Millennium Expansion Project
Environmental Impact Statement

CHAPTER 7:
LAND

TABLE OF CONTENTS

FIGURES

PLATES

TABLES

7.0 LAND RESOURCES

7.1 EXECUTIVE SUMMARY

7.1.1 Values

Soils and Land Suitability

The Millennium Expansion Project's (MEPs) soil and land environmental values are based on land suitability classifications as there are no accepted criteria for specifying land environmental values. This section is to be used in conjunction with **Chapter 13 – Nature Conservation** to determine the overall environmental values of the land.

Waste Rock and Coal Rejects Management

Waste rock can potentially exhibit acid forming and acid neutralising characteristics. If present, these characteristics need to be managed to prevent environmental harm and land contamination.

Visual Amenity

The existing landscape character and visual amenity is an environmental value to be maintained.

7.1.2 Issues

Soils and Land Suitability

The MEP's soil and land environmental issues include:

- clearing or disturbance of 1218 ha of land for open-cut mining and/or waste rock emplacements;
- topsoil reserves are variable across the MEP and require specific handling to ensure adequate supply and quality of topsoil for the proposed rehabilitation program;
- mining requires the use of a number of chemicals and hazardous materials that have the potential to contaminate land if not properly managed;
- some areas of land will have a diminished agricultural land suitability classification following mining; and
- some areas of land will have greater potential for erosion during and following mining operations.

Waste Rock and Coal Rejects Management

Analysis shows that coal reject material has a slightly increased acid forming potential. This material should not be exposed at the surface of final landforms nor should it be placed in the waste rock profile in such a manner as to allow contact with locally developed groundwater tables.

Visual Amenity

Potential visual impact generators may be the following MEP elements:

- additional open-cut pits;
- increased size of ROM coal stockpile for temporary stockpiling of coal destined for existing CHPP;
- out-of-pit waste rock emplacements (maximum 50 m);

- mine lighting requirements;
- access/haul roads; and
- mine rehabilitation areas.

7.1.3 Mitigation Strategies

Soils and Land Suitability

Strategies to mitigate MEP's soil and land environmental issues and impacts include the following:

- progressive rehabilitation of disturbed/exposed land will occur as soon as viable areas become available;
- topsoil will be stripped to the recommended depths ahead of mining disturbance and stockpiled at the recommended heights;
- erosion and sediment control measures will be undertaken as required, consistent with the *Technical Guidelines for Environmental Management for Exploration and Mining in Queensland* (DME, 1995) and as detailed in **Table 7-4;**
- rehabilitation of disturbed land will, as a minimum, aim to ensure a stable landform with self-sustaining vegetation cover;
- where possible, Peabody's rehabilitation program will endeavour to return land to a grazing land suitability;
- where land is unsuitable to return to a grazing land use (e.g. due to slope), or a specific environmental land use (e.g. protection of an endangered ecosystem, development of environmental corridors, protecting environmental offsets or maintaining healthy riparian areas) has been identified as the preferred option, Peabody will endeavour to reconstruct a bushland ecosystem with similar environmental values of surrounding native ecosystems;
- materials that could potentially contaminate land will be transported, handled, stored and used in compliance with the relevant Australian Standards and site procedures; and
- activities that could potentially contaminate land are reported to DERM in the form of Notifiable Activities, for inclusion on their Environmental Management Register.

Waste Rock and Coal Rejects Management

Analysis of overburden and interburden has shown this material to be relatively benign with no limitation to use in final landform development and revegetation. The overburden and interburden rocks were found to be generally not acid forming material and are therefore not expected to pose a risk of acid mine drainage. The pH and salinity of this material is also not restrictive for use in final landforms and revegetation.

Coarse rejects generated on-site will be strategically encapsulated within waste rock emplacements. Fine rejects will be flocculated and settled in special tailings sumps, then trucked to purpose built cells. The tailings will be dewatered and combined with coarse rejects within waste rock emplacements.

Visual Amenity

The magnitude of impact or degree of change as a consequence of the proposed activities within the MEP is expected to be low to moderate due to the presence of limited vantage points which provide views of the MEP infrastructure. The magnitude of visual impact following decommissioning is regarded as low due to the creation of a final vegetated landform that will resemble the existing undulating landscape. This will have a beneficial environmental outcome due to the re-establishment of native vegetation in an area which is currently sparsely vegetated.

The main indirect impact will be lighting from the proposed mine infrastructure, particularly in the vicinity of the active out-of-pit waste rock emplacements.

Lighting impacts will be mitigated by installing light fixtures in accordance with the *AS4282:1997 Control of the obtrusive effects of outdoor lighting*, i.e. that provide directed illumination to reduce light spillage beyond the immediate surrounds of the working area.

7.2 EXISTING ENVIRONMENT

In the absence of criteria for specifying environmental values for land in the *Environmental Protection Act 1994 (EP Act)* or its associated regulations and policies, the environmental value for land is often given in terms of its land suitability classification.

Whilst the land suitability classification does not focus significantly on the inherent environmental values, consideration is given to the environmental significance of flora and fauna that the land supports in **Chapter 13 - Nature Conservation** so that, when used in conjunction with the land suitability classification, the overall environmental value of the land can be ascertained.

7.2.1 Tenure

The Millennium Coal Mine is comprised of the following tenements:

- *Mining Lease (ML) 70312 'Millennium East';*
- *ML 70313 'Millennium West';*
- *ML 70344 'Mountain Pit';*
- *ML Application 70401 'North Poitrel'; and*
- *Mineral Development Licence (MDL) 136 'Mavis Downs'.*

Peabody and BHP Mitsui Coal Pty Limited (BMC) are the joint holders of ML 70312 'Millennium East'. This arrangement is referred to as the 'Red Mountain Joint Venture' (RMJV).

The MEP is comprised of three of the aforementioned leases namely, ML 70313, MLA 70401 and MDL 136. The leases adjoin a landscape dominated by a mosaic of large scale coal mines, and low density cattle grazing stations. The MEP leases occur on two land tenures and three easements, as detailed in **Table 7-1**.

Table 7-1 MEP Tenures and Land Owners

Tenement	Real Property Description	Landowner
ML 70313	Lot 2 GV165	Beryl Anne Nielsen
	Easement P SP184913	Millennium Coal Pty Limited
MLA 70401	Lot 2 GV165	Beryl Anne Nielsen
	Easement B SP178453	Ergon Energy Corporation MLA 70401 Limited
	Easement E SP1902563	Ergon Energy Corporation Limited
MDL 136	Lot 3 SP190266	Millennium Coal Pty Limited
	Lot 2 GV165	Beryl Anne Nielsen

7.2.2 Topography

The MEP topography is undulating with an overall gradient to the south, towards the Isaac River. The MEP is located in the upper catchments of New Chum Creek and West Creek, both tributaries of the Isaac River. All of the drainage lines, including the Isaac River, are ephemeral.

7.2.3 Geology

Regionally the MEP is located in the western-central Bowen Basin where Permian strata strike north-northwest and dip gently to the east, off the Comet Ridge. Within the Bowen Basin, the MEP is located on the western margins of the Taroom Trough within a heavily faulted and folded Permian subcrop. Locally the geology is complicated by the effects of multiple faults associated with the Jellinbah Fault system, a strike slip, reverse fault system extending some hundreds of kilometres through the middle of the Bowen Basin.

The target resource is contained within the Rangal Coal Measures, approximately 100 m thick.

The Leichhardt, Millennium and Vermont seams, occurring within the Rangal Coal Measures, will be targeted for mining. The coal seams are interbedded with fine-grained and low-permeability sediments (e.g. siltstones, shales and mudstones) and sandstones. The average seam thickness is 3.6 m with the interburden thickness ranging between 18-36 m.

The Rangal Coal Measures are underlain by the Permian Fort Cooper Coal Measures and is overlain by the Triassic Rewan Group. A series of northwest aligned faults displaying throws of up to 80 m disjoint the assemblage, with the Fort Cooper and Rangal Coal Measures outcropping in the centre of the MEP area.

The majority of the MEP area is covered with a veneer of Triassic Rewan sediments. In the south, Quaternary aged alluvium associated with the Isaac River overlies the Triassic - Permian sequence. Tertiary sediments are known to occur in isolation east and west of the MEP, forming topographic features. **Table 7-2** shows a generalised stratigraphic section of the MEP area including a brief lithologic description of each unit.

Table 7-2 Regional Stratigraphy

Summary of Stratigraphic Sequence			
Age	**Unit**	**Lithology**	**Thickness**
Quartenary	Recent Alluvium (Qa).	Soils, clays, silts, sands and gravels.	Up to 5 m
Tertiary	Suttor Formation (Ts).	Medium to coarse, cross-bedded quartz sandstone, conglomerate, sandy claystone, river channel conglomerate, overlying basalt.	6-120 m
	Basalt (Tb).	Weathered basalt soils, moderately weathered and fresh basalts.	Up to 80 m
Triassic	Clematis Sandstone (Re).	Cross-bedded medium to coarse quartz sandstone felsopathic in places, some fine and pebble quartz conglomerate.	Up to 450 m
	Rewan Formation (Rr).	Coarse green lithic sandstone, pebbles in places, some fine and pebble conglomerate and red and green mudstone.	5-70m
Upper to Middle Permean	Rangal Coal Measures (Pwj).	Coal seams, carbonaceous shales and mudstone, light grey litho felsopathic conditions, grey to dark grey siltstones and mudstones.	100-200 m
	Fort Cooper Coal Measures (Pwt).	Brown to green micaceous volcanolithic sandstone, conglomerate, carbonaceous shale, coal with thin beds of greyish white cherty tuff.	400 m
	Measures (Pwb).	Lithic labile sandstone, siltstone, carbonaceous shale, coal, local cherty mudstone and minor conglomerate.	250-750 m

7.2.3.1 Tertiary Material

The Rangal Coal Measures are covered by a thin (approximately 3m) layer of Tertiary unconsolidated clays, loose sands and soils. From the surface geological maps of the MEP area, the tertiary unit is part of the Suttor Formation.

7.2.3.2 Rangal Coal Measures

The Permian Rangal Coal Measures are approximately 100 m thick and comprise of light grey, cross bedded, fine to medium grained labile sandstones, grey siltstones, mudstones and coal seams. They are the uppermost Permian unit in the MEP. The open-cut mineable coal is present in three faulted blocks with strike length from 1-3 km. The bedding dip is approximately 5 degrees towards the south west.

The MEP resource comprises the Leichhardt, Millennium and Vermont seams from the Rangal Coal Measures and the Girrah seam from the underlying Fort Cooper Coal Measures, however the Girrah seam is not currently economical for mining.

The Leichhardt, Millennium and Vermont seams are the main targets. The Leichhardt seam is 4-5 m thick with ash contents between 15 and 25 %. The Millennium seam is approximately 0.5 m thick and the underlying Vermont seam 2 - 2.5 m thick.

The Leichhardt Seam separates into two coal mining horizons - the ‘Leichhardt Bottoms’ is typically 3.5 m thick and provides coking coal product and PCI (Pulverised Coal Injection) product, and the ‘Leichhardt Tops’, which is typically

2 m thick and provides PCI product only. A third seam, the Lower Leichhardt Seam (LB) exists where a clayey-silt band up to 4 m thick splits it from the residual Leichhardt Seam. LB provides a coking coal product.

The Vermont Seam comprises the 2-3 m thick Upper Vermont (VU) seam and the 1-3 m thick, high ash Lower Vermont Seam. The VU is subdivided into the Upper Vermont 1 (VU1) and Upper Vermont 2 (VU2) Seams. The interburden thickness between the Leichardt Seam and Vermont Upper Seam ranges from 12-24 m but is generally around 14-20 m.

The Fort Cooper Coal Measures are characterised by abundant tuff beds and high ash coal seams with the upper boundary being marked by a tuffaceous bed. The Girrah seam underlies this tuff bed with coarse green lithic sandstone conglomerates underlying the coal seam. The Girrah seam comprises coal, interlaminated carbonaceous mudstone, brown to fawn tuffaceous claystone and mudstone with minor siltstone and sandstone bands, with the cleanest coal plies occurring at the top of the seam.

7.2.3.3 Coal Resource

The MEP will build up to an average of 5.5 Mtpa ROM coal over a four year period (2012 - 2016), and will continue at this rate of production until mine closure in 2027. Mining will be undertaken by truck and excavator with total waste rock handling of up to 60 Mtpa with an average ROM strip ratio of 10.0 – 11.5 during full operation.

The target seams in the MEP area are marginally thinner than at the existing Millennium Mine. The Leichhardt seam typically comprises 5-6 m of clean, dull to dull-banded coal, which brightens marginally in the basal 1-1.5 m. A persistent, 2-4 cm thick, grey-brown, claystone marker, which is present 2.3-3.3 m below the roof of the seam in most holes, splits the seam into the Leichhardt Tops and Bottoms.

The Vermont Seam comprises a 3-4.5 m thick upper section, separated from a one metre thick, high-ash, tuff-banded basal section by, either wholly or in part, the Yarrabee Tuff Bed, a basin-wide stratigraphic marker that, at the Project Site, comprises 0.5-1 m of brown tuffaceous claystone.

The upper section of the Vermont Seam (VU1) can be subdivided into a 1.8-2.5 m thick upper ply of clean, dull-banded to interbanded coal (VU2) and a 1.2-2 m thick ply of coal interbedded with inferior coal/carbonaceous mudstone (VU1). VU2 splits from the rest of the seam north of approximately 7,556,500 mN.

The transition from the Rangal Coal Measures to the Rewan Formation is generally difficult to define and is often based on the change from the green-grey colour of the Rewan sandstones to the blue-grey colour of the Rangal sandstones. The transition between the formations is 15-60 m above the first major seam in the Rangal Coal Measures the Leichhardt Seam.

Along the margin of ML 70313 and MLA 70401 the Fort Copper Coal Measures outcrop, erosion has removed the Rangal Coal Measures resulting in a zone of seam absence which limits the extent of the resources.

Exploration data indicates that the MEP area is free of intrusives and the coals are not heat affected.

7.2.3.4 Coal Quality

Analytical results obtained from the exploration programs show that the MEP coal is a medium volatile, bituminous coal with low raw ash, low sulphur and low phosphorus by Australian standards. The resource has the potential to produce two products, a premium quality, hard coking coal that is derived from a blend of the Leichhardt, Millennium and the Vermont seams and a PCI product.

7.2.4 Land Use

Land within the MEP has historically been used for beef cattle grazing, although the last 20 years has also seen significant coal mining and exploration works undertaken in the surrounding region. The majority of the MEP has been cleared for improved pasture, with Buffel Grass well established in most soil units.

There is no evidence of any cropping in the area, other than possibly limited areas of forage.

7.2.5 Sensitive Environmental Areas

Grazing, road and track construction to varying levels have affected all the vegetation communities within the Project site. The levels of disturbance vary across these areas.

Of the 12 regional ecosystems identified within the Project site, two are listed as threatened ecological communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Four communities are classified as endangered or of concern under the Queensland *Vegetation Management Act 1999*.

Sensitive environmental areas are discussed in more detail in **Chapter 13 – Nature Conservation.**

7.2.6 Landscape Character

The landscape at the MEP comprises undulating rural land with isolated rocky knolls. The MEP drains to the south-east and is dissected by New Chum Creek running from north-west to south-east through the lease and into the Isaac River.

Most of the Project site has been cleared for the improvement of pastures for grazing. This has resulted in very little remnant vegetation remaining in this area, except for some areas associated with New Chum Creek.

7.3 SOILS, LAND SUITABILITY AND LAND CONTAMINATION

7.3.1 Soil survey Methodology

A soil survey and land suitability assessment was undertaken for the MEP by GTES Pty Ltd in May 2009 (refer to **Appendix F1 - Soils**). This report included new fieldwork results, as well as incorporating the results from two previous soil survey works covering different sections of the MEP area, namely the ‘Mavis Downs Soil Survey’ (Baker and Tuck, 2006) and the ‘Poitrel Soil Survey’ (Baker and Tuck, 2004).

7.3.1.1 Desktop Study and Survey Design

The survey method was selected following consideration of the *Guideline for Surveying Soils and Land Resources* (McKenzie *et al.*, 2008) and designed to provide sufficient information on land resources to allow the determination of soil type distributions, land suitability, soil erosion, rehabilitation potential and storm water runoff quality.

McKenzie et al (2008) advocates that the criteria for soil survey boundary placement should relate to the basic purpose of the survey e.g., boundaries should coincide with critical limits which determine the specific suitability of land use, in this case agricultural land suitability. In addition to this objective, the MEP survey also sought to determine spatial distributions of soil types with a view to topsoil management for re-use in mine rehabilitation programs.

McKenzie *et al.* (2008) further state that the required descriptions of soil horizon sequences may be effectively achieved using the methodology of Gunn et al. (1988). Accordingly, the method adopted in this survey is referred to by McKenzie *et al.* (2008) as a Qualitative Free Soil Survey (QFSS). QFSS is a commonly used method in broader scale agricultural lands as it enables flexibility in site selection compared to grid mapping techniques, ultimately achieving a more accurate and time effective result. It is particularly appropriate for the MEP, as topographic, vegetative and soil associations were found to be quite uniform across most of the area.

A desktop review was undertaken prior to the commencement of fieldwork and included initial site mapping based on; previous soil survey reports, accurate high resolution aerial photogrammetry, and a digital terrain model contour detail overlay. This initial site mapping was used to identify landform and vegetation patterns to assist with the selection of ground observation locations. The site map was progressively refined during the field work and completed following a review of field results, including chemical and physical analyses.

Previous soil survey reports were reviewed, as detailed in **Table 7-3** below, with relevant information incorporated into the final study.

Table 7-3 Previous Soil Surveys of Relevance to the MEP

Report By	Year Published	Report Focus
Story *et al.*	1967	Soils and land information at a scale of 1:50000.
Bourne and Tuck	1996	Agricultural management units for the Central Highlands region in Queensland.
Shields and Williams	1991 and 1996	Kilcummin land suitability survey.
Gunn *et al.*	1998	'*Australian Soil and Land Survey Field Handbook*' sets field guidelines for sampling and profile descriptions.
Isbell	1998 and 2002 (revised edition)	'*Australian Soil Classifications'* provided the standard soil classifications against which the MEP soils were compared.

Soils in future disturbance areas were mapped for this survey at approximately 1:25,000 scale in accordance with the guideline provided by Gunn et al (1988). This guideline is flexible and recognises complexity of landform, the surveyor's experience, and purpose of survey in the determination of the location and number of ground observations.

7.3.1.2 Fieldwork

Major soil characteristics were determined from the examination of soil profile morphology and key chemical attributes for the major soil horizons. Physical properties such as permeability and drainage characteristics were inferred from profile morphological characteristics, such as; concretions, depth to rock, observed root depth, colour and mottling. Typical depths of useable topsoil for future mine rehabilitation were determined using DME (1995) guidelines.

Sampling and profile inspection points were distributed across the entire project area to characterise all landform elements and geological units. Profile descriptions were established with due regard to the *Australian Soil and Land Survey Field Handbook* (Gunn, 1988), the *Australian Soil Classification* (Isbell, 1998) and the *Australian Soil Classification - Revised Edition'*(Isbell,, 2002).

Profiles were exposed using 40 mm and 75 mm hand augers and/or back-hoe excavations of representative sites. Augured sites were generally up to 1.5 m deep, unless refusal due to very hard clay or rock or irretrievable media was encountered. Where possible, profiles at cuttings and eroded channels were also recorded. Slope, landform, vegetation, land condition and geology were assessed at inspection points. Sampling and observation points were recorded using a global positioning system (GPS). In total, 143 sites were mapped across the MEP.

Soil samples from various depths at representative sites were subject to laboratory analysis by a NATA approved laboratory for chemical and physical characterisation. Of the 143 sites mapped, 69 sites were described at a 'detailed' level, with the remaining 74 'non-detailed' sites described with lower descriptive levels to confirm soil type, land condition and soil unit boundaries. Many non-detailed sites were also excavated in order to confirm the depth of the A horizon and upper B seam characteristics.

Photographs were taken at all representative sites and also at many of the non-detailed observation sites to assist with the final interpretation of soils and suitability.

7.3.1.3 Land Suitability Assessment

Two land suitability assessments were made comparing grazing and cropping land uses for each soil type identified on the MEP, in accordance with the following:

1) *Technical Guidelines for Environmental Management for Exploration and Mining in Queensland* (DME, 1995); and
2) Planning Guidelines for the *Identification* of *Good Quality Agricultural Land* (Department of Primary Industries and Department of Housing, Local Government and Planning, 1993) which supports the State Planning Policy 1/92: *Development and the Conservation of Agricultural Land*.

Soils in the region were originally formed from sediments originating from exposed shale strata or from the old Tertiary weathered zone. The subsequent partial or complete removal of the old Tertiary land surface and deep weathered zone determines the major characteristics of soils and the land in general, resulting in a mixture of soil types. The survey area includes remnants of the original Tertiary land surface and outcropping sandstone beds in the form of partially intact ridgelines. During field investigations sandstones were often encountered at shallow depth, a strong indication that many soils in the MEP area have been formed directly on sandstone and related sediments.

A total of 10 soil types were described in the survey. Overall, the soils of the project are either uniform; thin duplex Brigalow clays with quite coarse structured subsoils; or sandy duplex eucalypt plains. Some notable exceptions include localised areas of reddish brown sandy clays on sandstone and alluvial clay soils in the central portion of the MEP area associated with New Chum Creek.

The principal soil types are summarised **Table 7-4** along with their recommended management strategies. The soil type distribution is shown in **Figure 7-1**. The soil scheme of Isbell (1998) was used to classify soil types. The soil unit names divide soil types into three broad groups:

- A- Alluvial soils;
- B - Brigalow soils; and
- E - Eucalypt dominated soils.

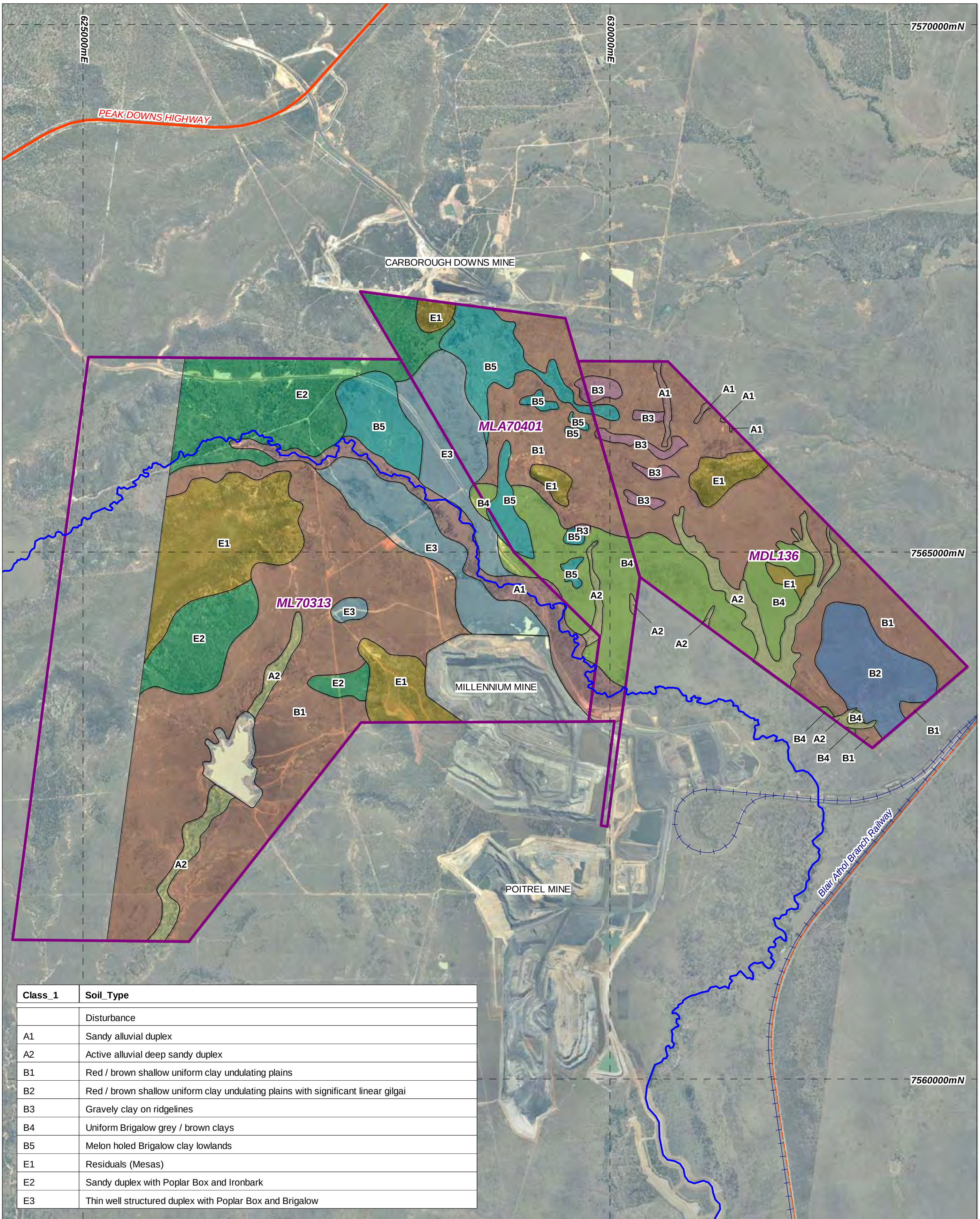
Table 7-4 Soil Mapping Units and MEP Area

Soil Unit	Concept	Description	Area (ha)
A1	**Riverine deep hard setting uniform to duplex sandy clays.**	**General -** Alluvial profile which is mostly a duplex soil with loamy sands generally extending in a range 15 – 40 cm over hard brown clay. Isolated areas have a much deeper sandy upper layer. The surface is firm sandy. Generally low plant available water which varies with depth of the upper layer. Overall the surface soil layer has low fertility, is not dispersive, saline or sodic but is best used in level rehabilitation due to a predisposition to set hard and erode. **Soil Chemistry -** The surface soil is dominated by fine to coarse sand over alkaline clay subsoils which may be saline and sodic. Nutrient levels are very low, typical of duplex country in the region. The surface has very low fertility and may tend to set hard given the proportion of fine sand and silt sized fraction. The effective soil depth is restricted mainly to the depth of the A horizon. Nitrogen and phosphorus is low, hence this soil will respond well to superphosphate application for pasture establishment. Reaction trend is neutral, becoming alkaline with increasing depth. **Management –** Nitrogen and phosphorus is low, hence this soil will respond well to superphosphate application for pasture establishment. Topsoil stripping for rehabilitation should avoid any contamination from the clay subsoil. The soil may be stripped moist or dry. Typically the soil can be stripped between 20 cm to 40 cm and should not extend into the bleached layer (if present) and/or the clayey B horizon. The upper sandy layer will be useful on rehabilitation of level surfaces such as dump tops. Trafficability is poor when wet, particularly once the subsoil wets out. This soil unit is susceptible to erosion, particularly on slopes leading into New Chum Creek. Thus clearing and or compacting of slopes above the Creek should take this into consideration.	**107 ha**
A2	**Alluvial – Uniform Brigalow clay drainage lines**	**General -** This soil occupies clay drainage lines leading into New Chum Creek with Brigalow regrowth predominating. The soil unit is susceptible to occasional flooding and once cleared, erosion processes become quite apparent, gully lines can be pot-holed and incised. The surface is usually cracking and quite firm and the sandy clays may extend beyond 2 metres. The surface 30-40 cm layer is a light sandy clay which usually becomes coarser and heavier textured with depth. **Soil Chemistry -** The soil is typical of Brigalow soils in the region in that nutrient levels are reasonable, salinity increases with depth, nitrogen levels are good and cation exchange is adequate. Phosphorus is low, hence this soil will respond well to superphosphate application for pasture establishment. Levels of salt are increasing down the profile and are moderate by 40 cm and saline by 80 cm. Soil is slightly alkaline. **Management –** This soil has very marginal crop potential due to hard, coarse structured clays at below 30 cm depth. Topsoil stripping for rehabilitation should avoid contamination from saline clay subsoil and a recommended maximum of 30 cm is proposed for topsoil stripping. Overall, the soil is reasonable with the major restrictions being plant moisture availability due to saline and coarse subsoils and tendency to seal due to the proportion of fine sand and silt. The soil unit is not as susceptible to erosion as nearby duplex soils, however a predisposition for hard setting/surface sealing makes the media more suitable for level to near level slopes in future rehabilitation. The soil should not be stripped wet due to compaction potential.	**92 ha**

Soil Unit	Concept	Description	Area (ha)
B1	**Red/brown uniform clay and thin duplex undulating plains on weathered sandstone**	**General**- This soil covers a substantial proportion of the survey area and occupies undulating plains up to 5 % slope of mostly cleared Brigalow, Blackbutt and Bauhinia. The surface 20 – 25 cm is firm to hard setting and sandy and is often very gravely and cobbled. Below lays stiff medium sandy clays which are neutral and red to brown coloured. Sheet wash erosion is common place following clearing. Ironstone and silcrete gravels can be typically up to 10 -15% of surface cover. Deeper in the profile 70-150 cm, weathered sandstone parent material or gravels generally predominate. **Soil Chemistry** – Nitrogen levels are quite good but phosphorus is low. Cation exchange is adequate and this soil will respond well to superphosphate application for pasture establishment. Non saline to 20cm but saline by 50 cm. Mildly alkaline at surface, but increasing alkalinity with depth. **Management –** One probable limiting aspect of this soil is related to the proportion of fine sand and silt which predisposes the medium to sealing and compaction, thus inhibiting water movement and root development; as well as the sporadic presence of ironstone cobbles and gravels, exposed by sheet wash. Salinity and ESP may be problematic below 50 cm depth and topsoil stripping for rehabilitation should avoid contamination from this saline, very hard and coarse structured clay subsoil. A recommended maximum of 20 cm is proposed. Overall, the soil is reasonably fertile with the major restrictions being the physical makeup which predisposed poor drainage and high erosion rates. The soil should not be stripped wet due to compaction potential.	**1008 ha**
B2	**Red/brown deeper uniform clay undulating plains with significant linear gilgai**	**General -** These soils are restricted to the southern portion of the MEP and comprise undulating plains up to 5 % slope of mostly cleared Brigalow, Blackbutt, Bauhinia and Currant Bush. The soil has a firm to hard setting sandy surface to 25 cm, which is often very gravely and cobbled. Below the soil comprises stiff, medium sandy clay which is neutral and red to brown coloured. Weathered parent material or gravels generally predominate by 80 cm depth. Shallow parallel linear gilgai is present and appears to be reflective of weathering processes developed on the folded sequences of shallow underlying sedimentary rock. **Soil Chemistry -** The surface soil is reasonably fertile, non sodic or saline to 80 cm. Subsoil horizons are also non saline or sodic. Mildly alkaline at surface, but increasing alkalinity with depth. **Management –** As for soil unit B1. Unsuited for cropping due to hard, coarse structured clays below 30 cm depth. The depth of useable topsoil averages 20 cm.	**80 ha**
B3	**Gravely clay on ridgelines**	**General** -The soils are uniform non-cracking red brown clay and thin duplex with hardsetting sandy clay surface. They are shallow and overlay weathering soft sandstone parent material. Occasional weathering sandstones outcrop on ridgelines. Mostly cleared of Blackbutt, Brigalow and associated Poplar Box. Currant bush and Leichardt bean is common. **Soil Chemistry** - The soil is reasonably fertile, non-saline to 80 cm and non sodic throughout and non-dispersive. Soil is alkaline throughout. **Management** - Unsuited for cropping due to hard, coarse structured clays below 30 cm depth and restricted plant available water storage potential. The depth of useable topsoil averages 20 cm.	**27 ha**

Soil Unit	Concept	Description	Area (ha)
B4	**Deep uniform Brigalow grey/ brown clay on level plains**	**General** - This is the better soil unit of the local area which is a generally non-cracking uniform friable grey/brown to red brown light textured clay on level to undulating plains. Brigalow regrowth is generally in better condition than on other clay soil units, generally more moisture noted deeper into the profile. The surface is generally sandy clay with occasional sandstone rocks and gravels and includes areas of normal gilgai (up to 30 cm deep) which may crack. **Soil Chemistry** - Overall the soil has reasonable surface fertility. Phosphorus and nitrogen are low to just adequate and cation exchange capacity is high and reflected by very high calcium and magnesium. Organic matter levels are moderate in the surface. The profile becomes sodic and saline below about 50 cm and Ca:Mg ratios are good to 60 cm. Alkaline throughout. **Management –** Excellent grazing soil but very marginal cropping due to restricted effective soil depth of about 50 cm maximum. Restricted plant available water storage potential below 40 cm. The depth of useable topsoil may extend to 50 cm (Averages 40 cm).	**200 ha**
B5	**Melon holed Brigalow clay lowlands**	**General -** The significant Gilgai (melon-hole) development dominates the surface landscape to the extent that it is very irregular. Approx. 50% or more of land surface is heavily melon-holed (typically 40-100 cm deep) with massive hard yellow brown to brown cracking clays. Outcrops of sandstone occur, (some as vertical sandstone bands with quartz) as well as ironstone, silcrete gravels, cobbles and rocks. Some melon-holes are up to 1.5 m deep and 20 m across. This highly irregular landscape supported Brigalow before clearing. Post clearing, the land has been used for grazing. However because of the mounding and associated heaving of gravels and rocks as well as the frequently bare Gilgai bases, the suitability potential is somewhat restricted. **Soil Chemistry -** Chemically, the 'puff' of the melon-hole is very saline and sodic by 30 cm depth and increasing with depth. Moderate salt on the surface. The highly alkaline subsoil conditions may impede plant take-up of key metals. Apart from very low phosphorus, the surface horizon has reasonable fertility. Nitrogen levels are quite good as is cation exchange capacity. **Management –** Very little of this soil would offer value in rehabilitation due to a high probability of incorporation of saline/sodic/highly alkaline subsoil. The depth of useable topsoil is very restricted to 10 - 15 cm from mound areas only. The clays are very poorly structured and hard in the melon-holes and would set hard in rehabilitation. Useful grazing soil but not suitable for cropping due to severe physical aspects and restricted effective soil depth.	**141 ha**
E1	**Residuals (mesas)**	**General -** A number of remnants of the old Tertiary land surface remain in the form of elevated mesas. The land types in these areas varies from steep and very shallow skeletal loams in association with outcropping sandstone and silcrete rock on the margins to quite deep red gradational soils in localised areas of the larger remnant areas. Most soils in the MEP area are reddish brown skeletal and shallow duplex soils with a range of vegetation dominated by Acacia and Eucalypt species. The extent of proposed active mining disturbance does not extend to most significant mesa areas. So this unit only occupies a relatively small portion of the soilscape within the lease areas likely to be significantly disturbed. The inaccessible nature of the mesa terrain coupled with the rockiness makes the area poorly suited to grazing or any other agricultural purpose. No samples were taken for analysis for this reason. In the limited areas of deeper duplex soils on the mesa surface, analysis data for the E3 unit is considered applicable to these areas. **Soil Chemistry –** No analysis undertaken. **Management –** The restricted soil depth and extreme rockiness will basically prevent any significant recovery for rehabilitation purposes, except as a source of rocks and gravels for blending with overburden and soil to produce rock mulch for steep slopes.	**229 ha**

Soil Unit	Concept	Description	Area (ha)
E2	**Deeper sandy duplex Eucalypt plains**	**General** – This sandy soil unit includes extensive areas of both cleared and remnant poplar box vegetation and regrowth. The soil is typical of many Poplar Box regimes in Central Queensland. Poor drainage is indicated by the presence of a thick bleached A2 horizon and heavy subsoil mottling at some sites. Deeper sands occur to the north on the foot slopes of the nearby remnant mesa and the area supports quite good buffel pasture. The sandy surface layer can exploit short duration thunderstorm rain. Water tends to accumulate above the clay B horizon which causes the soils to become quite boggy and saturated after rain. Associated vegetation includes Narrow Leaf Ironbark and minor occurrences of Bauhinia, Blackbutt and small clumps of Brigalow. The soil can thicken considerably in localised areas where sand wash from mesa erosion has occurred for very long periods. **Soil Chemistry** - The 20 cm depth of the sandy surface has low overall fertility but tends to set hard although Ca: Mg suggests reasonable physical conditions. Cation levels are low as are nitrogen, phosphate and organic matter. Trace elements and organic matter are OK. Below the surface 20cm horizon sodium exchangeable percentage is in the dispersive category, however salt is low. The subsoil pH is slightly alkaline which is not limiting. The clay subsoil has indications of very coarse structure, mottling and tendency to form a dense cloddy medium. **Management** – Hard country with broad acre grazing potential but not suitable for any form of cropping. This soil is suitable for grazing at fairly broad stocking rates. The depth of useable topsoil is restricted to the A horizon which may run to almost a 100 cm deep in isolated areas. The average nominated useable depth is 20 cm. The subsoil is not considered suitable for use in rehabilitation.	**264 ha**
E3	**Moderately thin sandy duplex soils**	**General –** The soil unit is older alluvial plains and occurs in local proximity to New Chum Creek. It is a contrast texture soil with variable Poplar Box dominance in association with Brigalow and Bauhinia and intergrades into upland uniform non cracking Brigalow clay. The surface layer typically extends to 10 – 25 cm and is a sandy loam overlying medium sandy clay subsoils. Erosion of the surface has reduced thickness of the sandy A horizon in some areas bringing this soil closer to uniform clays such as B1 unit. The effective soil depth is considered better than most duplex soils in the area as the structure of the clay B horizon is reasonable allowing deeper root penetration. **Soil Chemistry –** Apart from low phosphorus the surface horizon has reasonable fertility and the major agricultural aspect limiting this soil is the proportion of fine sand which predisposes sealing. Nitrogen levels are usually good and cation exchange is adequate. There is no indication of a salinity or sodicity (dispersion) problem with levels of salt not increasing down the profile. Soil reaction is neutral, tending alkaline. Overall, the soil is reasonable with the major restrictions being a tendency to seal and set hard predisposing high erosion rates. **Management -** Quite good grazing potential but very marginal for cropping. The depth of useable topsoil varies with opportunity for deeper stripping with more intensive profile observations. A nominal strip depth of 25 cm is recommended. The soil may be stripped moist or dry and should not extend into any bleached layer (if present) and or hard pale, mottled clayey B horizon. If stripped, the soil will be useful on rehabilitation of level surfaces such as dump tops.	**189 ha**



Class_1	Soil_Type
	Disturbance
A1	Sandy alluvial duplex
A2	Active alluvial deep sandy duplex
B1	Red / brown shallow uniform clay undulating plains
B2	Red / brown shallow uniform clay undulating plains with significant linear gilgai
B3	Gravely clay on ridgelines
B4	Uniform Brigalow grey / brown clays
B5	Melon holed Brigalow clay lowlands
E1	Residuals (Mesas)
E2	Sandy duplex with Poplar Box and Ironbark
E3	Thin well structured duplex with Poplar Box and Brigalow

S:\Projects\PE001 Millennium Coal EIS_MapInfo\Workspaces\PE001_M204A.wor

MET SERVE

Peabody

LEGEND

- MEP tenement
- Principal road
- Road (sealed)
- Railway
- New Chum Creek

Data Source:
Imagery, Infrastructure, Tenement - Minserve. Topography (250k) - Geoscience Australia.
Soils - GT Environmental Services.

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Soil Mapping Units in the MEP Area

0 1 2

Kilometres

Scale: 1:50,000 (A4)

20/10/2010

Datum: GDA94
Projection: MGA55

FIGURE 7-1

7.3.2 Pre-Mine Land Suitability Assessment

The relative land suitability for beef cattle grazing as well as dry land cropping was investigated as part of the land suitability assessment. Numerous land suitability assessment methods are available for different applications. For the purpose of this report, two land suitability assessments were undertaken.

7.3.2.1 Mining Guideline

The first assessment methodology follows recommendations in the *Technical Guidelines for Environmental Management for Exploration and Mining in Queensland* (DME, 1995). The land suitability classification for a specified land use is given using the classes shown in **Table 7-5**.

Table 7-5 Land Suitability Classes

Class	Description
Class 1	High quality land with few or very minor limitations.
Class 2	Land with minor limitations.
Class 3	Moderate limitations to sustaining the use.
Class 4	Marginal land requiring major inputs to sustain the use.
Class 5	Unsuitable due to extreme limitations.

Source: DME, 1995

This land suitability classification method is based upon identifying the limiting factor(s) for each specified land use on the different soil types. The suitability class is then determined by the most severe limitation or combination of limiting factors.

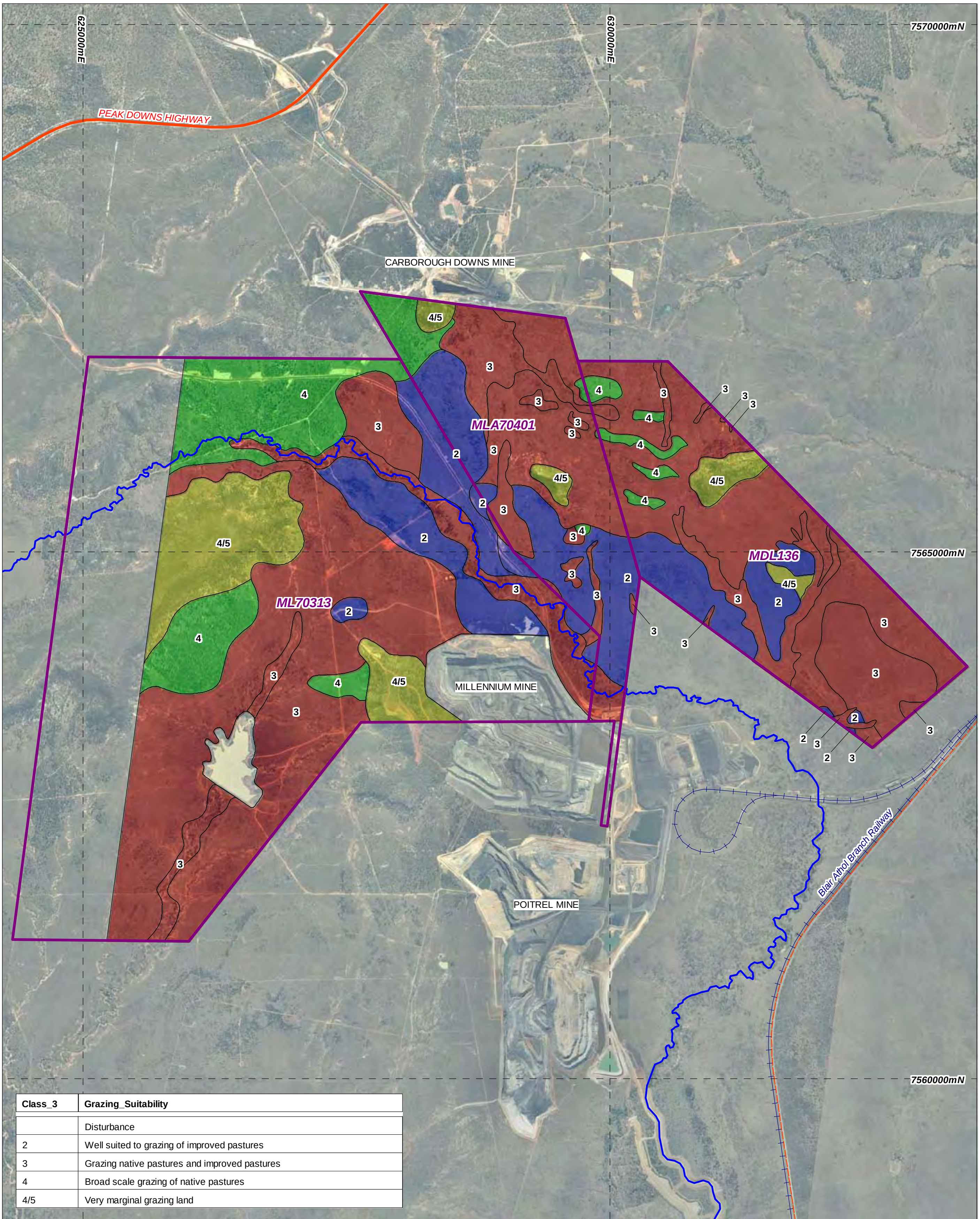
Grazing suitability on the MEP is limited by restricted soil water availability, erosion susceptibility and fertility. Much of the area is prone to erosion caused by overstocking, however land management practices in the MEP appear to have been sound and dense pasture cover on most soils was noted at the time of the soil survey (Tuck, 2009). Destocking has been actively encouraged since the start of operations at Millennium Mine which is likely to have contributed to the good pasture cover.

Cropping suitability has similar limitations as grazing i.e. restricted soil water availability, erosion susceptibility and fertility, and in addition none of the soils display the necessary surface mulching characteristics for cropping and all are relatively hard setting, with hard blocky clays mostly within 40 cm of the surface. Climatic conditions, namely unreliable and insufficient rainfall, are also a significant limitation to potential cropping.

Land suitability classes for grazing and cropping for each soil unit are detailed in **Table 7-6** and are shown in **Figure 7-2** and **Figure 7-3** respectively.

Table 7-6 MEP Land Suitability Classifications – Cropping and Grazing

Soil Unit	Soil Description	Land Suitability Class		GQAL Class	Preferred Use
		Grazing	Cropping		
A1	Active Alluvial Deep Sandy Duplex and Earths.	3	5	C1	Grazing native and improved pastures. Deeper sandy A horizon improves short-term water availability (e.g. storm rain is immediately available) but limits long-term storage.
A2	Alluvial – uniform Brigalow clay drainage lines.	3	5	C1	Grazing native pastures and improved pastures.
B1	Red/brown shallower uniform clay undulating plains on sandstone.	3	5	C1	Grazing native and improved pastures.
B2	Red/brown deeper uniform clay undulating plains with significant linear gilgai.	3	4/5	C1	Grazing native and improved pastures.
B3	Gravelly clay on ridgelines.	4	5	C2	Grazing native and improved pastures. Hard and sealing sandy surface restricts moisture. Soil depth is restricted.
B4	Uniform Brigalow grey /brown clays.	2	4	C1	Well suited to grazing of improved pastures if well managed to control erosion risk.
B5	Melon holed Brigalow clay lowlands.	3	5	C1	Broad scale grazing native and improved pastures. Regrowth and prolonged wetness can be a significant problem.
E1	Residuals (Mesas).	4/5	5	D	Very marginal grazing land.
E2	Sandy Duplex Of Poplar Box .	4	5	C2	Moisture storage is a problem however these soils can utilise short rainfall events as little moisture is tied up in the clay matrix.
E3	Thin well-structured duplex. Poplar Box/ Brigalow.	2	4/5	C1	Moisture storage is better due to good effective rooting depth. These soils can also utilise short rainfall events as little moisture is tied up in the clay matrix.



Class_3	Grazing_Suitability
	Disturbance
2	Well suited to grazing of improved pastures
3	Grazing native pastures and improved pastures
4	Broad scale grazing of native pastures
4/5	Very marginal grazing land

S:\Projects\PE001 Millennium Coal EIS_MapInfo\Workspaces\PE001_M205A.wor

MET SERVE

Peabody

LEGEND

- MEP Tenement
- Principal road
- Road (sealed)
- Railway
- New Chum Creek

Data Source:
Imagery, Infrastructure, Tenement - Minserve. Topography (250k) - Geoscience Australia.
Soils - GT Environmental Services.

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Overall Pre-Mining Grazing Land Suitability for the MEP Area

0 1 2

Kilometres

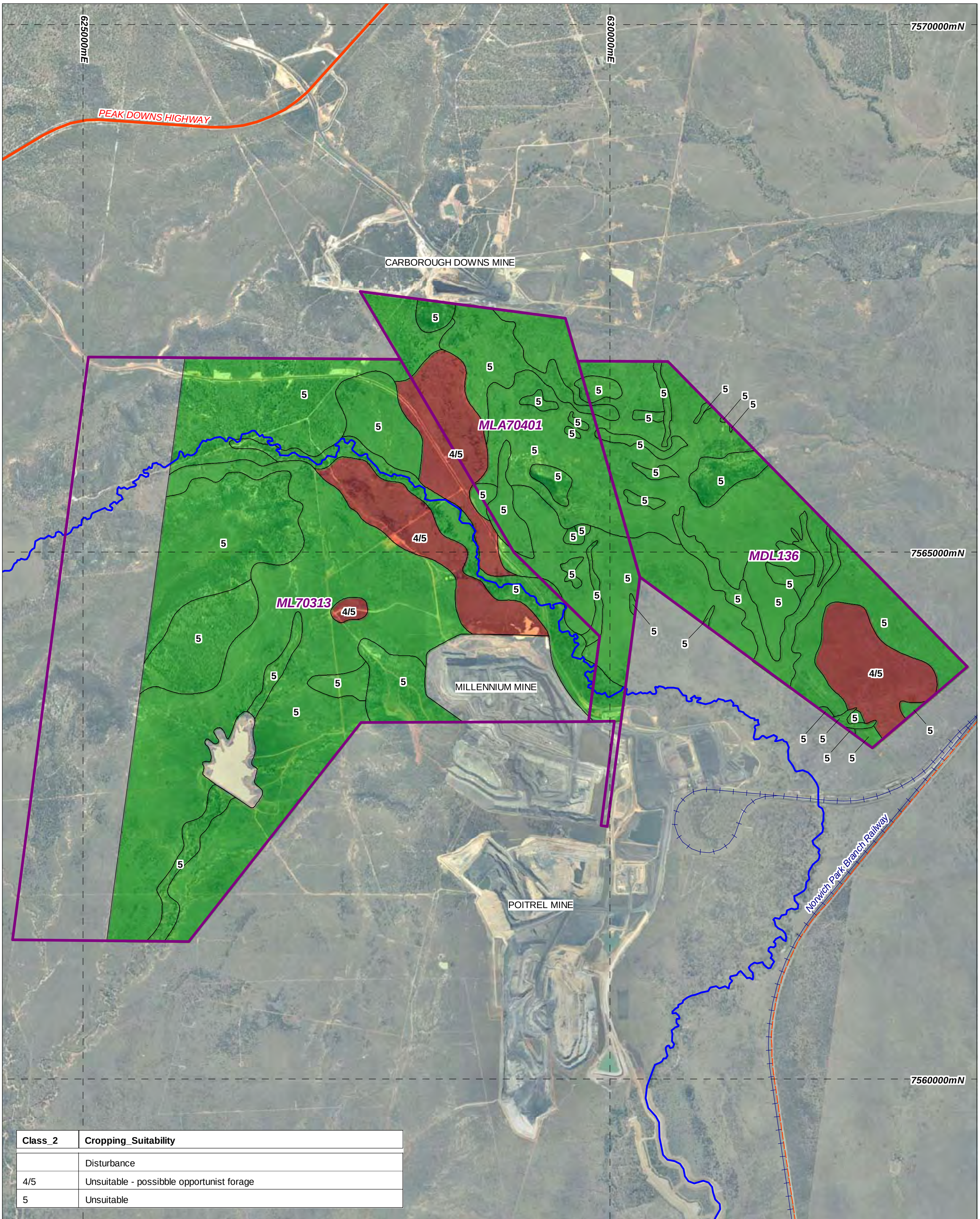
Scale: 1:50,000 (A4)

20/10/2010

N

Datum: GDA94
Projection: MGA55

FIGURE 7-2



Class_2	Cropping_Suitability
	Disturbance
4/5	Unsuitable - possibble opportunist forage
5	Unsuitable

S:\Projects\PE001 Millennium Coal EIS_MapInfo\Workspaces\PE001_M206A.wor

MET SERVE

Peabody

LEGEND

- MEP Tenement
- Principal road
- Road (sealed)
- Railway
- New Chum Creek

Data Source:
Imagery, Infrastructure, Tenement - Minserve. Topography (250k) - Geoscience Australia.
Soils - GT Environmental Services.

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Overall Pre-Mining Cropping Land Suitability for the MEP Area

0 1 2
Kilometres
Scale: 1:50,000 (A4)

20/10/2010

Datum: GDA94
Projection: MGA55

FIGURE 7-3

7.3.2.2 Planning Guideline

The second land suitability assessment methodology, regularly used for planning approval purposes, was introduced by the Department of Primary Industries and the Department of Housing, Local Government and Planning via their *Planning Guideline – The Identification of Good Quality Agricultural Land, Queensland* (1993) which directly relates to State Planning Policy 1/92 – *Development and the Conservation of Agricultural Land, Queensland.*

The Planning Guideline establishes four classes of agricultural land for Queensland:

- **Class A Crop Land** is suitable for current and potential crops but may include a range of low to moderate limitations to production;
- **Class B Limited Crop** is marginal for current and potential crops due to severe limitations; but is suitable for pastures. Engineering and/or agronomic improvements may be required before land is considered suitable for cropping;
- **Class C Pasture Land** is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment. C1 designates suitability for improved pastures. C2 designated land suitable for native pasture. C3 designates land suitable for limited grazing of native pastures; and
- **Class D Non Agricultural Land** is not suitable for agricultural use due to extreme limitations. This may be undisturbed land with significant habitat, conservation and/or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop or poor drainage.

The relevant section of the GQAL map provided by the Isaac Regional Council shows that the MEP falls mainly within the C1 category, with areas of lesser quality C2 and D to the western portion of the survey area.

There are no Class A or B lands in the MEP area, therefore no areas are considered suitable for cropping land. The findings of the survey by Tuck (2009) agreed with the Planning Guideline assessment. GQAL classes assigned for each soil type are shown in **Table 7-6** above.

State Planning Policy 1/92*: Development and Conservation of Agricultural Land* provides a framework for considering the value of GQAL in development assessment. The policy acknowledges that there will be developments that can legitimately impact GQAL because they represent an overriding benefit to the community; this is particularly applicable to the MEP where there is no suitable cropping land and variable quality areas of grazing land.

The MEP will provide the following community benefits:

- it allows for the utilisation of the coal resources of the State;
- it would provide substantial employment within the Isaac Regional Council for the next 16 years, and prevent the loss of the existing 220 jobs at the Millennium Mine;
- it would allow the continuation and expansion of a locally significant industry that provides substantial export income to the State;
- there is no alternative location on land of lesser agricultural quality, as the Project location is dictated by the location of coal reserves;
- much of the land would be returned to grazing after mining; and
- the land is typical of medium to poor quality grazing land in the region.

The existing GQAL classifications indicate that grazing (Class 3 land) is the only agricultural production land use for the MEP that is sustainable over the long-term. Given there is no Class 1 or Class 2 GQAL, the community benefits that will result from the MEP and that the rehabilitation plan is to return the majority of the MEP to grazing land at the end of mine life, any impacts to GQAL are assessed to be minimal and acceptable.

7.3.3 Land Contamination

A number of activities associated with the existing Millennium Mine and proposed MEP are classified as notifiable activities. Notifiable activities are listed in Schedule 3 of the *EP Act*. Under the *EP Act*, Peabody has a duty to notify DERM should potentially contaminating activities be carried out on site. Land that has been or is being used for notifiable activities is recorded on the Environmental Management Register (EMR), which is maintained by DERM.

The notifiable activities that are currently undertaken at the existing Millennium Mine, associated with mine waste and petroleum fuel storage, will also be undertaken within the MEP area.

7.3.3.1 Existing Land Contamination

A search was conducted on the Queensland EMR and the Contaminated Land Register (CLR) to determine if any lots that were covered by the expansion area (MLA 70401 and MDL 136) were registered. No sites on the properties relating to these areas are included on the EMR or the CLR. Refer to **Appendix F1 – Soils** for a copy of the searches.

The MEP site has been used for sheep and cattle grazing. Contamination may have occurred from the past use of agricultural chemicals such as dips, drenches and herbicides, however, no such facilities have been identified at the MEP. No evidence of any potentially contaminating activities was found during soil surveys. The built environment is limited to cattle fences, minor access tracks and small stock dams. No buildings, cattle yards, dips, old dump sites or illicit dumping were discovered during the soil survey. It is highly unlikely that the land has been contaminated by agricultural activities to any significant extent.

It was therefore concluded that no further evaluation or investigation into possible contaminated land as a result of past activities was required.

7.3.3.2 Potential for Contamination

The mine workshop and fuel storage areas are recognised as having the potential to generate contaminated land through hydrocarbon spills. The activities proposed at the MEP pose a limited risk of contamination for the following reasons:

- all chemicals and fuels will be appropriately stored in accordance with relevant Australian Standards; and
- existing facilities and procedures for the prevention of land contamination and management of wastes at the Millennium Mine will be utilised or expanded for the MEP.

7.4 OVERBURDEN AND COAL REJECTS CHARACTERISATION

The specific objectives of this assessment are to:

- determine the acid forming potential of the overburden and coal rejects, and evaluate the acid mine drainage, and salinity and sodicity risks associated with the expansion area;
- determine the chemical composition of the overburden and coal rejects in order to identify any toxic element concerns for revegetation; and
- identify the potential geochemical implications for overburden and coal reject disposal and mine operations and provide preliminary recommendation for environmental management.

This section provides the results and findings of the geochemical investigations carried out on mine rock and coal reject samples from the MEP along with potential environmental impacts. Preliminary recommendations for operational and long-term environmental management and for future geochemical investigation requirements are also provided.

7.4.1 Methodology

The laboratory program included the following tests and procedures:

- pH and EC determination (all samples);
- acid-base analysis (total %S, Acid Neutralising Capacity (ANC), Net Acid Producing Potential (NAPP)), (selected samples); and
- multi-element scans on solids and water extracts (selected samples).

7.4.1.1 pH and Salinity

pH and electrical conductivity will indicate the inherent acidity and salinity of the material when it is initially exposed. The general salinity ranking based on $EC_{1:2}$ is provided in **Table 7-7.**

Table 7-7 Salinity ranking based on EC1:2 measurements

$EC_{1:2}$ (dS/m)	Salinity
< 0.5	non-saline
0.5-1.5	slightly saline
1.5-2.5	moderately saline
> 2.5	highly saline

7.4.1.2 Acid-Base Accounting

The acid-base account evaluates the balance between acid generation processes (oxidation of sulphide minerals) and acid neutralising processes (dissolution of alkaline carbonates, displacement of exchangeable bases, and weathering of silicates). The values arising from the acid-base account are referred to as the maximum potential acidity (MPA), derived from total sulphur concentrations, and the ANC, respectively. The difference between the MPA and ANC value is referred to as the NAPP.

7.4.1.3 Metal Enrichment and Water Extract Analysis

Multi-element scans are carried out to identify any elements that are present in a material at concentrations that may be of environmental concern with respect to water quality and revegetation. The assay results from the solid samples are compared to the average crustal abundance for each element to provide a measure of the extent of element enrichment.

Water extract (1:5 w/v sample: water) tests were carried out in order to provide an indication of relative element solubility.

7.4.1.4 Sample Selection

The geochemical analysis of the overburden and coal rejects samples consisted of 163 samples from five drill holes (**Table 7-8**) representing the major lithologies of the stratigraphic sequence throughout the proposed pit area.

All 163 samples were analysed for saturated Paste pH, and electrical conductivity (EC). 38 samples from three drill holes (012-VA, MV001P, MV004P) were further analysed for total Sulphur (%S), ANC, Acid Producing Potential (APP), and water extract analysis. A further 18 samples from two drill holes were analysed for pyritic, sulphate sulphur, and multi element analysis.

Table 7-8 Drill hole details

Drill hole	Date Dilled	Easting (AGD84)	Northing (AGD84)	RL (mAHD)	Bore Depth (m)
012-VA	7/04/2009	631452	7563928	234	30
017-LD	10/04/2009	631413	7564436	246	30
028-VB	9/04/2009	631413	7564436	246	42
MV001P	1/05/2009	631301	7564683	250	114
MV004P	29/04/2009	632074	7563591	250	120

Sample selection was based on lithology and the spatial distribution of the drill-holes. **Table 7-9** presents a breakdown of the lithologies sampled and the number of samples collected for each lithology. Samples were collected from the selected core intervals and crushed to minus 4 mm and a 200 g split was then pulverised to minus 75 µm prior to testing. Sample preparation was carried out by SGS. The pH and EC determinations were performed on the crushed sample and all other analyses were performed on the pulverised portions.

Table 7-9 Number of Overburden Samples Collected for Major Lithologies of the MEP Stratigraphic Sequence

Lithology	Number of samples
Sandstone	36
Mudstone	31
Carbonaceous Mudstone	42
Coal	37
Claystone	7
Clay	5
Soil	5
Total	**163**

7.4.2 Geochemical Results

7.4.2.1 pH and Salinity

All overburden samples were analysed for pH and salinity (EC) using both a 1:5 soil: water mix and an aged paste (1:2 soil: water).

The pH of all samples from the five holes analysed fall within the range 7.5-9.9. These samples are slightly to moderately alkaline and are within the general range of Australian soils (3-10 pH units) and in the upper range of Australian agricultural soils (4.5-9 pH units).

The salinity of the samples tested ranged between 130 and 850 µS/cm for $EC_{1:5}$ Soil water extract. This range of soil salinity is low to moderate and, in conjunction with the pH results above, will not be a limiting factor to the use of this material in final landform development.

7.4.2.2 Acid Forming Characteristics

The oxidation of sulphidic material to produce sulphuric acid is a natural process resulting from the exposure of minerals such as pyrite to atmospheric conditions (Environment Australia, 1997), and is calculated as the acid producing potential in kg H_2SO_4/t.

Carbonate minerals have the ability to neutralise acid, which is calculated as the acid neutralising capacity in kg H_2SO_4/t.

The net acid producing potential (NAPP), is the difference between the acid producing potential and the acid neutralising capacity of a material. NAPP gives an indication of a materials potential to generate acid. A positive result shows acid generation potential and a negative result indicates that the material is non-acid producing (Department of Mines and Energy, 1995).

Net acid generation (NAG) differs from the acid producing potential in that it measures the actual acid production and neutralisation of material, as opposed to the total theoretical potential.

The acid forming characteristics of six samples were assessed. Of these, four were of interburden materials (holes MV001P and MV004P) and two were samples of overburden (hole 012-VA). Guidelines are shown in **Table 7-10** and the sample analysis are shown in **Table 7-11**.

Table 7-10 Typical Geochemical Classification Criteria Based on NAPP and NAG Test Data[1]

Primary Geochemical Material Type	NAPP (kg H2SO4/t)	NAG pH
Potentially Acid Forming (PAF).	> 10	< 4.5
Potentially Acid Forming-Low Capacity (PAF-LC).	0-10	< 4.5
Non Acid Forming (NAF).	Negative	4.5
Acid Consuming (ACM).	less than -100	4.5

[1] LEADING PRACTICE SUSTAINABLE DEVELOPMENT PROGRAM FOR THE MINING INDUSTRY. Australian Department of Communications, February 2007.

Table 7-11 Acid Potential Results – MEP Overburden Samples

Reference	Units	PQL	Method	CE63702	CE63702	CE63595	CE63595	CE63701	CE63701
Description				**MLE 2195 - Mavis Downs MV001P**	**MLE 2195 - Mavis Downs MV001P**	**MLE 2181 - Mavis Downs**	**MLE 2181 - Mavis Downs**	**MLE 2195 - Mavis Downs MV004P**	**MLE 2195 - Mavis Downs MV004P**
Sample Description				**MV001P E21**	**MV001P E41**	**Drill Hole 012-VA E8**	**Drill Hole 012-VA E9**	**MV004P E21**	**MV004P E41**
Sample No.				21	41	8	9	21	41
Replicate				1	1	0	0	1	1
Type of Sample				Chip	Chip	Soil	Soil	Chip	Chip
Date Extracted						11/05/2009	11/05/2009	29/04/2009	29/04/2009
Date Analysed						20/05/2009	20/05/2009		
pH (Paste)	pH Units	<0.1	AN212 CEI-400	[NT]	[NT]	8.4	8.4	[NT]	[NT]
Aged EC (1:2)	µS/cm	<5	AN106	[NT]	[NT]	1700	1000	[NT]	[NT]
pH (1:5)	pH Units	<0.1	AN101	9.3	[NT]	[NT]	[NT]	8.2	9.7
Electrical Conductivity (1:5)	µS/cm	<5	AN106	280	[NT]	[NT]	[NT]	330	260
Total Sulfur	% w/w	<0.005	ASSMAC_20A	0.018	0.044	0.01	0.014	0.36	0.043
S_{HCl}	% w/w	<0.005	ASSMAC_20B	<0.005	<0.005	<0.005	<0.005	0.017	<0.005
Total Oxidisable Sulfur, TOS	% w/w	<0.005	Calculation	0.014	0.043	0.006	0.01	0.35	0.039
Acid Neutralisation Capacity (ANC_{BT})	% $CaCO_3$	<0.1	ASSMAC_19A1 /AN214	0.9	6.3	6.2	19	0.6	2.3
Acid Neutralisation Capacity	kgH_2SO_4 /t	<0.5	ASSMAC_19A1 /AN214	9.2	62	61	190	5.5	23
NAGP	kg H_2SO_4/t	<0.5	AN215 CEI-043	<0.5	1.3	<0.5	<0.5	11	1.2
NAGP (inc ANC)	kg H_2SO_4/t		Calculation	-9	-60	-60	-2.00E+02	5.1	-20
pH_{ox}	pH Units	<0.1	AN212 CEI-400	[NT]	[NT]	8.3	8.5	[NT]	[NT]
Net Acid Generation pH7	kg H_2SO_4/t	<0.5	AN212 CEI-400	[NT]	[NT]	<0.5	<0.5	[NT]	[NT]

As shown in **Table 7-11** above, of the six samples tested as part of the investigation for the MEP, five had negative NAPP (calculated NAGP including ANC) and therefore are non-acid forming. The two overburden samples from hole 012-VA also have a pH(ox) greater than 8 and are confirmed as non-acid forming.

The analysis of interburden sample (MV004P E21) shows a low acid producing potential; however this sample is a coal sample and, depending on coal quality, would not be expected to form a major component of waste rock.

7.4.2.3 Metal Enrichment and Solubility

Heavy metal content in the overburden samples were assessed against environmental and health based investigation levels established by the *National Environmental Protection (Assessment of Site Contamination) Measure 1999* (National Environment Protection Council, 1999). Heavy metals analysed include arsenic, cadmium, copper, chromium, lead, nickel and zinc.

The overburden samples were assessed against the environmental investigation levels and health-based investigation levels to provide an indication of the potential for overburden dumps to be a source of heavy metal contaminated leachate, based on the concentrations in the in-situ overburden material.

As shown in **Table 7-12**, the concentrations of all heavy metals within the overburden tested were below the investigation level concentrations. The solubility of most heavy metals could increase with elevated acidity, however the overburden is not anticipated to generate significant acid mine drainage. The above two findings indicate the stockpiling of overburden is unlikely to be a source of heavy metal contamination.

Table 7-12 Heavy metal concentrations in overburden samples

Metal	Environmental investigation level (mg/kg)	Health based investigation level (mg/kg)	Concentration range in analysed overburden samples (mg/kg)	Samples exceeding environmental and health investigation levels*
Arsenic	20	100	<0.5–20	None
Cadmium	3	20	<0.1-0.3	None
Copper	100	1000	2–59	None
Chromium	1	100	<0.5–0.95	None
Lead	600	300	2.7–37	None
Nickel	60	600	2.2–31	None

* Based on 'Standard' residential use as defined in Department of the Environment (1998).

The above data combined with the alkalinity of the overburden samples also suggests that there is little risk of significant metal enrichment and environmental mobility of key metals.

7.5 VISUAL AMENITY

This section provides an assessment of the visual quality and character of land surrounding the MEP area, and any potential impact on the visual quality and character as a result of the Project. Visual amenity at the existing Millennium Mine is not specifically included in this assessment; however the final views provided do include combined landforms from the existing Millennium Mine and the MEP.

This section addresses the methodology used, the existing landscape and visual characteristics, potential effects and impact generators, and provides an assessment of the visual impact both during the life of the MEP and from a residual perspective.

The environmental value to be maintained is the existing landscape character and visual amenity.

7.5.1 Legislation/Guidelines

Due to the absence of Queensland or Australian guidelines for assessing landscape and visual impact for mining or similar developments, the United Kingdom's Landscape Institute - *Institute of Environmental Management and Assessment Guidelines* were used. It is recognized that not all elements of the guidelines were relevant to Australia and/or mining projects, but the standard approach and identified landscape and visual amenity criteria were both relevant and applicable. By using their assessment/classification tables, the following conclusions have been drawn as to the visual impacts from open-cut coal mining activities.

Town Planning personnel from the Isaac Regional Council (IRC) were consulted to identify if any specific scenic amenity guidelines or published documents were available for the local region, however none existed. IRC indicated the previous Nebo Shire Council (now amalgamated into IRC) planning documents would contain any relevant information for visual assessment considerations for local development approvals.

It is acknowledged that, despite utilising an approach developed to minimise the subjective nature of visual impact assessments, some subjectivity is inherent and unavoidable in the visual impact assessment process.

7.5.2 Methodology

7.5.2.1 Desktop Study and Field Observations

A desktop study was conducted initially and involved an analysis of topographic maps and aerial imagery for the entire MEP and immediate surrounding area. The location of known surrounding homesteads were included on an aerial photograph with topographic contours so that high and low points could be noted and potential viewpoints marked on a plan.

Viewpoints that were identified from the desktop analysis were visited on 25th May 2009 and assessed for sensitivity to the proposed development. The weather conditions were favourable for conducting the assessment, characterised by sunshine with very little to no cloud.

Photographs were taken from a number of viewpoints using both compact and SLR digital cameras.

7.5.2.2 Local Council Designations

IRC advised that the area of the MEP, and the broader surrounding area, does not form part of any statutory landscape designation.

The MEP is located wholly within the boundary of the previous Nebo Shire Council, so the Nebo Shire planning document was referenced. Under that plan the MEP area is classified as Rural land, which includes the specific provision for mining operations.

Lake Elphinstone and Mt Britton are the only rural locations in Nebo Shire mentioned as having visual amenity significance. They are both distant from the MEP and will not be impacted by this Project.

7.5.2.3 Development of Photographic Montages with Predicted Mine Contours

Photographs from existing viewpoints were taken in the field, recording elevation, GPS position and the bearing in degrees of the photograph taken. Meanwhile a 3-D model of the mine plan was developed in a Geographic Information System (GIS) software package. The information recorded at the time the viewpoint photograph was imported with the photographic image into the 3-D model of mine contours, to provide a visualization of predicted mine impacts on visual amenity from the actual viewpoint in the field. These montages give a visual representation of actual impacts from the Project and are presented later in the assessment.

7.5.2.4 Landscape and Visual Impact Assessment

The term 'landscape assessment' describes the existing character and quality of the landscape of the surrounding area, whereas the term 'visual assessment' relates to the changes that arise in the composition of the available views as a result of changes to the landscape, to peoples' responses to the changes, and to the overall effects with respect to visual amenity or aesthetic condition. For the purposes of the landscape and visual assessment, visual amenity is assessed for areas both within and peripheral to the MEP.

The characterisation of the Project, including the proposed waste rock emplacements and associated surroundings, has been based on an assessment of natural, cultural, social, aesthetic and perceptual factors as they exist today compared to the predicted landscape character following the completion of proposed mining and post-mining rehabilitation activities.

This landscape and visual assessment involved an assessment of landscape and new infrastructure features that are not part of any previous mine development approval.

7.5.3 Landscape Assessment

7.5.3.1 Existing Land Use

The MEP is bounded to the north and south by other mining operations and to the east and west by grazing land. Grazing also occurs on non-operational areas of the existing Millennium Mine lease. The Peak Downs Highway runs to the north of the project with the Millennium/Poitrel Access Road entering the MEP on ML 70313.

The region contains rich thermal and metallurgical coal resources, with a number of open-cut and underground mining ventures being located within a distance of 20 km, including the Isaac Plains, Carborough Downs and Poitrel mines, and the recently approved Daunia mine.

Millennium Mine shares a northern boundary with the Carborough Downs underground mine, and a southern boundary with the Poitrel and Daunia open-cut mines.

7.5.3.2 Natural Factors

The MEP comprises undulating rural land with isolated rocky knolls. Irregular-shaped low mesa-like features are found in the eastern and southern portions of the MEP, with a more significant mesa/ridgeline to the west of the MEP. Elevation of the mesas in this area ranges up to 320 m AHD.

The MEP drains to the south-east and is dissected by New Chum Creek running from north-west to south-east through the lease and into the Isaac River.

The site has been extensively cleared for cattle grazing but also retains areas of remnant native vegetation, particularly riparian vegetation along creeks.

7.5.3.3 Social and Cultural Factors

As discussed previously, the MEP and surrounding area comprises land used for cattle grazing with a number of mines co-existing to the north, south, and south-east. The Moranbah area supports numerous mines and their associated infrastructure which are often located near roads in visible areas.

There is little residential development in the region apart from immediate town centres, with only isolated homesteads located within the area surrounding the MEP, specifically the Annandale and Moorvale homesteads to the north-east of the MEP, the Wotonga homestead to the west and the Mavis Downs homestead to the east as shown in **Figure 7-4**. Homesteads to the south and south-east have the Daunia and Poitrel mines at closer distances than the MEP.

No public complaints have been registered about the existing Millennium Mine in regard to visual amenity and no significant increase to visual amenity impacts are expected from the MEP.

Cultural heritage associated with European exploration and establishment of homesteads in the region is discussed in **Chapter 14 – Cultural Heritage**.

The existing social environmental and associated social impact assessment is included in **Chapter 15 - Social**.

7.5.3.4 Landscape Sensitivity

Landscape sensitivity is categorised as high, medium, low or negligible according to the degree to which a particular landscape or area can accommodate change arising from a particular development without detrimental effects on its character. The classification of sensitivity is based on:

- the existing land use;
- the pattern and scale of the landscape;
- visual enclosure/openness of the views and the distribution of visual receptors;
- scope for mitigation measures which would be in character with the existing landscape; and
- the value placed on the landscape.

The landscape within the vicinity of the MEP is considered to have a low sensitivity to landscape changes arising from the MEP, given that it primarily supports rural and mining activities, including the relevant mining infrastructure for the MEP e.g. CHPP, train load-out, offices and workshops, that are already in place at the existing Millennium Mine.

7.5.4 Visual Assessment

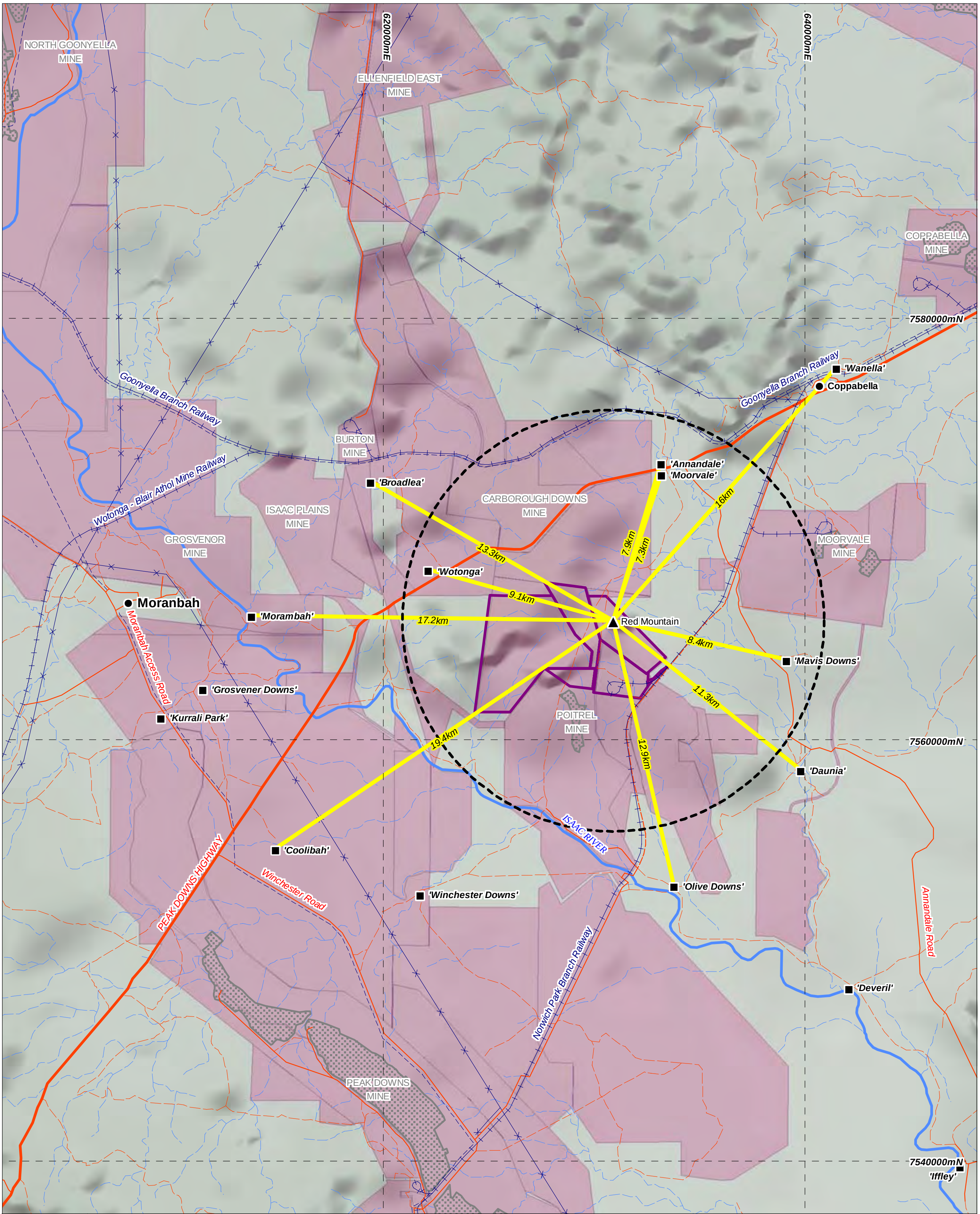
7.5.4.1 Existing Visual Elements

Given that the MEP operations will utilise the existing CHPP and other infrastructure, the main features of the Project activities that may impact on current visual amenity are out-of-pit and in-pit waste rock emplacements for the Mavis and Millennium pits, with an average final height of 40m (maximum 50m) above the existing landscape surface. Mine design for the MEP highlights the extension of the existing Millennium pit and expansion into the separate Mavis pit to the north-east. Mining of the Millennium pit will continue towards the north-west, whereas mining for the Mavis pit will begin in the northern portion of ML70401 and progress to the south-east.

The MEP will require some initial out-of-pit waste rock emplacements and additional internal access/haul roads, however all other required mining infrastructure is already in place for the Millennium Mine. The out-of-pit and in-pit waste rock emplacements are likely to be the most visible infrastructure associated with the MEP. Waste rock emplacements for the Mavis pit will be constructed sequentially from north to south as the open pit is developed throughout the mine life.

The visibility of these MEP activities would, however, be generally restricted due to:

- the generally low lying nature of the MEP landscapes/infrastructure within the overall landscape and their distance from publicly accessible vantage points;
- existing natural mesa landforms which the proposed waste rock dumps simulate;
- the escarpment immediately west of the MEP which provides screening from vantage points to the west of the Project; and
- existing vegetation, which provides partial to full screening for much of the mining impacts, particularly along many roadside vantage points.



S:\Projects\PE001 Millennium Coal EIS_MapInfo\Workspaces\PE001_M207A.wor

MET SERVE

Peabody

LEGEND

- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- Powerline
- Pipeline
- River
- Watercourse
- Town
- Homestead
- Peabody tenement
- Other ML & MDL tenement
- Existing mine
- 10km radius from Red Mountain

Data Source:
Peabody tenement - Minserve. Other tenement - EEDI.
Topography (250k) - Geoscience Australia.

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Location of Homesteads near the MEP

0 5 10

Kilometres

Scale: 1:250,000 (A4)

12/10/2010

N

Datum: GDA94
Projection: MGA55

FIGURE 7-4

7.5.4.2 Viewpoint Sensitivity

Viewpoint sensitivity is determined by a number of factors including:

- viewing distance;
- viewing frequency;
- viewpoint importance;
- viewing duration; and
- viewing angle and focus.

In general, sensitivity increases with frequency, importance, duration, angle and focus of the view, but decreases with distance.

Using the factors above, the most sensitive viewpoints were identified as surrounding homesteads. Additionally, viewpoints deemed of cultural significance are those that are included in guidebooks and tourist maps. In the desktop search conducted for the broader area surrounding the MEP, Federation Walk and Grosvenor Park were identified as potential viewpoints of cultural significance for tourism and local amenity. Federation Walk and Grosvenor Park are located on the eastern side just before entering the township of Moranbah along the Moranbah Access Road. Grosvenor Park is a picnic spot located on Grosvenor Creek.

Surrounding homesteads and culturally significant viewpoints have been assessed as Principal Viewpoints. The main public viewpoint in the area is the Peak Downs Highway. As the Peak Downs Highway is classified as a transport route, views would be transitory and as a viewpoint would be classified as less sensitive. These are assessed as Secondary Viewpoints.

Principal Viewpoints

Residential properties are considered as potentially sensitive to visual impacts where the residents are exposed on a regular and/or prolonged basis. The locations of the four closest residential properties are illustrated on **Figure 7-4**.

Plates 7-1 to **Plate 7-7** present a series of photographs from surrounding homesteads looking back towards the existing Millennium Mine.

Plate 7-1 Existing view from the Annandale Homestead towards the MEP

Plate 7-2 Existing view from the Moorvale Property towards the MEP

Plate 7-3 Existing view from the Wotonga Homestead towards the MEP

Plate 7-4 Existing view from the Olive Downs Homestead

Plate 7-5 Existing view from the Daunia Homestead towards the MEP

Plate 7-6 Existing view from the Mavis Downs Homestead

Plate 7-7 Existing view from the Winchester Homestead

As can be seen from these photographs of the existing views, no evidence of the existing Millennium Mine is currently impacting on the visual amenity of these properties. An assessment of the visual impacts on these properties identified that the MEP generally will not be seen from the homestead vantage points due to the nature of the topography and intervening vegetation. However, there will be locations within some of the properties where MEP infrastructure will be visible.

It is not expected that users of the Federation Walk and the Grosvenor Park picnic spot, near the township of Moranbah, will be visually impacted by the MEP given the escarpment that runs on the western side of the Project, effectively blocking any visual impacts towards Moranbah.

Secondary Viewpoints

Based on the desktop assessment of the topographic map for the area, it was considered likely that a number of secondary viewpoints would occur along the Peak Downs Highway. Subsequent field inspections demonstrated it was generally difficult to obtain views of the potential MEP area other than isolated and fleeting glimpses of the proposed infrastructure areas from the Peak Downs Highway due to the screening provided by roadside vegetation and the presence of undulating intervening terrain in the line of sight.

7.6 POTENTIAL IMPACTS AND MITIGATION MEASURES

7.6.1 Resource Utilisation

The Project will not impact on other coal or mineral resources in the region. Coal seam gas has previously been extracted from the Millennium Mine area but that operation has currently ceased. If any future coal seam gas extraction is required, Peabody will negotiate and enter into an appropriate agreement with the holder of the relevant petroleum leases. The Project will be developed to minimise resource wastage and sterilisation by using efficient mine planning.

7.6.2 Post Mine Land Suitability

Factors influencing changes in land suitability include changed physical, chemical and biological properties of soil, changes in slope and slope length and soil depth. The suitability of waste rock dumps for grazing is constrained by slope angle, the nature of soil cover, and altered soil moisture profile.

7.6.2.1 Rainfed Cropping

As mentioned in **Section 7.3.2** above, no areas considered suitable for rainfed cropping were identified in the survey area prior to mining. From previous knowledge and experience within the Bowen Basin coal industry it is not envisaged that this would be an appropriate or possible post-mining land use.

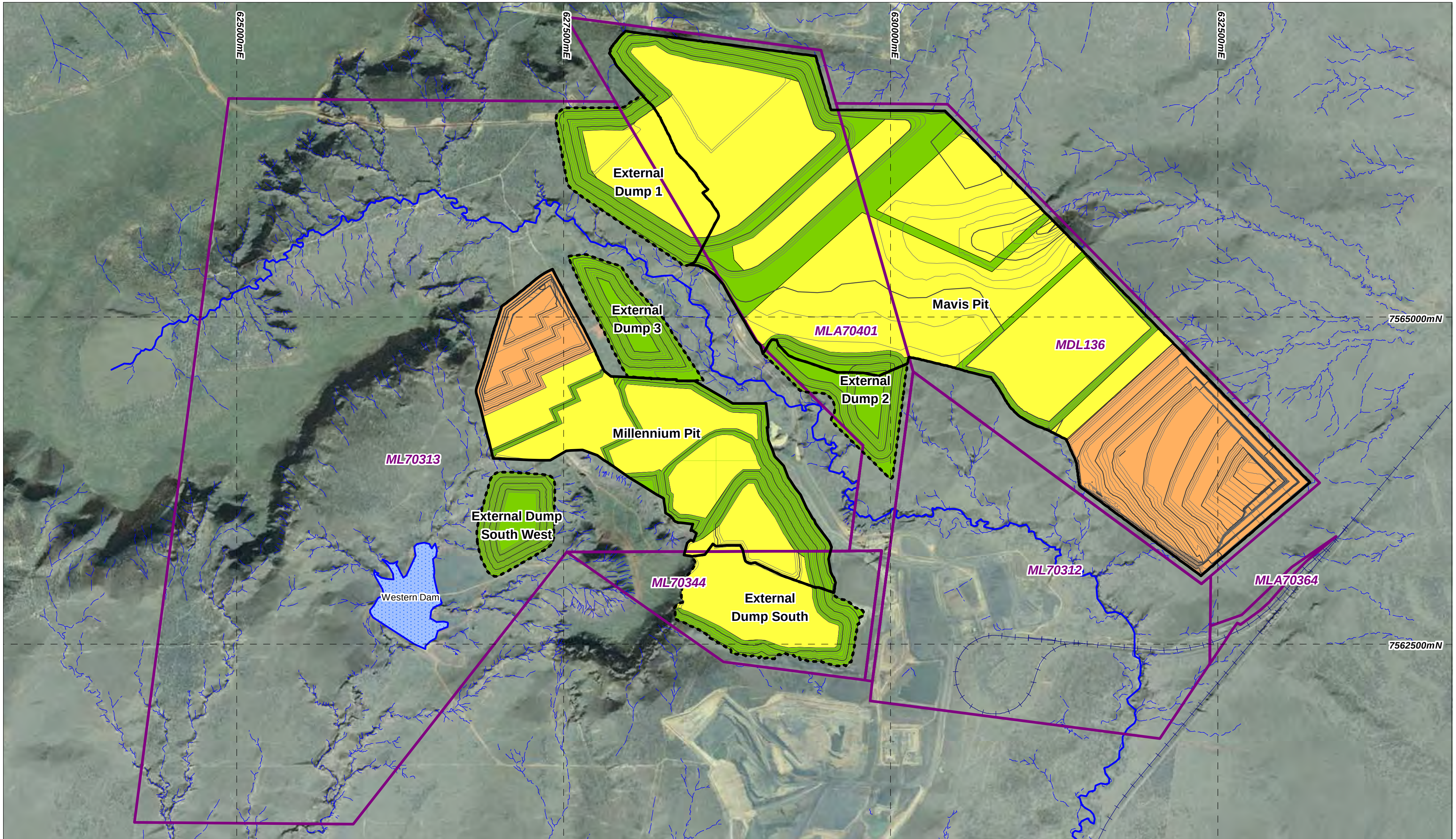
7.6.2.2 Cattle Grazing

The major limitation to cattle grazing the land post-mining is based on slope. Slopes < 11% in the Bowen Basin are considered realistic grazing lands, constituting Class 3-4 grazing land, with erosion susceptibility being the major limiting factor governing the class. Grazed slopes above 11-13% in the Bowen Basin are highly prone to degradation from erosion if not managed appropriately.

Assuming these guidelines are applied to the MEP, steeply sloping areas such as the slopes of final waste rock dumps, ramps and the final void are unlikely to sustain grazing.

The final area of post mining land use proposed for grazing in shown in **Figure 7-5**, while the change in area of grazing land suitability is predicted in **Table 7-13**.

S:\Projects\PE001 Millennium Coal EIS_MapInfo\Workspaces\PE001_M208A.wor



MET SERVE

Peabody

0 800
Metres
Scale: 1:40,000 (A4)

LEGEND

- Peabody tenement
- Railway
- New Chum Creek
- Watercourse
- 2027 pit footprint
- 2027 dump footprint
- Major contour (20m)
- Minor contour (5m)

Final Landuse

- Native bushland
- Cattle grazing
- Final mining void

Data Source: Infrastructure, Tenement, Topography - Minserve.

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Final Landuse - End of Mining 2027

20/10/2010

Datum: GDA94
Projection: MGA54

FIGURE 7-5

Table 7-13 Change in Land Suitability for Grazing - MEP

Land Suitability Class	Area within MEP (ha)	
	Pre-mining	Post-Mining
1	0	0
2	388.3	105.3
3	1424.5	562.5
4	289.8	920.3
5	228.6	743.1
Total	**2331.2**	**2331.2**

7.6.3 Subsidence

As the MEP will be an open-cut operation, subsidence will not be an issue requiring management.

7.6.4 Land Disturbance

By the manner of its operation, open-cut mining causes significant land disturbance. The MEP will mine through approximately 987 ha of land at a maximum depth of 190 m. Waste rock will be placed over an additional 231 ha to a maximum height of 50 m. A final void with an area of 166 ha and a volume of 135 million m^3 will be left at the end of mine life. These impacts are typical of open-cut mining methods currently used in the Bowen Basin. However, there are also significant mitigation and management measures that are put in place progressively, throughout the life of the mine to minimise both the degree and the extent of these impacts.

Chapter 5 – Rehabilitation and Decommissioning details the progressive and final rehabilitation plans and ultimate success criteria for the MEP. As a minimum, all areas significantly disturbed by mining activities would be rehabilitated to a stable landform with a self-sustaining vegetation cover. Progressive rehabilitation would commence within two years of when areas become available. Land would be regarded as successfully rehabilitated when nominated targets for land suitability, land use, landform stability, and land contamination have been met. The disturbance and handling of soils, landform recreation and stabilisation would be guided by the following principles:

- all topsoil and soil forming materials would be stockpiled in a manner which retains soil qualities;
- re-use of all soil-forming materials would occur progressively;
- limit soil stripping to the minimum area required for operational purposes at any one time;
- achieve physically and chemically stable landforms;
- achieve appropriate landform profiles, revegetation and surface water management to minimise erosion and sedimentation; and
- revegetate new landforms with selected plant species, appropriate for achieving a physically stable landform.

Potential impacts and mitigation measures for changes to topography or surface water drainage channels that will remain at the end of mine life are detailed in **Chapter 10 – Water Resources**.

7.6.6 Topsoil Management

7.6.6.1 Topsoil Stripping

Topsoil resources directly impacted from mining activities would be stripped ahead of mining for reuse in the rehabilitation program. To maintain the integrity of vegetation in areas adjacent to disturbed areas, appropriate erosion, sediment and dust controls would be established prior to and during soil disturbance.

Prior to stripping the soil, regrowth vegetation on areas to be disturbed would be cleared and windrowed. The windrowed material may be burnt on-site, chipped or retained for fauna habitat.

Specific recommendations for topsoil stripping for each soil description are summarised in **Table 7-14.** Based on this, the total volume of topsoil available from the MEP area is estimated to be in the order of 3,900,000 m^3 however as the entire MEP area will not be disturbed; only around 1,100,000 m^3 will need to be collected in advance of mining operations.

7.6.6.2 Handling and Storage of Topsoil

Designated topsoil stockpiling areas will be suitably prepared to ensure that surface runoff from up slope does not result in topsoil losses. Where possible, topsoil stockpiles will be constructed with dozers in a manner that will minimise compaction and create a rough surface to reduce erosion and maximise storage of rainfall.

Stockpile heights will be kept to a minimum and, depending on soil structure as per **Table 7-14**, will be no greater than 5 m. Where natural re-establishment does not take place within six months, stockpiles will have weed controls undertaken as required and be sown with grasses.

Topsoil stockpiling heights and storage time would be minimised as deterioration of soil chemical, physical and biological properties can occur during storage. Since the recommended stripping depth for most soils is between 20 - 40 cm, topsoil and subsoil would not generally need to be stripped and stockpiled separately.

However, if soil units A1, B2 and B4 are stripped to 50 cm and a definite distinction between topsoil and subsoil is apparent, the topsoil and subsoil will be stripped and stockpiled separately.

When re-using the stockpiled topsoil for rehabilitation purposes, the basic principle in determining the useable depths of topsoil for rehabilitation is its quality in comparison to the waste rock requiring rehabilitation.

As a guide, soils used in rehabilitation at the MEP would be applied to a depth of no less than 200 mm. This provides sufficient depth for ripping either during seeding or should follow-up maintenance work be required. In addition, waste rock can be expected to improve with years of exposure, leaching and plant colonisation and in some cases may provide better coverage than poor topsoil after an appropriate time-span.

Table 7-14 Soil Stripping Depth Guidelines - MEP

Soil Type	Recommended Stripping depth (cm)	Stockpile Recommendation	Comments
A1	30 cm. Possible 50 cm in ideal areas.	**Max 5 m height.** Scraper dumps ok.	Generally lighter textured (i.e., sandier) and higher fertility, although they may be quite variable and are generally prone to hard setting. Stripping depth is variable but most of this unit can be conservatively stripped to 30 cm and deeper if no hard or clay layer is encountered. Salinity is not of concern. These soils are not suited to application on sloping sites due to erosion potential. However these soils readily germinate and support both grasses and native trees.
A2	30 cm. Possible 50 cm in ideal areas.	**Max 3 m height.** Preferable truck dumping in 'free' configuration. Avoid scraper dumps due to compaction.	Deeper more clayey alluvia available in limited quantities in Brigalow drainage lines. This soil covers a relatively minor area and occupies some small clay drainage lines leading towards New Chum Creek. Soils are suitable for sloping rehabilitation.
B1	20 cm. No deeper.		Suitable for rehabilitation for modest slopes but with limitations due to the firm to hard setting nature as a result of the fine sandy clay texture. In addition, they are often very gravelly and cobbled at surface. The stiff subsoil clays are usually saline, dispersive and sodic and it is important that stripping depths not go too deep.
B2	20 cm. No deeper.		A firm to hard setting sandy surface, often very gravely and cobbled at surface, overlies stiff medium sandy clays which are neutral and red to brown coloured. Useful on level to gently sloping sites – avoid steeper slopes due to hard setting disposition.
B3	20 cm. No deeper.		Relic ridgelines and scree slopes associated with residual mesas. Uniform non-cracking red brown clay and thin duplex with hardsetting sandy clay surface overlaying shallow light sandy clays and weathering soft sandstones parent material. As with B2 useful for flatter rehabilitation sites.
B4	40 cm Possible 50 cm in ideal areas.		The most preferred soil in the survey area for rehabilitation use and has better application on sloping rehabilitation than all other soils in the MEP.
B5	15cm on mounds. Nil in depressions.		Limited usefulness in rehabilitation. Stripping between Gilgai may not be practicable in some areas and soils are quite saline. Where Gilgai are not so pronounced, strip no more than 10cm between Gilgai. Use on flat surfaces only.
E1	Very limited. See comment.	**Max 5 m height.** Scraper dumps ok.	Variable profile but surface usually very hard with extensive gravels and rock. Generally not strippable terrain. Although if practicable, recover rock for use in rock mulch mix for steeper rehabilitation slopes.
E2	20 cm. Possible 40 cm in ideal areas.		The soil may thicken in localised areas offering more strippable soil. Do not strip into clay. Useful for flatter areas of rehabilitation. High erosion potential.
E3	30 cm. No deeper.		Quite good soil but do not strip if presence of hard, pale, bleached layer is encountered.

7.6.7 Erosion and Stability

7.6.7.1 Erosion Potential

Most soil types are susceptible to erosion if exposed, with susceptibility increasing with the more undulating nature of the terrain. Bourne and Tuck (1996) assessed the susceptibility of the major Central Highlands soil types for sheet, rill, gully and wind erosion. They found the risk of erosive gullying increases significantly should the 'A' soil horizon be depleted or removed by sheet erosion as a result of poor land management. This is because most soil types in the region have clay 'B' horizons which are sodic and highly dispersive.

Table 7-15 provides an indication of the susceptibility of each soil type on the MEP to the different types of erosion.

Table 7-15 Susceptibility of Soils to Erosion

Soil Unit	Description	Sheet	Rill	Gully	Wind
A1	Active Alluvial Deep Sandy Duplex and Earths .	High	Low	Medium	Medium
A2	Alluvial – uniform Brigalow clay drainage lines.	Medium	Medium	High	Low
B1	Red/brown shallow uniform clay undulating plains.	High	Medium	Medium	Low
B2	Red/brown deeper uniform clay undulating plains with significant linear Gilgai.	High	Medium	Low	Low
B3	Gravely clay on ridgelines.	High	High	Medium	Medium
B4	Uniform Brigalow grey/brown clays.	Medium	Medium	Low	Low
B5	Melon holed Brigalow clay lowlands.	Low	Low	Low	Low
E1	Residuals (Mesas).	Medium	Medium	High	Low
E2	Sandy Duplex Of Poplar Box .	High	Medium	High	Medium
E3	Thin well-structured duplex of Poplar Box/Brigalow.	High	High	Medium	Medium

7.6.7.2 Erosion Mitigation

It is generally accepted that to limit erosion, disturbed areas should be stabilised as quickly as practicable. In accordance with this practice, progressive revegetation would be undertaken on the MEP as soon as viable areas become available. Erosion and sediment control measures would be employed which are consistent with the practices described in the *Technical Guidelines for Environmental Management for Exploration and Mining in Queensland* (DME, 1995).

Areas where the final land form would result in changed slopes include the waste rock emplacements and the internal slopes of the final void. Specific measures to minimise erosion for each of these areas are outlined in **Table 7-16**.

Table 7-16 Erosion Controls for Mining Activities

Area	Control Measure
Cleared Land.	• Restrict clearing to areas essential for the on-going operational works; • Windrow vegetation debris along the contour; • Minimise length of time soil is exposed; • Divert run-off from undisturbed areas away from the works; and • Direct run-off from exposed areas to sediment dams.
Exposed Sub-soils.	• Minimise length of time subsoil is exposed; and • Direct run-off from exposed areas to sediment dams.
Active waste rock emplacements.	• Direct all run-off from waste rock emplacements to sediment dams; • Avoid placement of sodic waste material on final external batters; • Control surface drainage to minimise the formation of active gullies; and • Use soil and rock mulching to armour long and/or steep slopes.
Residual Voids.	• Progressively backfill during operations where possible; • Regrade slopes and/or provide suitable erosion treatments on geotechnically unstable voids; • Use of rock mulch to control erosion; and • Apply seed and fertilizer as necessary to ensure rapid re-establishment of suitable ground cover.
Dams.	• Retain useful water storages to support grazing use; and • Rehabilitate any dam not required post mining by regrading embankments, capping any residual saline material, replacing topsoil, ripping on the contour and seeding.
Drainage Channels.	• Provide protection in drainage lines (e.g. rip rap, grass) where water velocity may cause scouring; and • Ensure drainage channels are sized to suit the catchment and climatic conditions.
Haul Roads.	• Confine traffic to maintained tracks and roads; • Install sediment traps, silt fences, hay bales where necessary to control sediment; and • Rehabilitate disturbed areas around construction sites promptly.

The design parameters for the construction of erosion control works such as rock armoured or grass lined waterways would be in accordance with sound engineering and soil conservation earthworks principles. Drainage will be designed and constructed to the accepted engineering standard.

The outer slope of some waste rock emplacements will be reduced to a 3(H):1(V) gradient and covered with up to one metre of competent sandstone rock mulch. The runoff from these slopes will thus be minimised and retained on the surface and will not scour below the rock mulch layer. A small volume of topsoil will be blended with the sandstone material to encourage the germination of native shrubs and trees on these slopes. A trial rehabilitation area covered with erosion resistant sandstone rock mulch is stable after two years (Millennium Coal, 2009).

Prior to establishing grasses on the reshaped landforms, the surfaces will be ripped on the contour. Ripping will increase depression storage on the slopes and allow a significant quantity of water to be stored before run-off commences. Between rips, the surface will be ploughed on the contour to create a satisfactory seed bed and also to increase surface roughness. Depending on the results of sodicity tests, gypsum application may be required to reduce the erosion potential by improving soil structure and increasing colloidal stability, thereby minimising clay dispersion.

Sediment control dams will be constructed as required to minimise the amount of soil lost to erosion during rainfall events. Details of the sediment control dams and channels are in **Chapter 10 – Water Resources**.

Where possible, topsoil would be directly transferred onto adjacent areas prepared for rehabilitation. Where long-term topsoil stockpiles are required, these would be seeded with pasture grasses to minimise erosion.

7.6.7.3 Erosion Monitoring

An indicator of landform stability is the extent of soil loss from rehabilitation sites relative to background rates of soil loss. Selected final slopes on rehabilitation sites would be monitored to ensure that acceptable levels of erosion are maintained.

The erosion monitoring program would include the following:

- the logging of rainfall and climatic conditions;
- an assessment of vegetation cover at permanent, representative monitoring locations;
- documenting evidence of failure or instability on rehabilitated slopes at permanent, representative monitoring sites; and
- maintaining photographic records at permanent, representative photographic stations, taken on a six monthly basis.

Qualitative surveying (described above) would be undertaken to indicate excessive sediment loss from landforms. If necessary, sediment traps may also be utilised as an indicator of soil loss.

7.6.8 Land Contamination

7.6.8.1 Notifiable Activities

The existing Millennium Mine and proposed MEP are classified as notifiable activities. Under the *EP Act*, Peabody has a duty to notify DERM should potentially contaminating activities be carried out on-site. Any land that has been or is being used for notifiable activities is then recorded on DERM EMR.

Under Schedule 3 of the *EP Act*, the notifiable activities that are currently being undertaken at Millennium Mine and that are proposed for the MEP come under the definitions of:

- Mine Wastes; and
- Petroleum Product or Oil Storage.

These notifiable activities are associated with the Environmentally Relevant Activities (ERAs) that are listed in **Table 7-17** below.

Table 7-17 Environmentally Relevant Activities at the MEP

ERA Number	ERA Name
ERA 7	Chemical Processing
ERA 8	Chemical Storage
ERA 16	Extractive Activities
ERA 21	Motor Vehicle Workshop

The ERAs proposed at the MEP pose a limited risk of contamination for the following reasons:

- all chemicals and fuels would be appropriately stored in accordance with relevant Australian Standards;
- explosives are stored in accordance with the requirements of AS187 – Explosives Storage and Transport; and
- the existing facilities for the prevention of land contamination and management of wastes at the Millennium Mine would be utilised or expanded upon for the MEP.

As part of the decommissioning of the mine at the end of mine life, appropriate contaminated land investigations will be undertaken and remediation plans will be developed and implemented in accordance with the DERM *Guidelines for Assessment and Management of Contaminated Lands in Queensland*. Findings will be detailed in the Final Rehabilitation Report as required for lease relinquishment.

Further details of management and mitigation strategies for contaminated lands during both operational and decommissioning stages of the MEP are contained in **Chapter 5 – Rehabilitation and Decommissioning** and **Chapter 9 – Waste** (refer to **Table 9-1** and **9-2**).

7.6.8.2 Waste and Hazardous Waste Management

Waste management strategies would be implemented to minimise the risk of land contamination at the site. Waste management would aim to promote sustainable waste management practices in accordance with the *Environmental Protection (Waste) Policy 2000*.

Further strategies for the prevention of land contamination due to the storage, spillage or disposal of hazardous materials are included in **Chapter 9 – Waste**.

7.6.8.3 Waste Rock Management

Analysis of waste rock samples from the existing Millennium Mine (Millennium Coal, 2008) found the majority of the waste rock has negligible sulphur content and a net acid neutralising capacity due to a high content of calcium carbonate.

This view is supported by anecdotal evidence at Millennium Mine, with no visible indications of pyritic oxidation in rehabilitated waste rock to date and no expression of such occurrences in water sampling results. Metal and elemental levels in the existing waste rock are at expected background levels, and have low to moderate salinity and sodicity. Overall the results indicate that the waste rock has sufficient acid neutralising capacity to ensure acid drainage is not generated.

7.6.8.4 Rejects Management

Rejects are a combination of coarse and fine materials that are removed from the ROM coal as part of the coal washing and preparation processes. Coarse rejects generated on-site will be strategically encapsulated within waste rock emplacements. Fine rejects are flocculated and settled in special tailings sumps, then trucked to purpose built cells.

The tailings are dewatered and combined with coarse rejects within waste rock emplacements. Given that the rejects will be disposed of within the waste rock emplacements at depths of no less than 10 m, there is not expected to be any land contamination from the rejects.

7.6.9 Visual Amenity Impacts

7.6.9.1 Impact Generators

Given that the MEP is the expansion of an existing open-cut mine operation that will require little if any additional infrastructure, the only visual elements that require assessment are:

- additional open-cut pits;
- increased size of ROM coal stockpile for temporary stockpiling of coal destined for existing CHPP;
- out-of-pit waste rock emplacements (maximum 50 m);
- mine lighting requirements;
- access/haul roads; and
- mine rehabilitation areas.

There will be minimal impacts from these visual impact generators as they will primarily be screened by topography and vegetation. Out of pit waste rock emplacements will be partially visible at some points along Peak Downs Highway and potentially visible from the closest homesteads.

Direct lighting is unlikely to be visible at any location outside the MEP, however indirect lighting – or the glow from the operations at night - is likely to be noticeable from a number of viewpoints along Peak Downs Highway and nearby homesteads. The lighting associated with the MEP mine infrastructure is likely to comprise:

- flood lighting for active operational areas;
- elevated flood lighting in the vicinity of the active waste rock emplacements;
- the truck access/haul road; and
- vehicle lights.

The post-mining rehabilitation objective is to rehabilitate above ground disturbance to a low intensity grazing land use with native vegetation along batters and in a mosaic on remaining areas. This means that out of pit rock dumps will be look similar to the existing mesa structures and will blend in with the surrounding landscape.

The only residual disturbance will comprise the final voids which will not be visible from the ground anywhere outside the mining lease.

7.6.9.2 Landscape Character and Visual Amenity

The existing visual amenity value of the MEP in the surrounding region is considered low-moderate (common) given the lack of any significant or unusual visual elements and the large areas of land throughout central Queensland that display similar landscape characteristics. The landscape itself exhibits some positive character, however there is significant evidence of alteration to natural features resulting from agriculture and mining, so the views are far from pristine.

Subjectively, views of agriculture and mining appeal to some parts of the community and not to others. While in visual assessments they are generally accepted as reducing the landscape character and visual amenity, to many people they actually increase these values. In particular, visitors to the central Queensland area are known to seek views of operating coal mines and farming properties, and would be disappointed if they were not able to view agricultural vistas and mine sites for which the region is known. For these people, unfortunately, views of the MEP will be minimal and unlikely to be noticed by most travelers along the Peak Downs Highway.

The undulating nature of the landscape will be maintained through the nature of the mine plan and ongoing rehabilitation strategies. The nature of the landscape is therefore assessed as being tolerant of this change, and the level of impact to the landscape character as being low.

7.6.9.3 Visual Impact

To assess the magnitude of the visual impact of the MEP on the visual resource on its own and from a cumulative perspective, four main factors were considered, namely visual intrusion, visibility, exposure and sensitivity, and lighting.

Visual Intrusion

The MEP has been assessed on the nature of its likely intrusion (physical characteristics) on the visual quality of the surrounding environment and its compatibility/discord with the landscape and surrounding use. Intrusion includes both the removal of existing visible landscape features and the creation of new visible landscape features.

The open-cut pit operations for MEP will involve removing some elevated parts of the local landscape, while waste rock emplacements will become new elevated additions to the local landscape. These are likely to be visible in some parts of the localised area and along small sections of the Peak Downs Highway.

The rehabilitation objective for the site upon decommissioning is to return areas disturbed by mining activities to a mosaic of grazing land and self-sustaining native vegetation, in accordance with their land suitability. The rehabilitation of the MEP will be progressively and will include the removal of infrastructure on completion of mining. Some infrastructure may remain at the request of landowners, e.g. roads, dams etc or due to Joint Venture commitments. Areas not disturbed by the mine operations would automatically be suitable for their pre-mine land use.

Waste rock emplacements will be shaped to retain existing mesa characteristics and will be generally consistent with the existing undulating landform, as is the case with current operations. Consequently, residual visual impacts are assessed as low to moderate as few features in the landscape will change, and the proportion of the existing view that will change is very low. There are no sensitive receptors (residences) that will be significantly affected by the change in the view. Progressive rehabilitation of waste rock dumps will also reduce adverse visual impacts.

Visibility

The MEP waste rock emplacements will not be widely visible by the residents in the zone of potential influence. Residences to the north-west have visibility blocked by elevated land while residences to the south-west and south-east have visibility impeded or blocked by vegetation, undulating landscapes and existing open-cut mining operations. Only residences to the north and east have potential views of the MEP operations. Of these locations, natural vegetation and topography will impede or block views of the mine most of the time.

Plate 7-8 and **Plate 7-9** shows a comparison between the current view and a modelled 3-D representation of the view of the MEP at the end of mine life that will be visible from the Annandale and Moorvale homesteads.

Plate 7-10 and **Plate 7-11** shows a current view and a modelled 3-D representation of the view of the MEP from the internal Millennium-Poitrel access road. While this view will not be visible to members of the public, it demonstrates how well the final landform will blend in with the existing undulating nature of the region.

3-D modelling undertaken for the Wotonga homestead showed that no part of the MEP was visible due to the intervening mesa to the west of the MEP operations.

Plate 7-8 Current View of the MEP from the Annandale and Moorvale Access Roads

Plate 7-9 Modelled 3-D View of the MEP from the Annandale and Moorvale Access Road

Plate 7-10 Current View of the MEP from the Millennium Poitrel Access Road

Plate 7-11 Modelled 3D View of the MEP from the Millennium Poitrel Access Road

In addition to the creation of internal and external waste rock emplacements, other changes to the land form will include the removal of two mesas (Red Mountain and Poitrel Hill) in the creation of the Mavis Pit.

The rocky material within these mesas may be used to create rock mulch for cladding the external slopes of waste rock emplacements. A large mesa outcrop area to the west on ML70313 and to the south on ML70313 and ML ML70344 will not be disturbed. Where waste rock emplacements are adjacent to mesas, such as on ML 70344, their land form will be blended in with the landform of the mesa outcrop.

Due to location of waste rock emplacements, elevated natural landforms, surrounding mining operations and the layout of the mine itself, no mine infrastructure such as haul roads, train load-outs, maintenance buildings or CHPP infrastructure will be visible from the surrounding public roads or the local landholder residences.

The main features that will be visible to varying degree are the waste rock emplacements. These are likely to be visible from the Annandale, Moorvale and Mavis Downs residences and from some sections of the Peak Downs Highway. In all cases these views will be at least partly screened by vegetation and therefore should not be significantly intrusive in the generally undulating landscape.

The post-closure rehabilitated landform of the waste rock emplacements will be similar to the surrounding areas of low-intensity grazing land with a mosaic of native vegetation on an undulating landform. Both the landforms and the vegetation cover will mimic the existing visual values and upon completion of mining will be cohesive with the existing landscape character.

The final voids will also form a significant feature of the post-mining landform. Final voids will remain unfilled, and will form a lake that will be fenced off. Ramps will be retained in the final landform and it is proposed that the ramp slope slopes will be left at angle of repose if determined to be geotechnically stable with the sides benched to allow rehabilitation.

The final low walls will be benched. The highwall slope, if in geotechnically stable ground which has not been mined, could remain at the final batter angles as long as it is made safe to ensure humans and animals do not harm themselves. All exposed coal seams will be covered with inert material wherever possible, and the voids will be fenced off.

Except for some limited views of the waste rock emplacements from the Annandale and Moorvale homestead access roads; views at residences will not be intrusive. Given the above factors, the overall visibility the MEP in the general area is assessed to be low.

Exposure and Sensitivity

Visual exposure relates to the distance of the view, where it is recognised that the impact of an object diminishes at an exponential rate as the distance from the observer increases. The visual sensitivity of most receptors is assessed as being low as the most sensitive receptors considered in this assessment are the residences in the area of the proposed mining activities. Except for Annandale and Moorvale, they are located at distances of more than 8 km from the MEP, and the views are screened by vegetation and intervening landforms.

Moorvale, the closest residential location to the proposed MEP, lies approximately 7.9 km from the central location of the MEP. Due to effective screening from the relatively dense riparian vegetation, views would be limited to the out-of-pit waste rock emplacements at the southern end of the MEP. According to the conceptual mine plan for the MEP, waste rock emplacements may be up to approximately 50 m higher than the pre-existing ground surface, with an average height of approximately 40 m. Other mine infrastructure would not be visible due to screening from the waste rock emplacements, the intervening topography and vegetation.

Based on the information presented above, the assessment of impact significance on visual exposure is regarded as low to moderate as impacts would be localised and for a very short duration for travellers on the Peak Downs Highway, and certain mitigating measures would be implemented if required.

Lighting Impacts

Mining operations at the MEP, as with the existing Millennium Mine, will continue at night. Therefore lighting associated with haul road and infrastructure areas is likely to be visible at night time as a glow in the sky. While no direct impact to any sensitive viewpoints are predicted, mitigating measures such as retention or planting of vegetation between sensitive viewpoints and the mine will be assessed for effectiveness to minimise any lighting impact if this becomes an issue.

Out-of-pit waste rock emplacements are likely to be the most obvious elements of the MEP, with lighting on these dumps visible at night from some viewpoints. Lighting on waste rock emplacements will be minimised to that required for safe operations.

While no direct lighting impacts are predicted for any sensitive viewpoints, mitigating measures will be assessed for effectiveness to minimise any lighting impact if this becomes an issue.

Artificial lighting regimes can also result in changed habitat conditions for nocturnal fauna and associated impacts. Fauna known from within the ML that may potentially be affected by lighting associated with MEP activities are nocturnal birds such as the Australian owlet-nightjar (*Aegotheles cristatus*), Tawny frogmouth (*Podargus strigoides*) and Eastern barn owl (*Tyto javanica*), as well as various microbat species. All of these species are highly mobile and have abundant habitat outside the proposed disturbance area.

The only species of conservation concern from these faunal groups is the Little pied bat (*Chalinolobus picatus*), which is listed as 'near threatened' under the *NC Act.* This species may occur in remnant habitat fragments surrounding the MEP, however it is anticipated that lighting within working areas of the MEP will only penetrate the edges of remnant areas of vegetation and would not significantly impact on this species. It is also noted that artificial lighting tends to attract insects, and may therefore increase foraging opportunities for some nocturnal insectivores (e.g., microbats).

7.6.9.4 Visual Amenity Mitigation and Management

The magnitude of impact or degree of change as a consequence of the proposed activities within the MEP is expected to be low to moderate due to the presence of limited vantage points which provide views of the MEP infrastructure. The magnitude of impact on decommissioning is regarded as low and beneficial due to vegetative rehabilitation and the creation of a final landform which will conform to the existing undulating landscape and the establishment of native vegetation in an area which is sparsely vegetated.

The main indirect impact will be lighting from the proposed mine infrastructure, particularly in the vicinity of the active out-of-pit waste rock emplacements. Lighting impacts will be mitigated by installing light fixtures in accordance with the *AS4282:1997 Control of the obtrusive effects of outdoor lighting*, i.e. that provide directed illumination to reduce light spillage beyond the immediate surrounds of the working area. For example, a screen or louvre attached to the light fitting to control light flux for all angles above 10 degrees below the horizontal would effectively reflect light onto the ground, and improve lighting levels.

Other mitigating measures to reduce impacts on the visual amenity of the area include:

- use of high pressure sodium lights where possible;
- establishment of buffer vegetation between the proposed new surface infrastructure and sensitive receptors; and
- retaining existing vegetation on-site wherever possible.

Based on the above assessment, the MEP is assessed as having a low to moderate visual impact on the surrounding area.

The intent of the Nebo Shire Planning Scheme Strategic plan will also be maintained by encouraging the continued use of the lands not affected by the mine pit, out-of-pit waste rock emplacements, access/haul road and other mine infrastructure for agricultural purposes, both during mining operations and following site rehabilitation at the completion of mining.

The gentle undulating landscape will not inhibit the continued and future use for grazing in these undisturbed parts of the MEP.

7.6.10 Cumulative Impacts

The Project site and the locality have primarily been used for grazing rather than cropping and much of the Project site will be suitable for grazing post-mining. The post-mining land use is proposed to comprise a mosaic of self-sustaining vegetation communities and grazing land, using appropriate native tree, shrub and grass species, and improved pasture species where suitable.

The cumulative impacts on land use in the region would be relatively high during mining operations; however, for the end of mine life, the majority of mines have a rehabilitation plan that includes grazing and native vegetation in various proportions. While there will be changes in land use and reductions in land suitability during mining, once mine decommissioning is completed and as much land as possible is returned to the pre-existing land use – the final cumulative impact will be significantly reduced.

The cumulative impact on visual amenity is difficult to quantify. The region has few, if any, significant or unusual visual elements and there are large areas of land throughout central Queensland that display similar landscape characteristics. While mining has definite visual impacts, how an individual perceives these impacts can vary significantly.

As the MEP has minimal impact to the visual amenity, the addition of this to the region's cumulative impacts is also minimal. The MEP will be only intermittently visible from the Peak Downs Highway and then only as a relatively small extension of the existing mesa formations in the area.

Whilst the MEP may be slightly visible from the Annandale and Moorvale homesteads, the cumulative impact is again low as the nearest homestead is almost 8 km away. Homesteads in the MEP area have already adapted to existing mining operations without any specific issues being raised. Since the MEP is not a new mine and will be utilizing existing infrastructure, it is unlikely to significantly add to the visual impacts to nearby sensitive receptors.

Due to the management and mitigation measures proposed for the MEP, there is not expected to be an increase in cumulative impacts in relation to final land use, land contamination or visual amenity.

7.7 REFERENCES

Baker & Tuck, G.A. 2004, Soils and Land Suitability Survey of Poitrel, Report to SKM for inclusion in the Poitrel EIS.

Baker & Tuck, G.A. 2006, Soils and Land Suitability Survey of Mavis Downs, Internal report to Millennium Coal.

Bourne, G.F. & Tuck, G.A. 1996, Understanding and Managing Soils in the Central Highlands, Resource Information and Field Manual, QDPI.

Department of Communications 2007, Leading Practice Sustainable Development Program for the Mining Industry.

Department of Mines and Energy 1995, Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland.

Department of Primary Industries and Department of Housing, Local Government and Planning 1993, Planning Guidelines: Identification of Good Quality Agricultural Land.

Department of the Environment, 1998, *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland*, Queensland Government, March 1998.

Environment Australia, 1997, *Managing Sulphidic Mine Wastes and Acid Drainage*. Best Practice Environmental Management in Mining, Department of the Environment, Australian Government, Canberra.

Gunn, R.H, Beattie, J.A., Reid, R.E. & van de Graff, R. 1988, Australian Soil and Land Survey Handbook, Inkata Press, Melbourne.

Isbell, R.F. 1998, The Australian Soil Classification, CSIRO Publishing.

Isbell, R.F. 2002, Revised Edition, The Australian Soil Classification, CSIRO Publishing.

Millennium Coal 2008, Millennium Coal Mine Environmental Management Plan, August 2008.

Millennium Coal 2009, Millennium Coal Plan of Operations, 31 December 2009 to 31 December 2010.

McKenzie, N.J., Grundy,M.J., Webster. R. & Ringrose-Voase. A.J. 2008, 2nd edn, Guideline for Surveying Soils and Land Resources, CSIRO Publishing.

National Environment Protection Council 1999, National Environment Protection (Assessment of Site Contamination) Measure 1999, National Environment Protection Council.

Shields, P.G. & Williams, B.M. 1991, Land Resource Survey and Evaluation of the Kilcummin area, Queensland, QDPI Bulletin QV 91001.

Story, R., Galloway, R.W., Gunn, R.H. and Fitzpatrick, E.A. 1967, Lands of the Isaac - Comet Area, Queensland, CSIRO Land Research Series No.19.

Tuck, G.A. 2009, Soil and Land Suitability, Millennium Expansion Project, Millennium Coal Mine, 2009, GT Environmental Services.