Millennium Expansion Project
Environmental Impact Statement

CHAPTER 5:

REHABILITATION AND DECOMMISSIONING

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5.0 REHABILITATION AND DECOMMISSIONING

5.1 EXECUTIVE SUMMARY

5.1.1 Environmental Values

The environmental values that have been considered in relation to rehabilitation and decommissioning at the MEP include:

- the health and well-being of people;
- the diversity of ecological processes and associated ecosystems;
- maintaining soil resources and agricultural land capability;
- maintaining water quality and aquatic ecosystems in waterways; and
- creation of stable and sustainable landforms.

5.1.2 Issues

Potential issues associated with rehabilitation and decommissioning at the MEP include:

- during the life of mine, the following land disturbance areas are predicted:
  - 731 ha will be disturbed by the Mavis Pit, including two mesas (MLA 70401 and MDL 136);
  - 256 ha will be disturbed by the continuation of the Millennium Pit (ML 70313);
  - two final voids will remain at the end of mine life (65 ha on ML 70313; 166 ha on MDL 136); and
  - 231 ha will be disturbed to create four external waste rock emplacements (ML 70313).
- approximately 66 ha of remnant or regrowth vegetation is likely to be cleared for the MEP;
- the process of mining results in two predominant types of material that require rehabilitation, waste rock and coal waste products (rejects and tailings);
- the overburden analyses indicate that it is alkaline with low salinity and nil to very little acid producing potential;
- the overall characteristics of the rejects are:
  - sulphate concentrations are proportionately high indicating some pyrites;
  - samples indicated negligible net acid production potential (i.e. pH > 4);
  - pH range approximately 7-8.5;
  - EC range from 900-1450 µS /cm; and
  - no elevated trace metal concentrations were indicated.
- there are some areas of disturbed land that will not be available for rehabilitation until later in the mine life for the following reasons:
  - the disturbed area is effectively integrated with nearby, unavailable areas;
  - the chemical characteristics of the overburden may improve with time of exposure, thereby improving the success of the rehabilitation.
- the stability of final landforms is critical to the overall success of rehabilitation of the MEP site;

- the final voids will be significant features of the post-mining landform eventually forming water bodies;
- the alignment of New Chum Creek will be unaffected by the MEP, with minimal disturbance within 100 m of the creek channel (except haul road crossings), and as such little rehabilitation will be required;
- the proposed access and haul roads that will link the MEP to the Millennium Mine cross New Chum Creek in two places. These low level crossings are in riparian zones that are sensitive environmental ecosystems, therefore construction of these crossings will require careful management;
- although it is the intent to maximise the area of rehabilitated land suitable for grazing, there will be areas of disturbance where a non-grazing outcome is the preferred post-mine objective; and
- rehabilitation to native bushland will need to include acceptance of introduced Buffel grass in the final landform, as it is expected that it will infiltrate native grassed areas.

5.1.3 Mitigation Strategies

Strategies to mitigate MEP's rehabilitation and decommissioning issues and impacts include the following:

5.1.3.1 Rehabilitation Design

- mine wastes and disturbed land will be rehabilitated to a condition that is self-sustaining or to a condition where the maintenance requirements are consistent with an agreed post-mining land use;
- surface water and/or groundwater that leaves the lease will not be degraded to a significant extent. Current and future water quality will be maintained at levels that are acceptable to users downstream of the site;
- areas 100 m either side of New Chum Creek are designated as 'stand-off zones' and will not be disturbed except for the identified crossings;
- disturbance in Endangered Regional Ecosystems (EREs) will be avoided where possible. If disturbance within an ERE is unavoidable, control strategies will be implemented to minimise disturbance and vegetation offsets will be provided for the disturbed areas, as required;
- the major post-mine land use goal for areas other than voids, ramps and waste rock emplacement batters is to enable cattle grazing compatible with the surrounding district;
- where grazing is unsuitable due to limitations through restricted soil water availability, erosion susceptibility and fertility, these areas will be revegetated with a mixture of local native tree, shrub and grassland species, and returned to native bushland;
- Peabody is committed to the concept of progressive rehabilitation and, where possible, will undertake rehabilitation of all active mining areas within two years of disturbance;
- to manage and monitor progressive rehabilitation, the MEP will prepare a rehabilitation plan that will be updated as required;
- rehabilitation will be monitored as required to ensure success criteria will be met. This monitoring will include an assessment of:
  - plant establishment, growth, diversity and cover; and
  - evidence and type of erosion.
- rehabilitation performance criteria will be submitted to the DERM for review and comment in a Rehabilitation Management Plan; and
- representative sites deemed to have reached minimum performance criteria will be selected as analogue sites for the verification of all bushland and grassland rehabilitation land. Natural sites will be monitored to provide

a reference for planning of rehabilitation sites but not as the criteria for rehabilitation verification. Sites will be maintained in adjoining un-mined grazing land to provide a reference for planning of rehabilitation sites but not as the criteria for rehabilitation success.

5.1.3.2 Landform Design

- landform rehabilitation design at the MEP will be based on the following criteria:
  - outer waste rock emplacement slopes will be designed at no greater than 3(H):1(V) gradient. A minimum of one metre of competent rock mulch shall be placed over waste rock emplacement slopes with a 3(H):1(V) batter to mitigate erosion potential and maximise survival rate of rehabilitation vegetation species;
  - the surface of waste rock emplacements will be shaped with a gently undulating topography to mimic the surrounding landscape and naturally promote some localised ponding, thereby enhancing habitat values;
  - the low wall of the final void will remain benched as long as the spoil is geotechnically stable under these conditions. The low wall will drain internally into the final void;
  - the highwall slope, if in geotechnically stable ground, will remain at the final batter angles and made safe, otherwise it will be benched with 15 m benches at 20 m intervals; and
  - perimeter stormwater diversions will be designed and constructed to meet appropriate standards. Drainage will be designed and constructed to include a +0.6 m freeboard and provide for a 1 in 20 year flood event.

5.1.3.3 Rejects Management

- coarse rejects generated on-site will be strategically encapsulated within waste rock emplacements;
- fine rejects (tailings) are flocculated and dewatered in constructed tailings sumps, then trucked to purpose built cells and encapsulated with the coarse rejects within waste rock emplacements; and
- a Rejects Management Plan will be developed to accompany the LOM mine plan. The aim of this plan is to provide sufficient treatment and storage capacity for coal washery waste for the remainder of the mine life.

5.1.3.4 Topsoil Management

- Peabody is committed to the salvage and use of all topsoil suitable for rehabilitation, and as such topsoil will be strategically stripped ahead of mining in accordance with a Topsoil Management Plan. The Topsoil Management Plan will indicate how topsoil is to be removed, transported and stored to maximise soil condition. A register will be developed indicating locations, amounts and storage timeframes;
- stripping operations will be staged so that the minimum area practicable is disturbed at any one time. Topsoil from all areas cleared of vegetation will be segregated for rehabilitation purposes. Topsoil will not intentionally be mixed with spoil or subsoil at any time unless advantageous from a structural perspective;
- stripped topsoil will be placed directly onto final landforms where possible; and

- spreading of topsoil will be undertaken from the top of slopes to minimise erosion damage created by storm runoff. Topsoil compaction will be minimised during spreading by placing topsoil in windrows on the final surface which can then be distributed by a dozer working on the soil. Subsequent machinery passes will be necessary in order to establish vegetation and to construct erosion control structures if required.

5.1.3.5 Revegetation Methods

- direct seeding will be used to sow the reshaped and topsoiled rehabilitation areas with pasture grass or native tree and shrub/grass seed. Deep ripping on the contour prior to seeding and fertilisation will be undertaken to a minimum depth of 500 mm. Sowing will be completed during or as soon as possible after cultivation and at the beginning of the wet season;
- seed mixes will consist of plant species compatible with local vegetation communities, proven as suitable to the proposed final landform topography and regional climate, as well as meeting the short term and long term rehabilitation objectives; and
- revegetation will occur within the 100 m buffer distance on each side of New Chum Creek to improve diversity of areas previously cleared due to pastoral activities.

5.1.3.6 Erosion Control Measures

- land that has been disturbed by mining operations and cannot be immediately rehabilitated has an increased erosion potential. Soil sediment from these areas will be managed by:
  - minimising the area disturbed;
  - ripping on contours;
  - treating run-off in sediment sumps and dams; and
  - progressive rehabilitation of disturbed areas.
- all temporary control measures will be removed after the disturbance site is stabilised.

5.1.3.7 Flood Control

- flood levees will be constructed to minimise impacts of flooding and any potential for release of contaminants to the environment, including protection of the final void at the end of mine life.

5.1.3.8 Final Rehabilitation and Decommissioning

- at the end of mine life, an assessment report will be undertaken by a Registered Professional Engineer of Queensland (RPEQ) covering the geotechnical issues and erosivity of the proposed final landforms, including final voids, to demonstrate long-term stability;
- an investigation into final voids will be undertaken to develop mine decommissioning acceptance criteria;
- the final void will be fenced off to restrict access for safety purposes;
- where nominated as beneficial by the landowner, water management structures will be left in an operational state after mining has ceased; and
- a diversion drainage channel will be constructed to the north-west of EWRE 1. The drainage channel will be constructed to approved engineering standards, including lining with riprap if scour velocities indicate potential scouring of the channel. Where scouring is unlikely, the channel will be stabilised and revegetated with appropriate riparian species.

5.2 GUIDELINES AND OBJECTIVES

The rehabilitation of mined lands is an important component of any mining project. The existing rehabilitation program at the Millennium Mine, which consists of detailed planning and design of post mine landforms, followed by the progressive implementation of rehabilitation activities including erosion control and design for long-term geotechnical stability, will be extended to cover the proposed MEP and will continue throughout the mine life.

EPA Guideline 18: Rehabilitation requirements for mining projects provides information on both progressive and final rehabilitation requirements for mining projects operating in Queensland under the provisions of the *Environmental Protection Act 1994* (*EP Act*). This is the predominant guideline that has been used for determining the MEP Rehabilitation and Decommissioning management strategy.

In addition to *EPA Guideline 18,* the proposed rehabilitation strategy for the MEP will meet requirements contained in:

- Environmental Management Policy for Mining in Queensland 1991 (*DME, 1991);*
- a policy framework to encourage the progressive rehabilitation of large mines (*EPA, 2004);*
- Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (*DME, 1995*);
- Leading practice sustainable development program for the mining industry-Mine Rehabilitation (*Department of Industry, Tourism and Resources, 2006a*); and
- *Leading practice sustainable development program for the mining industry-*Mine Closure and Completion (*Department of Industry, Tourism and Resources, 2006b)*.

Peabody is committed to the rehabilitation goals listed in *EPA Guideline 18*, that the rehabilitated landform is safe to humans and wildlife; non-polluting; stable, self-sustaining and free of maintenance; and able to sustain an agreed post-mining land use.

Specifically, the rehabilitation strategy for the MEP will have the following objectives:

- mining and rehabilitation will aim to create a landform with land use capability and/or suitability similar to that prior to disturbance unless other beneficial land uses are pre-determined and agreed;
- mine wastes and disturbed land will be rehabilitated to a condition that is self-sustaining or to a condition where the maintenance requirements are consistent with an agreed post-mining land use; and
- surface water and/or groundwater that leaves the lease will not be degraded to a significant extent. Current and future water quality will be maintained at levels that are acceptable to users downstream of the site.

5.3 MINING PROCESSES

Combining mining operations and rehabilitation works at the MEP is complex, requiring coordination between numerous physical elements and operational processes. For clarity, the pre-mining and mining processes are detailed below, and the rehabilitation processes are detailed in **Section 5.4.**

5.3.1 Land Disturbance and Clearing

During the life of mine, the following land disturbance areas are predicted:

- 731 ha will be disturbed by the Mavis Pit, including two mesas (MLA 70401, MDL 136);
- 256 ha will be disturbed by the continuation of the Millennium Pit (ML 70313);
- Two final voids will remain at the end of mine life (65 ha on ML70313; 166 ha on MDL 136); and
- 231 ha will be disturbed to create four external waste rock emplacements (ML 70313).

Areas 100 m either side of New Chum Creek are designated as 'stand-off zones' and will not be disturbed except for the identified haul road crossings and revegetation management purposes (e.g. infill planting or weed control).

The conceptual mine plan for the MEP demonstrates that no specific construction activities are required; therefore clearing activities will be restricted to the proposed open-cut pits and waste rock emplacement areas. Existing infrastructure for Millennium Mine, including offices, workshops and access roads, will be utilised by the MEP, though they may be relocated to improve efficiencies.

Approximately 66 ha of remnant and regrowth vegetation is likely to be cleared for the MEP. According to DERM's *Conservation Status of Queensland's Bioregional Ecosystems*, some of these areas of vegetation are classified as Endangered Regional Ecosystems (ERE) and are of conservation significance. Disturbance in these EREs will be avoided where possible. If disturbance within an ERE is unavoidable, control strategies will be implemented to minimise disturbance and vegetation offsets will be provided for the actually disturbed areas, as required. Details of management and mitigation measures for EREs and areas of ecological significance are outlined in **Chapter 13-Nature Conservation**.

The MEP will ensure a sustainable approach for any land clearing including flora and fauna surveys and/or cultural heritage surveys of the area to be cleared if they have not previously been completed. If significant artefacts or protected species are identified, then an appropriate management plan will be developed to assist in the protection of the cultural heritage or ecological values.

Any vegetation that has no direct commercial value or is reusable will be cleared and stockpiled. Possible future use of stockpiled vegetation as a medium to be spread on the final landform to assist natural habitat establishment will be assessed at that time. Where it cannot be used, stockpiled vegetation will be burned in a controlled manner under the required permit.

5.3.2 Topsoil Salvage

Peabody is committed to the salvage and use of all topsoil suitable for rehabilitation, and as such topsoil will be strategically stripped ahead of mining as per the current Millennium Mine *Topsoil Management Plan* and according to the Peabody Topsoil Management Standard (ENV STD 001) where practicable. The topsoil management plan will indicate how topsoil is to be removed, transported and stored to maximise soil condition. A register will be maintained showing locations, types, amounts and storage timeframes.

Stripping operations will be staged so that the minimum area is disturbed at any one time. Topsoil from all areas cleared of vegetation will be segregated for

rehabilitation purposes. Topsoil will not intentionally be mixed with spoil or subsoil unless advantageous from a structural perspective.

Stripped topsoil will be placed directly onto final landforms where possible. This avoids double handling, eliminates the need to stockpile, and maintains the quality of topsoil. If the topsoil cannot be immediately placed on prepared landforms, it will be stockpiled in pre-determined locations as close as possible from where it is removed and within the area suitable for future rehabilitation works. This allows topsoil to be used in the progressive rehabilitation of areas where mining, backfilling and final shaping have occurred.

Some topsoil can be detrimental to rehabilitation due to the presence of weeds. A visual assessment for weeds will be undertaken prior to topsoil stripping. If weeds are present within the topsoil stripping area then appropriate weed management practices will be applied. If there is a high risk of weeds spreading during stripping, all equipment will be washed down prior to starting work in a new area.

The MEP includes considerable reserves of topsoil that may be used in mine rehabilitation programs. As a guide, all soils used in rehabilitation should be applied to no less than 200 mm. This provides sufficient depth for re-ripping should follow-up maintenance work be required. Soils placed to 150 mm or less can be significantly contaminated by spoil when a single pass of deep ripping occurs.

Chapter 7-Land provides details of the available soil types, volumes, stripping and stockpiling recommendations for all soils in the survey area.

5.3.3 Mining Operations

Following land clearing and removal of topsoil resources, specific mining operations commence. For the MEP, these will generally include blasting, removal of overburden material to waste rock emplacements, removal of coal for processing at the Coal Handling and Preparation Plant, transport of the product coal off-site for export and transport of the coal rejects on-site to appropriate containment structures. Further details of the MEP mining process can be found in **Chapter 4-Project Description.**

The process of mining described above results in two predominant types of material that require rehabilitation, overburden and coal rejects.

5.3.3.1 Overburden Characteristics

Characterisation of the overburden, both pre-mining and post-mining, is essential in understanding the physical and chemical properties of the material to be rehabilitated.

Pre-Mining

The initial overburden analyses undertaken during the exploration process indicate that the overburden is alkaline with low salinity and nil to very little acid producing potential.

The main overburden type at the MEP is weathered and un-weathered clayey Permian sediments that may include minor areas of lateritised fine Tertiary sands. Data available from this and other Peabody mine sites in the region (Millennium Coal, 2008) indicates that:

- the majority of the overburden has negligible sulphur content and a net acid neutralizing capacity due to a high content of calcium carbonate;

- materials that make up the coal seam roof and partings (between seams) exhibit a comparatively higher net acid producing potential. However such material represents an extremely small fraction of the total overburden and is considered insufficient to counteract the acid neutralizing capacity of the majority of the spoil. This view is supported by results at the Millennium Mine with no visible indications of pyritic oxidation in rehabilitated spoil to date and no expression of such occurrences in water sampling results; and
- the majority of overburden exhibits the following characteristics:
  - low to moderate salinity and sodicity;
  - strongly alkaline with resultant acid neutralising capacity;
  - moderate dispersion and sealing tendency;
  - metal and elemental levels at expected background levels; and
  - low fertility.

Post-Mining

Physical disruption during the mining process has the potential to change the nature of spoil materials and their interaction with the surrounding environment in a number of ways. Changes which may occur include:

- exposure of unweathered material to oxidation processes near the post-mining landform surface can result in the release of oxidation products that are prone to transport by surface runoff or infiltration e.g. salts and acid;
- soils and rock expand when loosened through blasting and excavation, can swell by 15-18%. As a result, not all spoil can be contained within the mined out excavations, leading inevitably to slopes and elevated areas above the original landform. The post-mining material will also have a higher initial porosity than the original in-situ spoil. Some residual settlement is expected, but this will have little effect on the final landform;
- soil that supported a specific type of plant growth on the pre-mining landform may not be able to support the same plant growth on the post-mining landform due to physical and chemical changes that have occurred; and
- poorly structured and dispersible soils and spoils will be prone to erosion, particularly on slopes.

As part of the mining process, the overburden material is placed in waste rock emplacement areas to pre-planned heights to ensure that all material can be contained and managed within the Mining Lease. Once final height and grades are achieved, this material is then ready for rehabilitation.

5.3.3.2 Coal Rejects

Coal rejects are a combination of coarse and fine material that are removed as part of the coal beneficiation processes (crushing and washing). 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 cells are encapsulated along with the coarse rejects within waste rock emplacements.

A number of geochemical characterisation investigations of coal processing plant rejects have been undertaken since the commencement of Millennium Mine operations and are applicable to the MEP.

The overall characteristics of the rejects are summarised as follows:

- the material includes solutes containing sodium chlorides and sulphates at elevated levels that may restrict plant growth;

- sulphate concentrations are proportionately high indicating some sulfur based mineralogy (possibly pyrites);
- samples indicated negligible net acid production potential (i.e. pH >4);
- pH range approximately 7-8.5;
- EC range from 900-1450 µS/cm (considered by DEEDI to be saline); and
- no elevated trace metal concentrations were indicated.

A Rejects Management Plan will be developed to accompany the LOM mine plan. The aim of this plan is to provide sufficient treatment and storage capacity for coal washery waste for the remainder of the mine life.

5.3.3.3 External Waste Rock Emplacements

External waste rock emplacements (EWRE) are located outside the mine pit. The EWRE design is based on the need to store overburden in a managed and environmentally controlled location that will allow efficient and safe on-going mining operations, consistent with final rehabilitation objectives. These objectives primarily aim to:

- maintain low soil losses consistent with adjacent lands of equal land capability by encouraging a self-sustaining vegetation cover on all landforms;
- limit erosion potential through surface cladding and implementation of appropriate control measures; and
- minimise off-site impacts.

The material to be placed in the EWRE will include overburden, coarse coal rejects and dewatered tailings/fine coal rejects. Coarse coal rejects and dewatered tailings will be trucked to the EWRE and encapsulated in overburden. Dewatered tailings will be held in containment cells built into the EWRE to hold in place until capped with waste rock. The geochemical test work indicates that the coal rejects material is saline. The mine plan will attempt, where possible, to ensure the placement of saline materials at depth away from the rehabilitation surface.

Internal slopes will be constructed to mirror the natural undulations on surrounding topography, collecting some localised drainage internally with the remainder directed externally. The majority of the area will be shaped to encourage the return of native grasses. The upper surface will be respread with approximately 200 mm of topsoil.

Where EWREs are adjacent to mesas, such as on ML 70344, the land form of the EWRE will be blended in with the landform of the mesa outcrop.

External Batters

As has been implemented at the existing Millennium Mine, some of the outer slopes of the dumps will be reduced to a 3(H):1(V) gradient and covered with a minimum of 1 metre of competent sandstone-based rock mulch. The steeper batters minimise the area covered by the waste rock emplacements, thereby minimising clearing and making optimum use of the available land area.

A competent benign sandstone source has been identified and occurs periodically in an average 20 metre strip above the coal seam. The material was tested and underwent a wetting and drying process to ascertain if the sandstone was stable under weathering. After four months, approximately 50% of the sandstone material showed little sign of weathering which, when mixed with the weathered decomposed sandstone or topsoil, is expected to provide an erosion resistant rock mulch. It is modeled, that there will be adequate

quantities of competent, non-slaking sandstone to sheet the outer slopes of the spoil dumps.

The sandstone may be blended with gravels and soil to create an erosion resistant surface with approximately 40% competent large rock locked in place with smaller fraction. The runoff will thus be retained on the surface and will not scour below the rock mulch layer.

The outer slopes will be seeded with a mixture of grass species to augment the erosion control of the rock mulch. Topsoil will be blended with the sandstone scree material to encourage the germination of native shrubs and trees. Brigalow and associated species will be established on the cracking clay soils and to assist in their establishment, the drainage pattern will ensure that runoff is directed into these areas.

5.3.3.4 Internal Waste Rock Emplacements

As mining progresses, the mined out pit area becomes available for Internal Waste Rock Emplacement (IWRE) i.e. backfilling the void that has been left from mining operations. The IWRE will be shaped to reduce run-off to other areas. Rainfall will collect in these depressions. Most of this water will be dissipated through evapotranspiration, encouraged by establishment of deep-rooted vegetation. A bund will be constructed to prevent ponded water from flowing back toward the void down the low wall, since this could result in erosion cutting back through the reshaped landform. Depending on the land-form, external drainage lines will merge with existing natural drainage lines.

The upper surface and outer slopes will be re-shaped as per the EWRE.

5.3.3.5 Infrastructure

In addition to the EWRE and IWRE areas, mining operations may impact on some areas of existing mine infrastructure. The site access road may require realignment involving the construction of 2.4 km of new road, in order to efficiently access the MEP areas. This will also require approximately 100 m of 66 kV overhead powerlines to be relocated following the same route as the road. The road and powerline realignment will be positioned to avoid remnant vegetation adjacent to New Chum Creek, and instead be located through the non-remnant area west of the northern drainage channel.

5.4 REHABILITATION PROCESSES

Rehabilitation of coal mines has been undertaken throughout Central Queensland for several decades, continually building upon existing knowledge and experience, and establishing optimum methods of revegetation in the region. This experience is applied to the MEP rehabilitation plan, along with information from site-specific results from the existing Millennium Mine rehabilitation program. Millennium Mine is testing the effectiveness of topsoil as plant growth media, and determining any requirements for, and rates of, fertiliser applications. Results from these trials will be applied to the MEP as they become available.

5.4.1 Design Criteria

Rehabilitation design at the MEP will be based on the following criteria:

- all areas significantly disturbed by mining activities will be rehabilitated to a stable landform with a self-sustaining vegetation cover;

- outer waste rock emplacement slopes will be designed at no greater than 3(H):1(V)) average gradient. A minimum of 1 m of competent rock mulch shall be placed over waste rock emplacement slopes with a 3(H):1(V)) batter to mitigate erosion potential and maximise survival rate of rehabilitation vegetation species;
- the surface of waste rock emplacements will be shaped with a gently undulating topography to mimic the surrounding landscape and naturally promote some localised ponding, thereby enhancing habitat values;
- the low wall of the final void will remain benched as long as the spoil is geotechnically stable under these conditions. The low wall will drain internally into the final void;
- the highwall slope, if in geotechnically stable ground, will remain at the final batter angles and made safe to ensure humans and animals do not harm themselves. Otherwise it will be benched with 15 m benches at 20 m intervals; and
- perimeter stormwater diversions will be designed and constructed to meet appropriate standards. Drainage will be designed and constructed to include a +0.6 m freeboard and provide for a 1 in 20 year flood event.

Table 5-1 Post-Mining Landform Design Criteria

Disturbance Type	Area (ha)	Design Criteria
Spoil dumps-external walls	289	Slope < 3(H):1(V)). Covered with 1 m competent rock/soil mulch.
Spoil dumps-top	698	Shaped to encourage internal ponding. Drainage to merge with natural drainage lines.
Voids, ramps and highwalls	281	Highwall to remain as is if geotechnical stability is sound or otherwise benched with 15 m benches at 20 m intervals. Bench low walls; or Reshape to obtain stability and ensure landform integrity of surrounding landforms .
Haul Roads	61	Remove any creek crossings and reshape to remain stable.

5.4.2 Progressive Rehabilitation

Peabody is committed to the concept of progressive rehabilitation and, where possible, will undertake rehabilitation of all active mining areas within 2 years of disturbance. However there are some areas of disturbed land that will not be available for rehabilitation until later in the mine life for the following reasons:

- the disturbed area is effectively integrated with nearby, unavailable areas; and
- the chemical characteristics of the overburden may improve with time of exposure, thereby improving the success of the rehabilitation.

To manage and monitor progressive rehabilitation, the MEP will prepare a rehabilitation plan that will be updated as required.

A summary of the progressive rehabilitation for the MEP is given below, with mine references taken from the Mine Stage Plans in **Figure 5-1 to Figure 5-5**.

5.4.2.1 Progressive Plan-2011

Mining is proposed to commence in 2011. The first activity associated with mining of the MEP will be clearing and topsoil recovery ahead of the excavation of the initial box-cut and coal access ramp in Mavis Pit. The EWRE 1 will be located to the south-west of this pit with a height up to 60 m.

Expansion of the Millennium Pit will continue, with spoil placed on the EWRE South-West. Topsoil from this area, and the expanded Millennium Pit will be stripped and stockpiled either side of the waste rock emplacement.

5.4.2.2 Progressive Plan-2012

In 2012, excavation of Mavis Pit will continue to the south-east, with infill of the pit from the north with waste rock. Infill of the Millennium Pit will continue. Rehabilitation will commence on EWRE 1. EWRE 2 will be located on MLA 70401 to the east of the Millennium Pit.

5.4.2.3 Progressive Plan-2015

By 2015, excavation of the Millennium Pit will be completed and rehabilitation will have commenced on EWRE 2, EWRE 3 and continue on EWRE 1. Rehabilitation of EWRE South-West will be completed and excavation of Mavis Pit will have commenced by this time.

5.4.2.4 Progressive Plan-2020

By 2020, Millennium Pit will be in-filled as much as practicable and ready for final re-shaping for rehabilitation. Rehabilitation of internal waste rock emplacements within the pit will continue and will also commence on the northern end of Mavis Pit. Rehabilitation of EWRE South-West will be completed.

5.4.2.5 Progressive Plan-2027

By 2027, rehabilitation of Millennium Pit low walls will be completed. The final void of Mavis Pit will also remain with internal waste rock ready for final re-shaping to form the low wall of the void. This low wall will be benched from the top of the internal waste rock emplacement to the pit floor of the final void. Rehabilitation of all other internal and external waste rock emplacements will be completed by this time. All haul roads will be decommissioned and rehabilitated.

626 000m E
628 000m E
630 000m E
632 000m E
642 000m N
640 000m N

MDL354
VALE AUSTRALIA (CQ) PTY LTD

ML70339
VALE AUSTRALIA (CQ) PTY LTD

MLA70735
VALE AUSTRALIA (CQ) PTY LTD

ML70401
MILLENNIUM COAL PTY LTD

MDL136
MILLENNIUM COAL PTY LTD

ML70313
MILLENNIUM COAL PTY LTD

ML70312
MILLENNIUM COAL PTY LTD

ML70344
MILLENNIUM COAL PTY LTD

Poitrel
ML4749
BHP MITSUI COAL PTY LTD

ML70116
BHP COAL PTY LTD

Decline
ROM
Carborough Downs Mine

MAVIS PIT
Inpit Dump
Pit Floor
Vermont Bench (B1)
Leichardt Bench (B2)
Bench 3 (B3)
Bench 4 (B4)
Mine Advance
External Dump 1
Max 60m above natural surface

MILLENNIUM PIT
Mine Advance
Pit A
100 RL
Pit B Near Completion
Pit Floor
170 RL
Pit B
210 RL
250 RL
Pit C
Inpit Dump
Inpit Dump
270 RL
South West Expit Dump
270 RL
South Expit Dump
310 RL

Existing Powerline
Previous Road Alignment
Site Access Road Realignment
66Kv Overhead Power Realignment
Final Rehab Toe
Haul Road
NEW CHUM CREEK
Min 100m Offset from Creek
Final Crest Position
Topsoil
Existing Haul Road
100m Offset from Creek
Final Rehab Toe
Final Crest Position
Final Rehab Toe
West Creek Environmental Control Dam
Existing Topsoil
Existing Rehab Area
Petrel Access Rd
Existing Topsoil
Levee
Product Stockpile
Tailings Cells
ROM Stockpiles
CHPP
Rejects
Rail Spur
Process Water Dam
Final Crest Position

Legend

- Mining Lease
- Mineral Development Licence
- 240 Topography (RL m) AHD
- 66kV overhead powerline
- Drainage

Mining Activity

- Expit active spoil dump
- Inpit active spoil dump
- Mining bench
- Pit floor
- Highwall

Rehab Areas

- Final spoil position for reshaping
- Completed rehabilitation

Topsoil Management

- Existing topsoil dumps
- Possible topsoil locations

NOTE: Mine plan shows maximum resource extraction case; includes mining of Lower Vermont Seams to the Millennium Lease Boundaries.

Design	E Noya (Minserve)
Drawn	R Aspland (Racad Cartography Pty Ltd)

Peabody

12.08.10

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Millennium Coal Pty Limited

Millennium Expansion Project

Mining Stage Plan 1 - 2011

Scale 1:20 000
(A3 Unreduced)

0 200 400 600 800 1000m

Datum: AGD84
Projection: AMG84

FIGURE 5-1

626 000m E
628 000m E
630 000m E
632 000m E
7 642 000m N
7 640 000m N

MDL354
VALE AUSTRALIA (CQ) PTY LTD

ML70339
VALE AUSTRALIA (CQ) PTY LTD

MLA70735
VALE AUSTRALIA (CQ) PTY LTD

ML70401
MILLENNIUM COAL PTY LTD

MDL136
MILLENNIUM COAL PTY LTD

ML70313
MILLENNIUM COAL PTY LTD

ML70312
MILLENNIUM COAL PTY LTD

ML70344
MILLENNIUM COAL PTY LTD

Poitrel
ML4749
BHP MITSUI COAL PTY LTD

ML70116
BHP COAL PTY LTD

Decline
ROM
Carborough Downs Mine

Inpit Dump
Pit Floor
Vermont Bench (B1)
Leichardt Bench (B2)
Bench 3 (B3)
Bench 4 (B4)
Existing Powerline
Site Access Road Realignment
66kV Overhead Power Realignment
External Dump 1
Max 60m above natural surface
Haul Road
Mine Advance
MAVIS PIT
NEW CHUM CREEK
MILLENNIUM PIT
Min 100m Offset from Creek
Final Crest Position

Mine Advance
Pit A
Bench 4
Bench 3
Bench 2
Bench 1
150 RL
Pit Floor
210 RL
250 RL
Inpit Dump
290 RL
Inpit Dump
External Dump South West
290 RL
West Creek
Environmental
Control Dam
External Dump South
310 RL
External Dump 2
Existing Topsoil
Existing Haul Road
100m Offset from Creek
Existing Topsoil
Existing Topsoil
Existing Rehab Area
Poitrel Access rd
ROM
Stockpiles
Tailings
Cells
Product
Stockpile
Level
CHPP
Rejects
Rail Spur
Process
Water
Dam
Final Crest Position
Final Crest Position

Legend

- Mining Lease
- Mineral Development Licence
- Topography (RL m) AHD (240)
- 66kV overhead powerline
- Drainage

Mining Activity

- Expit active spoil dump
- Inpit active spoil dump
- Mining bench
- Pit floor
- Highwall

Rehab Areas

- Final spoil position for reshaping
- Completed rehabilitation

Topsoil Management

- Existing topsoil dumps
- Possible topsoil locations

NOTE: Mine plan shows maximum resource extraction case; includes mining of Lower Vermont Seams to the Millennium Lease Boundaries.

Design	E Noya (Minserve)
Drawn	R Aspland (Racad Cartography Pty Ltd)

Peabody

12.08.10

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Millennium Coal Pty Limited

Millennium Expansion Project

Mining Stage Plan 2 - 2012

Scale 1:20 000
(A3 Unreduced)

0 200 400 600 800 1000m

Datum: AGD84
Projection: AMG84

FIGURE 5-2

626 000m E
628 000m E
630 000m E
632 000m E
7 642 000m N
7 640 000m N

MDL354
VALE AUSTRALIA (CQ) PTY LTD

ML70339
VALE AUSTRALIA (CQ) PTY LTD

MLA70735
VALE AUSTRALIA (CQ) PTY LTD

ML70401
MILLENNIUM COAL PTY LTD

ML70313
MILLENNIUM COAL PTY LTD

ML70312
MILLENNIUM COAL PTY LTD

MDL136
MILLENNIUM COAL PTY LTD

ML70344
MILLENNIUM COAL PTY LTD

Poitrel
ML4749
BHP MITSUI COAL PTY LTD

ML70116
BHP COAL PTY LTD

Decline
ROM
Carborough Downs Mine

Existing Powerline
Site Access Road Realignment
66kV Overhead Power Realignment

Inpit Dump
280 RL
200 RL

External Dump 1
Max 60m above natural surface

Pit Floor
Vermont Bench (B1)
Leichardt Bench (B2)
Bench 3 (B3)
Bench 4 (B4)
Mine Advance

MILLENNIUM PIT
MAVIS PIT

NEW CHUM CREEK
Min 100m Offset from Creek
100m Offset from Creek

Haul Road
Existing Haul Road
Commence Reshape/Rehab

Final Crest Position
Pit Floor
155 RL
170 RL
230 RL
250 RL

External Dump 3
Max 40m above natural surface

External Dump 2
Max 60m above natural surface

Inpit Dump

External Dump South West
Max 310 RL

External Dump South
310 RL

West Creek
Environmental
Control Dam

Existing Rehab Area
Poitrel Access rd

ROM
Stockpiles
Tailings
Cells
Product
Stockpile
Levee
CHPP
Rejects
Rail Spur
Process
Water
Dam

Legend

- Mining Lease
- Mineral Development Licence
- 240 Topography (RL m) AHD
- 66kV overhead powerline
- Drainage

Mining Activity

- Expit active spoil dump
- Inpit active spoil dump
- Mining bench
- Pit floor
- Highwall

Rehab Areas

- Final spoil position for reshaping
- Completed rehabilitation

Topsoil Management

- Possible topsoil locations

NOTE: Mine plan shows maximum resource extraction case; includes mining of Lower Vermont Seams to the Millennium Lease Boundaries.

Minserve

Design	E Noya (Minserve)
Drawn	R Aspland (Racad Cartography Pty Ltd)

Peabody

12.08.10

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Millennium Coal Pty Limited

Millennium Expansion Project

Mining Stage Plan 3 - 2015

Scale 1:20 000
(A3 Unreduced)

0 200 400 600 800 1000m

Datum: AGD84
Projection: AMG84

FIGURE 5-3

626 000m E
628 000m E
630 000m E
632 000m E
642 000m N
640 000m N

Decline
ROM
Carborough Downs Mine

MDL354
VALE AUSTRALIA (CQ) PTY LTD

ML70339
VALE AUSTRALIA (CQ) PTY LTD

MLA70735
VALE AUSTRALIA (CQ) PTY LTD

Existing Powerline
Site Access Road Realignment
66kV Overhead Power Realignment

Inpit Dump
330 RL

External Dump 1
Max 60m above natural surface

260 RL

Inpit Dump
240 RL

200 RL

NEW CHUM CREEK

MILLENNIUM PIT

ML70401
MILLENNIUM COAL PTY LTD

Min 100m Offset from Creek

Haul Road

Pit Floor
Vermont Bench (B1)
Leichardt Bench (B2)
Bench 4 (B4)
Bench 3 (B3)
Mine Advance
Final Crest Position

Final Crest Position
Pit Floor
155 RL

External Dump 3
Max 40m above natural surface

FIGURE 5-5

External Dump 2
Max 60m above natural surface

MAVIS PIT

ML70313
MILLENNIUM COAL PTY LTD

Inpit Dump
230 RL

250 RL

Inpit Dump
290 RL

Inpit Dump
330 RL

External Dump South West
Max 310 RL

Existing Haul Road
Commence Reshape/Rehab

100m Offset from Creek

ML70312
MILLENNIUM COAL PTY LTD

MDL136
MILLENNIUM COAL PTY LTD

Final Crest Position

ML70344
MILLENNIUM COAL PTY LTD

West Creek Environmental Control Dam

Levee
Tailings Cells
Product Stockpile
ROM Stockpiles
CHPP
Rejects
Rail Spur
Petrel Access rd
Process Water Dam

External Dump South
310 RL

Poitrel
ML4749
BHP MITSUI COAL PTY LTD

ML70116
BHP COAL PTY LTD

Legend

- Mining Lease
- Mineral Development Licence
- 240 Topography (RL m) AHD
- 66kV overhead powerline
- Drainage

Mining Activity

- Expit active spoil dump
- Inpit active spoil dump
- Mining bench
- Pit floor
- Highwall

Rehab Areas

- Final spoil position for reshaping
- Completed rehabilitation

Topsoil Management

- Possible topsoil locations

NOTE: Mine plan shows maximum resource extraction case; includes mining of Lower Vermont Seams to the Millennium Lease Boundaries.

Design	E Noya (Minserve)
Drawn	R Aspland (Racad Cartography Pty Ltd)

Peabody

12.08.10

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Millennium Coal Pty Limited

Millennium Expansion Project

Mining Stage Plan 4 - 2020

Scale 1:20 000
(A3 Unreduced)

0 200 400 600 800 1000m

Datum: AGD84
Projection: AMG84

FIGURE 5-4

626 000m E
628 000m E
630 000m E
632 000m E
642 000m N
640 000m N

MDL354
VALE AUSTRALIA (CQ) PTY LTD

ML70339
VALE AUSTRALIA (CQ) PTY LTD

MLA70735
VALE AUSTRALIA (CQ) PTY LTD

ML70401
MILLENNIUM COAL PTY LTD

MDL136
MILLENNIUM COAL PTY LTD

ML70313
MILLENNIUM COAL PTY LTD

ML70312
MILLENNIUM COAL PTY LTD

ML70344
MILLENNIUM COAL PTY LTD

Poitrel
ML4749
BHP MITSUI COAL PTY LTD

ML70116
BHP COAL PTY LTD

Decline
ROM
Carborough Downs Mine

Existing Powerline
Site Access Road Realignment
66kV Overhead Power Realignment
Renal Haul Road
100m Offset from Creek
Min 100m Offset from Creek
NEW CHUM CREEK

MILLENNIUM PIT
MAVIS PIT

Inpit Dump
External Dump 1
Max 60m above natural surface
External Dump 2
Max 60m above natural surface
External Dump 3
Max 40m above natural surface
External Dump South West
Max 310 RL
External Dump South
310 RL
West Creek
Environmental
Control Dam

Spoil Contouring to tie in
with remnant of small mesa
Final Crest Position
Pit Floor

Existing Topsoil
Existing Rehab Area
Poitrel Access Rd
Levee
ROM Stockpiles
Tailings Cells
Product Stockpile
CHPP
Rejects
Rail Spur
Process Water Dam

Legend

- Mining Lease
- Mineral Development Licence
- 240 Topography (RL m) AHD
- 66kV overhead powerline
- Drainage

Mining Activity

- Expit active spoil dump
- Inpit active spoil dump
- Mining bench
- Pit floor
- Highwall

Rehab Areas

- Final spoil position for reshaping
- Completed rehabilitation

Topsoil Management

- Possible topsoil locations

NOTE: Mine plan shows maximum resource extraction case; includes mining of Lower Vermont Seams to the Millennium Lease Boundaries.

Peabody

Minserve

Design	L Sprengel/E Noya
Drawn	R Aspland (Racad Cartography Pty Ltd)

12.08.10

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Millennium Coal Pty Limited

Millennium Expansion Project

Mining Stage Plan 5 - End of Mining 2027

Scale 1:20 000
(A3 Unreduced)
0 200 400 600 800 1000m

Datum: AGD84
Projection: AMG84

FIGURE 5-5

5.4.3 Standard Rehabilitation Processes

The standard rehabilitation processes are those that can be applied to any kind of land disturbance on the MEP.

5.4.3.1 Shaping and Contouring

Any areas of land that have been significantly altered from the existing topography e.g. EWRE and IWRE, will be reshaped to appropriately designed and approved landforms to meet the rehabilitation criteria.

5.4.3.2 Topsoil Spreading

Any areas of land that have had topsoil removed ahead of mining or have had existing topsoil cover significantly and negatively impacted by mining, will be spread with a layer of topsoil suitable for the proposed rehabilitation purposes.

Application of topsoil to the final graded surface provides the most suitable seed bed for the establishment of ground cover. Spreading of topsoil will be undertaken from the top of slopes to minimise erosion damage created by storm runoff. Topsoil compaction will be minimised during spreading by placing topsoil in windrows on the final surface which can then be distributed by a dozer working on the soil. Subsequent machinery passes will be necessary in order to establish vegetation and to construct erosion control structures if required.

5.4.3.3 Seeding

Direct seeding will be used to sow the reshaped and topsoiled rehabilitation areas with native and improved pasture grass or native tree and shrub seed. Deep ripping on the contour prior to seeding and fertilisation will be undertaken to a minimum depth of 500 mm. Sowing will be completed as soon as possible after cultivation and at the beginning of a typical rain season.

Seed mixes will consist of plant species compatible with local vegetation communities, proven as suitable to the proposed final landform topography and regional climate, as well as meeting the short term and long term rehabilitation objectives.

Fertiliser application rates will be developed as required, after review of the soil/spoil analyses for the area. As a guide, if the end land use is native bushland, fertiliser application at a rate of 20 kg/ha will be appropriate. For rehabilitation to pasture, fertiliser application rates in the order of 100-200 kg/ha will be appropriate.

The following procedures will be followed in undertaking direct seeding:

- seed and fertiliser application will be carried out in conjunction with, or immediately following the final ripping/ground cultivation;
- areas with a native bushland final land use will be seeded with native tree and shrub seed applied separately in alternate strips with native grasses; and
- areas with a grazing final land use will be seeded with a mixture of pasture species.

Any areas of land that have been reshaped and/or topsoiled will be seeded with the appropriate mix of seed species for the proposed final land use for that area e.g. potential exotic species for grazing areas and an appropriate native vegetation mix for a bushland ecosystem.

5.4.4 Specific Rehabilitation Processes

There are a number of potential impacts from mining operations that will require the impacted areas to have specific rehabilitation processes applied, as detailed below.

5.4.4.1 Sediment Control and Erosion

Erosion and sediment control is an essential component to achieving site stability, particularly on rehabilitated landforms that have steep or long slopes, and is usually achieved through a combination of vegetation establishment, structural cladding and surface drainage control.

Land that has been disturbed by mining operations and cannot be immediately rehabilitated has an increased erosion potential. Soil sediment from these areas will be managed by:

- minimising the area disturbed;
- treating run-off in sediment sumps and dams; and
- progressive rehabilitation of disturbed areas.

Soil sediment control dams will be constructed to the north and south west of EWRE South-West to prevent sedimentation of the West Creek Environmental Control Dam. Sediment control dams will also be constructed along the south-west of EWRE 1 and 2 to prevent sediment entering New Chum Creek.

Where possible, the downstream sediment and erosion controls will be installed prior to disturbance activities commencing. All temporary control measures will be removed after the disturbance site is stabilised. The haul roads will have sufficient surface drainage to prevent run-off eroding the road or adjacent areas.

The overall mine site water management and drainage system is described in detail in **Chapter 10-Water Resources**, and the potential for erosion for each soil type is described in **Chapter 7-Land**.

The erosion control measures recommended throughout the life of the MEP are summarised in **Table 5-2**.

Table 5-2 Erosion Controls for Mining Activities

Area	Control Measure
Cleared Land	• restrict clearing to areas essential for the works • windrow vegetation debris along the contour • minimise length of time soil is exposed • divert run-off from undisturbed areas away from the works • direct run-off from cleared areas to sediment dam
Exposed Soils	• minimise length of time subsoil is exposed • direct run-off from exposed areas to sediment dam
External/Internal Waste Rock Emplacements	• direct all run-off from dumps to sediment dams • avoid placement of sodic waste material on final external batters • control surface drainage to minimise the formation of active gullies • use soil and rock mulching to armour external batters • direct run-off from rehabilitated areas to sediment dams
Residual Voids	• progressive backfill during operations • regrade treatments for erosion and geotechnically unstable voids • use of rock mulch to control erosion • apply seed and fertilizer as necessary to ensure rapid re-establishment of pasture
Dams	• leave useful water storages to support grazing use • rehabilitate any dam not required post mining by: o regrading embankments; o capping any residual saline material; o replacing topsoil; o ripping on the contour; and o seeding
Haul Roads	• longitudinal v-drains on either side of the road • cleaning of v-drains at set intervals • rock check dams installed along the longitudinal v-drains, where necessary • rock armouring where the discharge exits via a 'breakthrough' • sediment that collects in the rock check dams cleaned, as required

Following a significant rainfall event, erosion repair work may be required in rehabilitated areas. Additional topsoil and seed will be utilised as required to repair larger eroded areas.

5.4.4.2 Flood Mitigation

Potential impacts from flooding and heavy rainfall events have been assessed for the MEP area in **Chapter 10-Water Resources**. Peabody will manage the impacts of flooding in accordance with *SPP 1/03-Mitigating the Adverse Impacts of Flood, Bushfire and Landslides*. Flood levees will be constructed to minimise impacts of flooding and any potential for release of contaminants to the environment, including protection of the final void at the end of mine life from the Probable Maximum Flood level, which is above the requirements in *SPP 1/03*. Location and sizing of flood levees have been determined for the MEP. To reduce internal operational water inflows, a bund will be constructed to prevent ponded water on the surface of internal spoil dumps from flowing toward the final voids down the final low walls.

5.4.4.3 *Geotechnical Stability*

Rehabilitation activities will incorporate the effective management of any potential risks associated with the geotechnical stability of waste rock emplacements and the final void. It is recognised that the stability of these final landforms is critical to the overall success of rehabilitation of the MEP site. Spoil disposal and mine plan designs for the MEP will be assessed by qualified engineers and the most appropriate mining and waste rock placement methods to ensure geotechnical stability of working slopes will be implemented.

The stability of pit and spoil dump slopes will be reviewed and designs amended as required throughout the life of the mine. These periodic reviews will be compared against engineering standards and experiences based at similar coal mines in the region, assessing slope geometries with respect to consequence of slope failure and type of slope.

Based on the topography of the MEP site it is unlikely that there will be any landslides resulting from natural causes. Disturbance to waterways has the potential to create land slippages and mining activities also have the potential to create minor localised slippages within the mine pits. Despite this low risk, should a land slide/slippage occur, Peabody will manage the impacts in accordance with *SPP 1/03*, in consultation with the Queensland Government State Disaster Management Group.

At the end of mine life, an assessment report will be undertaken by a Registered Professional Engineer of Queensland (RPEQ) covering the geotechnical issues and erosivity of the proposed final landforms, including final voids, to demonstrate long-term landform stability.

5.5 DECOMMISSIONING

Decommissioning will occur at the cessation of mining operations, but prior to formal mine closure, and will involve the removal of mine infrastructure and services, and the remediation of all disturbed areas. A Mine Closure Plan, currently being developed for the Millennium Mine, will be expanded to include the MEP as required. The Mine Closure Plan is being developed in consultation with appropriate stakeholders and DERM.

5.5.1 Exploration Areas

Any exploration areas will be rehabilitated in accordance with the *Code of Environmental Compliance for Exploration and Mineral Development Projects (EPA)*. These areas will be re-seeded with pasture grasses and returned to grazing.

5.5.2 External and Internal Waste Rock Emplacements

Both EWRE and IWRE will be rehabilitated as described in **Section 5.3.3** and **5.3.4** respectively and will remain as final elevated landforms.

5.5.3 Final Low Wall, Voids and Ramps

Due to mining practices, there will be no further spoil to fill the final voids and it is not economically feasible to push material back into the void. Consequently, the final void will form a significant feature of the post-mining landform, forming a water body that will be fenced off for safety.

Ramps will be retained in the final landform and it is proposed that the ramp slopes will be left at angle of repose, where geotechnically stable. Some

benching, battering or drainage control works may be required along ramps to control erosion and/or allow rehabilitation works.

The highwall slope, if in geotechnically stable ground, will remain at the final batter angles and be fenced to prevent harm to people or animals. The final low walls will be benched. All exposed coal seams will be covered with inert material wherever possible.

An investigation into residual voids will be undertaken to develop mine decommissioning acceptance criteria. The investigation will at a minimum include:

- a study of options available for minimising final void area and volume;
- development of design and success criteria for rehabilitation of final voids;
- a void hydrology study, addressing the long-term water balance in the voids, connections to groundwater resources and water quality parameters in the long-term;
- a pit wall stability study, considering the effects of long-term erosion and weathering of the pit wall and the effects of significant hydrological events; and
- a study of void capability to support native flora and fauna.

The final voids remaining at the end of the MEP life will cover approximately 231 ha with a maximum depth of approximately 190 m. Pits have been modelled indicating that they do not overflow during extreme rainfall events. Further details are in **Chapter 10-Water Resources**.

5.5.4 Water Management Structures

Where nominated as beneficial by the landowner, water management structures will be left in an operational state after mining has ceased. If the water management structure is not beneficial to the landholder, they will be decommissioned with the walls removed and/or the excavation backfilled and fully rehabilitated.

As a minimum, decommissioning will be conducted such that each dam, either:

- has become a stable landform, that no longer contains flowable substances; or
- has been approved or authorised under relevant legislation for a beneficial use and is subject to legally enforceable conditions of management.

5.5.5 Drainage

The alignment of New Chum Creek will be unaffected by the MEP, with no disturbance (apart from the possible powerline realignment and two haul road crossings which are detailed in **Chapter 10-Water Resources**) within 100 m of the creek channel. However, a minor drainage channel will be constructed to the north-west of EWRE 1 that will direct runoff draining around the EWRE and into New Chum Creek. The drainage channel will be constructed to approved engineering standards, including lining with riprap if scour velocities indicate potential scouring of the channel. Where scouring is unlikely the channel will be stabilised and revegetated with appropriate riparian species.

As outlined in the Millennium Mine 2009 Plan of Operations (Millennium Coal, 2009), Millennium Mine proposes to plant trees similar in composition to what was cleared in the area along the length of New Chum Creek within or near the Millennium Mine and the MEP. This revegetation will occur within a 100 m buffer distance on each side of the stream and will take place in areas

previously cleared due to pastoral activities. The 100 m buffer distance will ensure the planting will not be affected by future mining activities. This will increase the area of riparian margin along the creek and create a riparian corridor to encourage the development of local ecosystems within the mining leases.

5.5.6 Access/Haul Roads

At the end of mine life, haul roads will be rehabilitated to blend in with the surrounding landform. For the haul road crossings of New Chum Creek, culverts will be removed and a natural channel will be re-created. The disturbed areas will subsequently be revegetated with appropriate riparian species. Compacted areas will be ripped, topsoiled and reseeded.

5.5.7 Overhead Powerlines

Any overhead powerlines no longer required for the transmission of electricity will be dismantled and disposed of off-site by a recognised contractor. Any compacted areas around powerline footings will be ripped, topsoiled and re-seeded.

5.5.8 Waste Disposal

All waste material generated during the decommissioning process will be disposed of by an appropriately licenced contractor, with recycling of materials undertaken wherever possible. Hazardous materials, including waste oil, will be disposed of in accordance with the relevant EM Plan, Statutory Licence Conditions, MSDS requirements and Queensland waste tracking legislation. Any hydrocarbon contaminated soil identified within operational areas will be disposed of at an approved facility or bioremediated on-site. Further details are contained in **Chapter 9-Waste.**

5.6 MONITORING AND SUCCESS CRITERIA

Rehabilitation will be monitored as required to ensure success criteria will be met. This monitoring will include an assessment of:

- plant establishment, growth, diversity and cover; and
- evidence and type of erosion.

Rehabilitation performance criteria will be submitted to DERM for review and comment in a rehabilitation management plan. The rehabilitation management plan will, at a minimum:

- develop design objectives for rehabilitation of disturbed areas and post-mining land uses across the mine;
- specify soil and spoil characteristics for use in rehabilitation;
- detail rehabilitation methods applied to different areas of the MEP;
- identify success criteria for different rehabilitation areas;
- explain planned native vegetation rehabilitation areas and corridors;
- identify rehabilitation sites to be used to develop rehabilitation success criteria;
- develop a contingency plan for rehabilitation maintenance or redesign;
- describe end of mine landform design plan and post mining land uses across the mine; and
- propose ERE management and offset protection.

The success criteria developed for Millennium Mine will also be applied to the MEP, however the criteria may change as research findings and monitoring trends of past rehabilitation areas evolve.

5.6.1 Native Bushland

Representative sites deemed to have reached minimum performance criteria (refer to **Table 5-3**) will be selected as analogue sites for the verification of all bushland rehabilitation land. Natural sites will be monitored to provide a reference for planning of rehabilitation sites but not as the criteria for rehabilitation verification.

Table 5-3 Rehabilitation Success Criteria for Native Bushland

Objective	Measurement	Frequency/Location	Success criteria
Slope	Slope measured by aerial survey	Check areas that have been rehabilitated in the previous two years.	80% of areas less than 3(H):1(V))slope.
Ground Cover	Ground cover measured by quadrat method along 100 m transects at nominated monitoring sites. Incorporation of remote sensing techniques for extrapolation of quadrat data (above) across broad areas.	All sites every two years, alternate between wet and dry season. To be determined.	>60% where ground cover is defined as any cover that assists in controlling erosion and may include live or dead cover and possibly rocky debris.
Trees and Shrubs	Species composition, health and density	All sites every two years, alternate between wet and dry season.	Vegetative community is deemed by suitably qualified third party to have reached an acceptable and self-sustaining state. The communities are to be healthy, regenerating with a mixture of predominantly native trees, shrubs and grasses.
Active Erosion	Field erosion survey. Incorporation of remote sensing techniques across broad areas. (Currently subject of coal industry research).	Every two years. To be determined.	None proposed. Area deemed to have acceptable stability by suitably qualified third party.
Soil Chemistry	Surface soil sampling. Full detailed fertility analysis is to be conducted only on surface soil samples. Subsoil sampling of five layers (10, 20, 30, 40, 50 and 60 cm) done for pH, EC, R1 dispersion and major cations (to determine subsoil Ca:Mg, ESP and dispersion).	Every four years, all sites. Every four years, all sites.	EC < 0.6 dS/m to at least 45 cm depth pH < 8.9 and > 5.0 Trending to meet above criteria.

5.6.2 Grassland Suitable for Grazing

Representative sites deemed to have reached minimum performance criteria (refer to **Table 5-4**) will be selected as analogue sites for the verification of all grassland rehabilitation suitable for grazing. Sites will be maintained in adjoining un-mined grazing land to provide a reference for planning of rehabilitation sites but not as the criteria for rehabilitation success.

Table 5-4 Rehabilitation Success Criteria for Grasslands Suitable for Grazing

Objective	Measurement	Frequency / Location	Success criteria
Slope	Slope measured by aerial survey	Check areas that have been rehabilitated in the previous two years every two years	80% of areas less than 1V:20H slope
Ground Cover	Ground cover measured by quadrat method along 100 m transects at nominated monitoring sites	All sites every two years, alternate between wet and dry season	Ground cover >50% where ground cover is defined as any cover that assists in controlling erosion and may include live or dead cover and possibly rocky debris
Vegetation	Vegetation measured by quadrat method along 100 m transects at nominated monitoring sites	All sites every two years, alternate between wet and dry season	Legume and pasture species
Active Erosion	Field erosion survey. Incorporation of remote sensing techniques across broad areas. (Currently subject of Coal Industry research).	Every two years. To be determined.	None proposed. Area deemed to have acceptable stability by suitably qualified third party.
Soil Chemistry	Surface soil sampling. Full detailed fertility analysis to be conducted on surface soil samples. Subsoil sampling of 5 layers (10, 20, 30, 40, 50 and 60 cm) done for pH, EC, R1 dispersion and major cations (to determine subsoil Ca:Mg, ESP and dispersion).	Every four years, all sites. Every four years, all sites.	EC<0.6 dS/m to at least 45 cm depth. pH <8.9 and >5.0 Trending to meet above criteria.
Verify Grazing Suitability	A grazing trial to be conducted with measurement parameters appropriate to determine animal production performance at varying stocking rates. Also, limiting factors and severity determined as per Land Resources Branch (1989).	Not yet determined	Not yet determined

5.7 POST-MINE LAND USE

The over-riding principle for the rehabilitation program for the MEP is that all areas significantly disturbed by mining activities will be rehabilitated to a stable landform with a self-sustaining vegetation cover.

The major post-mine land use goal for areas other than voids, ramps and waste rock emplacement batters is to enable cattle grazing compatible with the surrounding district (refer to **Table 5-5**). The development of grazing as the preferred use has developed from stakeholder and land owner expectations, the current adjoining land use, strong indications of successful and sustained grazing use from data of topsoil quality (refer to **Chapter 7-Land**) and pasture development on rehabilitated overburden at the Millennium Mine.

Although it is the intent to maximise the area of rehabilitated land suitable for grazing, there will be areas of disturbance where a non-grazing outcome is the preferred post-mine objective, as shown in **Figure 5-6**. Grazing may be unsuitable due to limitations through restricted soil water availability, erosion susceptibility and fertility. Such areas will be prone to degradation from stocking pressure and will include steeper outer batters, final voids, and riparian zones. These areas will be revegetated with a mixture of local native tree, shrub and grassland species, and returned to native bushland.

It is highlighted that as grazing is the preferred final land use for some of the disturbance, rehabilitation to native bushland may need to include acceptance of Buffel grass encroaching into the final landform, as this will tend to dominate native grass species.

Table 5-5 Pre-and Post-Mining Land Use

	Disturbance type					
	Final Void Including High Wall And Low Walls	Spoil Dumps	Spoil Dumps (External Batters)	Sediment/Supply Dams	Diversion Channels and Riparian Zones	Road(s)
Pre-mine land use	Grazing	Grazing	Grazing	Grazing	Grazing	Grazing
Post-mine land use	Waterbody/ native bushland	Grazing	Native bushland	Waterbody/ grazing	Native bushland	Grazing
Post-mine land capability classification	N/A	Class 3 grazing land	N/A	N/A or Class 2 grazing land	Class 2 grazing land	Class 2 or 3 grazing land

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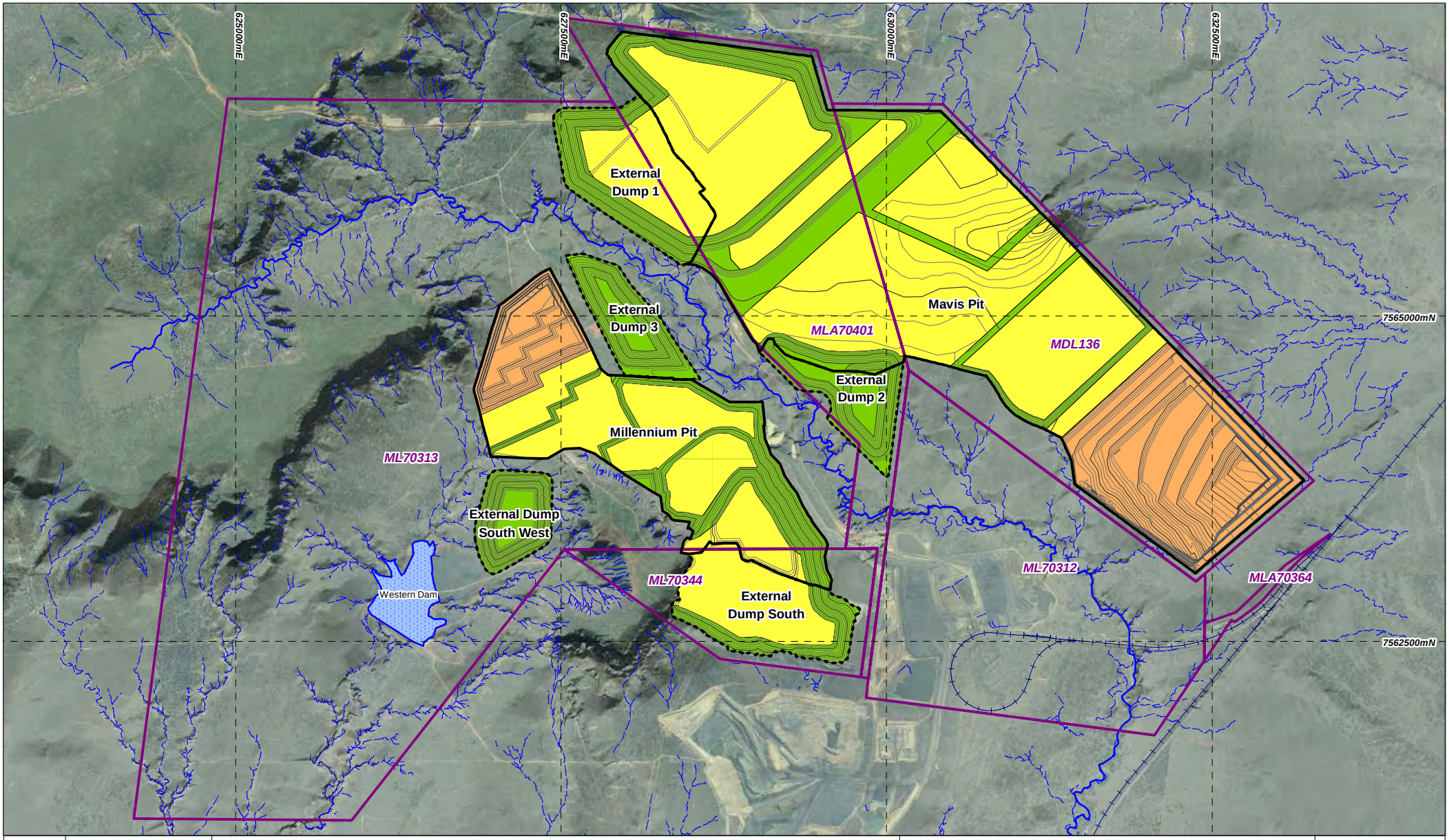

MET SERVE

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 5-6

5.8 REFERENCES

Department of Industry, Tourism and Resources 2006a, Leading Practice Sustainable Development Program for the Mining Industry: Mine Rehabilitation, Commonwealth of Australia.

Department of Industry, Tourism and Resources 2006b, Leading Practice Sustainable Development Program for the Mining Industry: Mine Closure and Completion, Commonwealth of Australia.

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

Department of Mines and Energy 1991, Environmental Management Policy for Mining in Queensland 1991.

Environmental Protection Agency 2004, Policy Framework to Encourage Progressive Rehabilitation of Large Mines.

Land Resources Branch 1989, Guidelines for Land Suitability Evaluation in Queensland. QDPI.

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

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