>	Angleton
<i>Panicum coloratu</i>	Bambatsi
<i>Cenchrus ciliaris</i>	Buffel
<i>Cynodon dactylon</i>	Couch, green
<i>Bothriochloa inculpta</i>	Creeping Bluegrass
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Panicum maximum</i> var. <i>trichoglume</i>	Green Panic, Gatton Panic
<i>Paspalum plicatulum</i>	Plicatulum
<i>Setaria incrassata</i>	Purple Pigeon
<i>Dichanthium sericum</i>	Queensland bluegrass
<i>Chloris gayana</i>	Rhodes grass
<i>Setaria sphacelata</i>	Setaria
<i>Themeda australis</i>	Kangaroo Grass

Legumes

Species Name	Common Name
<i>Desmanthus virgatus</i>	Desmanthus
<i>Medicago truncatula</i>	Barrel Medic
<i>Medicago polymorpha</i>	Common Burr Medic
<i>Medicago scutellata</i>	Snail Medic
<i>Vicia villosa</i>	Woolly pod vetch

Other Species

Species Name	Common Name
<i>Sida cunninghamii</i>	Paddys Lucerne
<i>Desmodium variens</i>	
<i>Eucalyptus crebra</i>	Narrow leaf – Iron Bark
<i>Corymbia tessellaris</i>	Morton Bay Ash
<i>Crisium vulgare</i>	Scotch Thistle
<i>Sidgesbeckia orientalis</i>	Sidgesbeckia
<i>Trema aspera</i>	Poison Peach
<i>Lantana camara</i>	Lantana
<i>Lantana montevidensis</i>	Lantana