25 REHABILITATION AND DECOMMISSIONING

25.1 INTRODUCTION

This chapter provides further assessment and information on rehabilitation and post-mining aspects for the Supplementary EIS, in response to various submissions on the EIS and refinements/modifications to the Project and mine scheduling since publication of the EIS.

The information presented builds on the EIS, Volume 1, Chapter 25 Rehabilitation and Decommissioning and should be read in conjunction with the EIS chapter. This chapter provides further information on selected items in the EIS chapter, including the post mining landform and rehabilitation activities and incorporates assessment of refinements/modifications to the Project subsequent to the EIS, including the provision of a final landform.

Chapter 6 Project Operations of the Supplementary EIS provides further details on changes to the Project.

To clarify points raised in submissions on the EIS regarding the order of discussion of rehabilitation, decommissioning and mine closure in Volume 1, Chapter 25 Rehabilitation and Decommissioning, activities on the ground will be undertaken in the order of progressive rehabilitation, then decommissioning including further rehabilitation, then mine closure. However, mine closure is the ultimate aim of rehabilitation and decommissioning and the objectives of the mine closure will influence the goals and strategies required for rehabilitation.

Establishing the mine closure objectives upfront ensures that rehabilitation and decommissioning activities are conducted to achieve the desired post-mining landform and land use. This is why Chapter 25 Rehabilitation and Decommissioning of the EIS was structured in the order of mine closure, then rehabilitation and decommissioning.

25.3 MINE CLOSURE OBJECTIVES

As discussed in Volume 1, Chapter 25 Rehabilitation and Decommissioning, section 25.3, mine closure objectives include that the site is left “suitable for the post-mining land uses agreed with relevant government agencies” and “in a condition which satisfies community, agency and landowner expectations”. Chapter 25 of the EIS contains benchmarks to ensure the land is in a condition and suitable for final land uses which satisfy community, agency and landowner expectations. These benchmarks are further discussed in Chapter 25 of this Supplementary EIS, under the sections 25.4.5 Completion Criteria and 25.4.6 Rehabilitation Action Plan.

A conceptual mine closure plan will be prepared in accordance with Xstrata Coal’s Mine Closure Planning Policy (HSEC STD13.1), covering the progressive conceptual plan for site rehabilitation including closure objectives and criteria, stakeholder identification, final land use options, interim completion criteria, potential risks and issues, and closure activities and likely timeframes. Under the policy, the plan is to be reviewed annually during the life of the mine, with an internal review of the full closure strategy every three years. This plan will include commercially sensitive information, including the financial costs of rehabilitation which will not be made publicly available.

25.4 REHABILITATION

In response to an EIS submission, to clarify the content of Element 6.3 of Enduring Value, as contained in Volume 1, Chapter 25 Rehabilitation and Decommissioning, section 25.4, ‘Enduring Value – the Australian Minerals Industry Framework for Sustainable Development’ (Enduring Value) is an program run by the Mineral Resource Council of Australia to which mining companies can become signatories, and which commits them to sustainable development principles. Xstrata Coal Pty Ltd is a signatory.

Element 6.3 of Enduring Value states ‘Rehabilitate land disturbed or occupied by operations in accordance with appropriate post-mining land uses’. This commitment is a minimum commitment made by Xstrata Coal Pty Ltd. EIS Volume 1 Chapter 9 section 9.6.5, and section 25.4 of this Supplementary EIS chapter, detail the land suitability and post-mining land use commitments made for the Wandoan Coal Project, which are higher standards than those required under Element 6.3 of Enduring Value.

25.4.1 REHABILITATION HIERARCHY

EIS Volume 1, Chapter 25 Rehabilitation and Decommissioning, section 25.4.1 stated that a 'lower value' land use, in terms of the rehabilitation hierarchy, may be more sustainable in preventing off-site impacts.

A potential example of a lower value land use being more sustainable would be the establishment of natural vegetation on land that was agricultural land pre-mining. A natural vegetation system excluded from cattle grazing could have a lower erosion potential and require lesser ongoing maintenance and monitoring than pastures used for grazing. The lower erosion potential would have less potential for sediment-laden runoff from the site, and therefore more sustainable in preventing off-site impacts.

However, as noted in the Rehabilitation Hierarchy, natural vegetation would be a low value land use, and is not a preferred land use by the local community and is therefore not a preferred option by the WJV.

The WJV is intending to rehabilitate most land to be suitable for agricultural use as existed pre-mining, which rates as hierarchy 4 on the rehabilitation hierarchy. Feedback received during the preparation of the EIS, and comments received with submissions on the EIS indicates the communities' preference for the Project to be returned to an agricultural land use post-mining. As discussed in section 9.6.5, rehabilitated overburden piles are proposed to be used for cattle grazing due to cropping being an unproved post-mining land use on these landforms. Cropping will be able to undertaken on undisturbed land within the MLA areas in cropping locations that existed prior to mining.

If, during the operation of the mine, consultation with stakeholders, including the local community and government regulators, indicates a preference for an alternative, higher economic value post-mining land use, the WJV may investigate such alternative post-mining land uses in consultation with the local community and government regulators.

25.4.3 REHABILITATION OBJECTIVES

Broad rehabilitation objectives are provided in EIS Volume 1, Chapter 25 Rehabilitation and Decommissioning, section 25.4.3 and the EM Plan. The rehabilitation objectives will continue to be refined in the Plan of Operations for the mine, and will be based on the content of the EIS, including the measures in section 25.4.6 of this Supplementary EIS.

25.3.4 REHABILITATION INDICATORS

Potential rehabilitation indicators were provided in EIS Volume 1, Chapter 9 Geology, Mineral Resources, Overburden and Soils, section 9.6.7 and Chapter 25 Rehabilitation and Decommissioning, section 25.4.4 and also in sections 9.5.6, 9.5.7, 9.6.5, 9.6.7 and 9.6.8 of this Supplementary. Rehabilitation indicators are provided in the EM Plan and indicators will continue to be developed for the Plan of Operations for the mine, and will be based on the content of the EIS, including the measures in section 25.4.6 of this Supplementary EIS.

25.4.5 COMPLETION CRITERIA

EIS Volume 1, Chapter 25 Rehabilitation and Decommissioning, section 25.4.5 contains discussion on completion criteria for the Project. Detailed completion criteria based on the nominated indicators will continue to be developed closer to the time of mine closure, in consultation with landowners, indigenous groups, community groups and government agencies, as part of the mine closure plan.

Completion criteria are included in the EM Plan based on the content of the EIS and Supplementary EIS, including the following:

- post-mining landform – EIS Volume 1, Chapter 9, section 9.6.1 and Supplementary EIS, Volume 1, Chapter 9, section 9.6.1
- overburden and soil management – EIS Volume 1, Chapter 9, sections 9.6.2 and 9.6.3, and Supplementary EIS, sections 9.6.2 and 9.6.3
- post-mining land use – Supplementary EIS Volume 1, Chapter 9, section 9.6.5
- post-mining land suitability classification – Supplementary EIS Volume 1, Chapter 9, section 9.6.5
- Ecology – EIS and Supplementary EIS, Volume 1, Chapter 17A, section 17A.5.2 and Chapter 17B, section 17B.6
- water management – EIS and Supplementary EIS, Volume 1, Chapter 11 Water Supply and Management, section 11.6

- decommissioning – EIS, Volume 1, Chapter 25, section 25.5
- public safety – EIS, Volume 1, Chapter 24, section 24.5.6.

25.4.6 REHABILITATION ACTION PLANS

As discussed in the EIS Volume 1, Chapter 25 Rehabilitation and Decommissioning, section 25.4.6, rehabilitation action plans will be prepared for each domain (part) of the mine to guide rehabilitation, and these action plans will be incorporated into the Project's Plan of Operations.

However, refinements and/or amendments to this final landform will occur as the Project develops.

A number of submissions commented on issues related to the post-mining landform and landuse, as well as rehabilitation activities. These items were addressed in various chapters of the EIS and Supplementary EIS. Reference to the rehabilitation and post-mining related mitigation measures from these chapters, as well as updates from this Supplementary EIS, have been compiled below.

Undisturbed areas

The final land use for undisturbed areas will be as per the EIS Volume 1, Chapter 9 Geology, Mineral Resources, Overburden and Soils, section 9.6.5.

Final voids

As discussed in this Supplementary EIS Chapter 6 Project Operations, section 6.4.4, the revised tailings disposal strategy for the Project has resulted in the Austinvale North, Austinvale, Leichhardt, Woleebee North and Woleebee Pits being used for tailings disposal, and therefore no final voids will remain in the final landform for these pits. As a result, MLA 50230 and MLA 50231 combined are likely to comprise fewer final voids than originally specified in the EIS.

Other final voids are likely to remain in the final landform due to economic constraints involved in transporting overburden, waste rock or oxidised coal between pits or from the CPP to pits to fully remove voids. Further details regarding final voids, is contained in the EIS Volume 1, Chapter 9 Geology, Mineral Resources, Overburden and Soils, section 9.6.7, and EIS Volume 1, Chapter 25 Rehabilitation and Decommissioning.

The final voids will be externally drained to minimise capture of overland flow. A final void will be formed by reducing the outer/boxcut slopes and adjacent overburden stockpiles to typically up to an average of 1(v):7(h), or 14.2% gradient. To infill the void, the gradient of the high wall will be reduced from a standing highwall angle of nearly 55° (1:0.7 or 143% gradient) to an angle of approximately 20° (1:3 or 36% gradient), bringing the pit floor up towards natural topographical surface. The low wall gradients will be reduced from an angle of repose of 35° (1:1.4 or 70% gradient) to an angle of approximately 24° (1:2.2 or 45% gradient). Depths of final voids will vary with the volume of material available at each pit for infilling. A 36% gradient means that a final void of 60 m depth would be approximately 300 m in width.

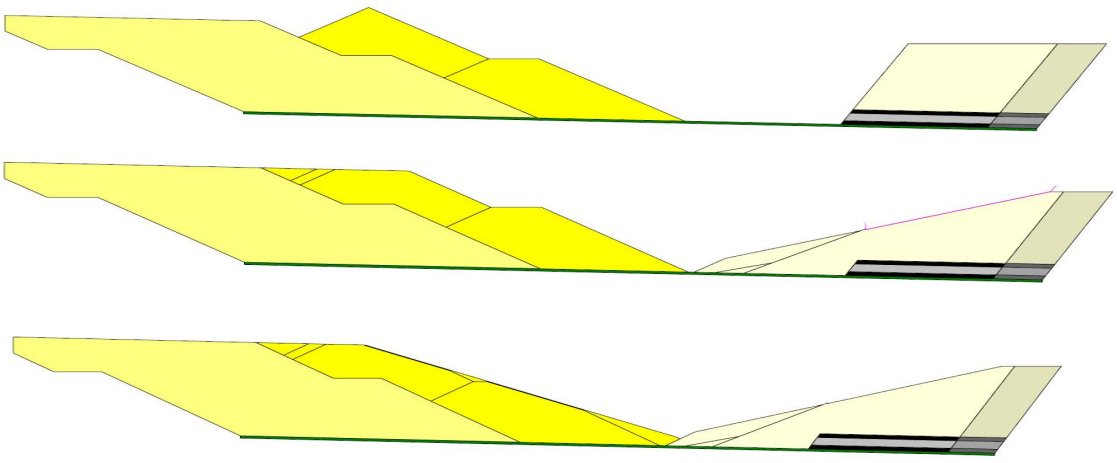

Figure 25-1: Cross sections of rehabilitated final voids with a 60 m final void depth, showing an excavated void (top), rehabilitation of adjacent overburden stockpiles and high wall (middle), and rehabilitation of a low wall (bottom)

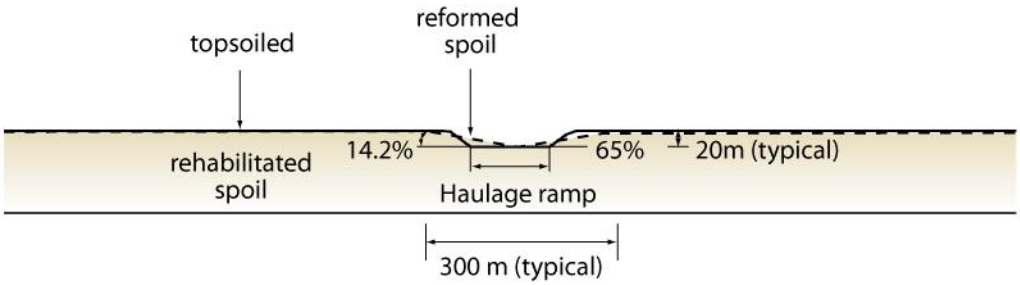

Figure 25-2: Cross section of rehabilitated ramp

Infrastructure areas and roads

Decommissioning and rehabilitation of infrastructure and road areas will occur as described in EIS Volume 1, sections 9.5.6, 9.6.6 and 25.4.6, and amended by information provided in section 9.6.5 of this Supplementary EIS.

Overburden stockpiles

Rehabilitation of in-pit overburden placed by dragline and elevated out of pit overburden stockpiles will occur as per the EIS Volume 1, Chapter 9 Geology, Mineral Resources, Overburden and Soils, sections 9.6.5 and 9.6.6, Chapter 11 Water Supply and Management, section 11.6.3, Chapter 25 Rehabilitation and Decommissioning, section 25.4.6 and amended by information provided in sections 9.6.5 and 11.6.3 of this Supplementary EIS.

The EIS Volume 1, Chapter 6 Project Operation, section 6.3.3 and Figure 6-5-V1.3, present the mining process by dragline, including the general profile of dragline strips post mining. As mining strips progress, void spaces will be filled with draglined overburden from the following strip, and partings used to fill between the overburden stockpiles in preparation for rehabilitation. Overburden stockpiles will be levelled out to cap all materials and shaped to provide a gently undulating landform, with shallow gradients between the dragline spoil rows before application of topsoil over landform.

Tailings dam

As discussed in Supplementary EIS, Chapter 6 Project Operations, section 6.4.4, tailings are proposed to be disposed of in-pit, and covered with up to approximately 20 m of overburden material. As such tailing dam features will no longer be present in the Project.

Creek diversions and levee banks

Rehabilitation of creek diversions and levee banks will occur as described in the EIS Volume 1, Chapter 9 Geology, Mineral Resources, Overburden and Soils, section 9.6.6, Chapter 11 Water Supply and Management, sections 11.6.1 and 11.6.6, Chapter 17B Aquatic Ecology, sections 17B.6.2 and 17B.6.7, and Chapter 25 Rehabilitation and Decommissioning, section 25.4.6 and amended by information provided in corresponding sections of this Supplementary EIS.

Water storage dams

Rehabilitation of water storage dams will occur as per the EIS Volume 1, Chapter 25 Rehabilitation and Decommissioning, section 25.4.6.

The following additional measures will also be undertaken in relation to water storage dams:

- in the decommissioning of water storage dams, any membrane liner and any hazardous material (including saline material) will be carefully removed and disposed of to ensure hazardous material does not seep into the surrounding or underlying soil, groundwater or surface water
- dams constructed under overland flow exemptions, as may be required under environmental authority conditions, will be removed and rehabilitated post-mining.

25.4.7 IMPLEMENTATION OF REHABILITATION STRATEGY

Rehabilitation strategies will be implemented to address rehabilitation objectives and indicators. As discussed in the EIS Volume 1, Chapter 9 Geology, Mineral Resources, Overburden and Soils, sections 9.6.1 to 9.6.3, Chapter 17A Ecology section 17A.5.2, and Chapter 25 Rehabilitation and Decommissioning, section 25.4.6, these strategies will broadly include:

- minimising the area of disturbed land at any one time through planning, staged development and designation of specific site areas.
- progressive rehabilitation over the life of the mine, with rehabilitation commencing within two years of land becoming available for rehabilitation.
- identification of land under rehabilitation and land to be rehabilitated will be included in each Plan of Operations, for the term of the Plan of Operation.
- preparation of a Biodiversity and Land Management Plan to manage ecological aspects of the Project, as described in the EIS Volume 1, Chapter 17A Terrestrial Ecology, section 17A.5.2.
- preparation of the following documents to manage rehabilitation and the final landform, as described in the EIS Volume 1, Chapter 9 Geology, Mineral Resources, Overburden and Soils, section 9.6.7:
  - erosion and sediment control
  - topsoil management and register
  - overburden dump construction
  - rehabilitation and revegetation
  - stormwater management
  - permit to disturb system
  - final void geotechnical assessments.
- Managing disturbance and topsoil through a permit to disturb system based on information contained in the EIS Volume 1, Chapter 9, section 9.6.3.

The rehabilitation strategy will be guided by the preparation of a Rehabilitation Procedure. This procedure will detail:

- rehabilitation objectives, based on information contained in the EIS Volume 1, Chapter 25, section 25.4.3
- reference sites and rehabilitation sites to be used for developing appropriate rehabilitation criteria and for rehabilitation monitoring
- end of mine landform design and post-mining land use across the mine, based on information contained in the Supplementary EIS, Chapter 9 sections 9.6.5, 9.6.8 and Chapter 25, section 25.4.6
- schematic representation of the final landform, inclusive of:
  - drainage design and features
  - slope design
  - cover design
  - erosion controls proposed on reformed land
  - these can be based on information contained in and the EIS and Supplementary EIS Volume 1, Chapters 9 and 11 and figures presented in Chapter 6.
- planned nature conservation rehabilitation areas and corridors
- soil and overburden characteristics and handling requirements, based on information contained in and the EIS Volume 1, Chapter 9 section 9.6
- planned rehabilitation methods for disturbed areas, based on information contained in the EIS Chapter 9, section 9.6 and the Supplementary EIS Volume 1, Chapter 9 section 9.6
- itemised revegetation criteria for both grazing and nature conservation, including creek diversions
- rehabilitation monitoring and maintenance planned to be applied to areas of disturbance
- monitoring methodology of rehabilitation and reference sites

The EIS Volume 1, Chapter 9 Geology, Mineral Resources, Overburden and Soils, section 9.6.7, stated that progressive rehabilitation will be undertaken over the life of the mine, and will commence within two years of land becoming available for rehabilitation.

Land will become "available for rehabilitation" once mining operations (e.g. placement of overburden or rejects) has been completed for a portion of land. A nominal two year period to account for settlement and stabilisation of overburden and to allow a safe distance from mining equipment for rehabilitation operators to be in the area is proposed. In considering the up to two years time period, it should be noted that pits will only advance horizontally between about 250 and 500 m per year.

Mine planning will be designed as such that a large portion of rehabilitation commences within two years of the land becoming available.

By the end of Year 5, rehabilitation activities will have commenced for sections of Austinvale Pit, Frank Creek Pit and Wubagul Pit, as shown in Figure 6-6-SV1.3. Figures 6-6-SV1.3 to 6-13-SV1.3, and 6-42-SV1.3 to 6-45-SV1.3 present the land to be rehabilitated or under rehabilitation at specific stages of mine operations. However, transfer of ownership of land to agricultural landowners will not be able to occur until DERM has certified that rehabilitation has been successful and the landform sustainable without maintenance requirements more than required for the surrounding landscape.

Risk assessment

The purpose of the rehabilitation risk assessment discussed in the EIS Volume 1, section 25.4.7 is to characterise and rank potential risks during rehabilitation (e.g. vegetation failure, downstream water impacts, socio-economic impact), such that mitigation measures can be appropriately targeted relative to their risk. The risk assessment will be site specific, and completed following detailed design. The risk assessment will be a component of the conceptual closure plan discussed in section 25.4.5 above.

Rehabilitation monitoring

EIS Volume 1, Chapter 25 Rehabilitation and Decommissioning, section 25.4.7 states:

Monitoring and assessment of progressive rehabilitation will be undertaken throughout the planning, construction, operational and decommissioning phases of the Project. If monitoring and assessment results indicate that the rehabilitation objectives may not be achieved, then the rehabilitation strategy will be modified.

This paragraph is amended to:

Monitoring and assessment of progressive rehabilitation will be undertaken throughout the planning, construction, operational and decommissioning phases of the Project. If monitoring and assessment results indicate that the rehabilitation objectives may not be achieved, then the rehabilitation strategy will be modified, to ensure that rehabilitation objectives are met.

Baseline monitoring

Baseline monitoring of a number of aspects will be required to feed into the planning of rehabilitation activities, and as discussed in various sections of the EIS. A summary of this baseline monitoring and an indication of timing of monitoring includes:

- stream water quality – as described the EIS and Supplementary EIS Volume 1, Chapter 11 Water Supply and Management, section 11.3.6 and associated technical reports, and will continue as discussed in the EIS and Supplementary EIS Chapter 11, section 11.6.1
- aquatic ecology – as described in the EIS and Supplementary EIS Volume 1, Chapter 17B Aquatic Ecology, section 17B.3, and associated technical reports, and continuing as discussed in the EIS and Supplementary EIS, Chapter 11 Water Supply and Management, section 11.6.1 and Chapter 17B, section 17B.6.10
- terrestrial ecology (flora and fauna) – as described in the EIS and Supplementary EIS Volume 1, Chapter 17A Terrestrial Ecology, section 17A.3 and associated technical reports
- land suitability classes – as described in the EIS and updated for the Supplementary EIS as discussed in section 9.3.7.

Ongoing rehabilitation monitoring

The WJV commits to engaging with local community groups to assist with rehabilitation and monitoring of the Project. Rehabilitation monitoring techniques similar to those used at other Xstrata Coal mines will be implemented for this Project.

As an example of monitoring techniques that may be used, Xstrata Coal's, Collinsville Coal Mine implements Ecosystem Function Analysis (EFA). EFA is an observation-based tool developed by the CSIRO that is used to

measure the biophysical efficiency of a site over rehabilitation, and is capable of incorporating differing vegetation growth rates in initial rehabilitation relative to older rehabilitation sites. The monitoring compares rehabilitated sites to analogue sites, and includes measures of soil properties, vegetation dynamics and habitat complexity. Recommendations on maintenance requirements and changes to rehabilitation processes are gained from the monitoring. Further details on EFA are available at http://www.csiro.au/services/EcosystemFunctionAnalysis.html

Rehabilitation maintenance

Under Chapter 7 Part 6 of the *Environment Protection Act 1994*, the Queensland Government, through DERM, will hold a bond, or financial assurance from the WJV accounting for a portion of the rehabilitation costs of the mine site. The amount of financial assurance held by DERM will be based on calculated rehabilitation costs and the environmental performance of the mine site. The financial assurance is recalculated with each Plan of Operations. Further details of the financial assurance process are contained in Financial Assurance for Mining Activities (EPA 2003), available from the DERM website at http://www.epa.qld.gov.au/environmental_management/land/mining/guidelines

To surrender land following the completion of mining and rehabilitation activities, the WJV will require approval from DERM under the *Environmental Protection Act 1994*. Under Division 2, Subdivision 1 of this Act, the WJV is required to submit a Final Rehabilitation Report which will:

- describe any ongoing environmental management needs for the land
- state details of:
  - the monitoring program and the results of monitoring rehabilitation indicators required under any condition of the environmental authority
  - any consultation with members of the public, community groups, government agencies, and other bodies in relation to the completion criteria for rehabilitation, as stated in the environmental authority.
- state an environmental risk assessment of the land
- propose the residual risks associated with the rehabilitation of the land, worked out under a guideline or other document publicly available from the administering authority.

DERM will assess the residual risks for maintenance or rehabilitation failure, and can refuse the surrender if not satisfied with the residual risk. DERM are able to require the WJV to make a payment to cover maintenance of potential residual risks of the area.

Subject to the residual risk payment discussed above, once the land has been surrendered the management and maintenance will be the responsibility of the landowner.

It should be noted that future legislation changes could alter these requirements.

Examples of similar rehabilitation methodologies and post mining land use

Interest in cattle grazing on rehabilitated land has advanced in recent years as the shortage of available land for agricultural, and community expectation of the return of mined lands to their pre-mining land use, is acknowledged by government regulators and mining companies. Coal mines in Queensland currently pursuing a cattle grazing post mining land use, or conducting trials into cattle grazing on rehabilitated land include Blackwater, Goonyella Riverside, Norwich Park and Collinsville mines.

The amount of recorded data available across Queensland on rehabilitated grazing sites is limited and long term grazing assessment data (five years plus) is non-existent, although there are assessments of sites which have been rehabilitated some time ago, but have only recently been utilised for cattle grazing. There is some data available from the Hunter Valley in NSW but it is a largely temperate grazing system as opposed to the sub-tropical systems that dominate Central Queensland. However it is worth noting that the Hunter Valley rehabilitation project did produce a grazing capacity that was equal to if not better than the grazing on unmined land (Grigg, 2000).

The Australian Coal Association Research Program (ACARP), in association with the University of Queensland, have conducted a number of studies into cattle grazing as a post-mining land use in Queensland, including:

- ACARP Project C8038 Completion criteria for pasture-based rehabilitation in the Bowen Basin
- ACARP Project 9038 Sustainable grazing on rehabilitated lands in the Bowen Basin (Grigg 2000)
- ACARP Project C14053 Assessing grazing risks for rehabilitated pastures in Central Queensland.

Other relevant studies into pasture landscapes and cattle grazing include:

- the nature and management of rehabilitated pastures on open-cut coal mines in central Queensland by A Grigg, *et al*., in *Tropical Grasslands* (2000)
- effects of pasture cover on soil erosion and water quality on central Queensland coal mine rehabilitation by C Carroll and A Tucker, in *Tropical Grasslands* (2000)
- net primary productivity and rainfall use efficiency of pastures on reconstructed land following open-cut coal mining in central Queensland, Australia, by A Bisrat *et al*. in *Tropical Grasslands* (2004)
- Ravensworth Operations (Narama and Ravensworth West) Pasture and Soil Evaluation, Neil Nelson Agvice Pty Ltd (2005).

These studies have shown that cattle grazing on rehabilitated land in Central Queensland can be an achievable and sustainable post-mining land use, and may have comparable erosion rates and productivity relative to the surrounding natural landscape (Peck and Chamberlain 2001). However, management requirements of rehabilitated land differ from that of natural landscapes, and careful management of stocking rates is required to prevent erosion and degradation.

The data collected from the grazing evaluations by Grigg (2000) are expected to provide a indication of the grazing potential for the Wandoan mining area after rehabilitation as the soils properties, pasture species, rainfall and proposed rehabilitation methods are similar to Wandoan. Stocking rates recommended by Grigg (2000) on three sites in Central Queensland, based on a four year study are provided in Table 25-1, while average weight gain performance data is provided in Table 25-2. Further details on stocking rates is provided in the Supplementary EIS Chapter 22 Economics, technical report STR22-1-SV1.5 Wandoan Coal Project Supplementary EIS Economic Evaluation of Agricultural Production under Mining Lease.

Table 25-1: Example stocking rates for the rehabilitated sites

Rehabilitation site	Stocking rate (ha/head)	Comments
Blackwater	3.2	Estimate based on measured performance from three set stocking rates.
Goonyella Riverside	4.0	Estimate based on measured performance from a number of set stocking rates.
Norwich Park	3.0	The measured performance of this stocking rate would indicate that the long term stocking rate could be higher.

Source: after Grigg 2000

Table 25-2: Example weight gain performance data for rehabilitated sites

Rehabilitation site	Average daily gain (kg/head/day)	Comments
Blackwater	0.62	Data collected from February 2000 to August 2003.
Norwich Park	0.42	Data collected from May 2000 to April 2004.

Source: after Grigg 2000

The Stocking rates for Norwich Park and Blackwater indicate that the rehabilitated pastures are producing performance that is comparable to unmined land in the same area (Peck and Chamberlain, 2001).

The sustainability of these grazing sites was assessed by monitoring dry matter production and percentage of vegetative cover. The results correlate with data from the Department of Primary Industries and Fisheries (2004) that sustainable grazing could be obtained if utilisation rates were kept at 30% or less of total dry matter produced per year and canopy cover was maintained at above 50%. These levels ensured minimal soil movement in the evaluated sites. The dry seasons experienced during the Blackwater, Norwich Park and Goonyella Riverside evaluation trials also highlighted that a 30% utilisation rate in 80% of years gave the pastures some reserves to be able to cope with dry periods where utilisations may increase in those 20% of years because of a lack of productive rainfall.

It must be acknowledged that cattle grazing as a post-mining land use has a higher risk profile compared to nature conservation, and unsuccessful rehabilitation relating to cattle grazing has occurred at mine sites, including relating to trace element deficiencies or toxicities in cattle. Unsuccessful nature conservation rehabilitation also has and does occur at mine sites. However, as shown above, knowledge exists within the mining industry to achieve sustainable cattle grazing. Methods to minimise the risk of rehabilitation failure, as

discussed previously in the EIS, include site specific trials early in mining operations to tailor rehabilitation methodologies to the local conditions of the site, adjusting rehabilitation techniques based on monitoring results, and remediation of erosion identified.

Examples of rehabilitation of mined land to a stable, sustainable, landform with cropping land use are very limited at present. However, research and technological advances over the 30-year lifespan of the mine, means that before the end of the mine life, cropping may be an achievable post-mine land use. As a result of the current unproven nature of these technologies, the WJV cannot commit at this time to achieving cropping as a final land use. However, WJV commits to rehabilitation trials, which may include cropping trials, to ascertain whether Wandoan rehabilitation sites can produce stable, sustainable landform under cropping.

Xstrata Coal have rehabilitated land to a cattle grazing land use at their Ravensworth Operations in the Hunter Valley, NSW and Collinsville Mine in the Bowen Basin. The rehabilitation methodology used for the Project will be similar to that used by Xstrata Coal at other mine sites in which it has an interest. Some examples of the rehabilitation techniques and findings from Xstrata Coal's Ravensworth Operations and Collinsville Mine are contained below.

Ravensworth Operations

The Ravensworth Operations (Narama and Ravensworth mines) are located in the Hunter Valley in NSW. Xstrata Coal took over ownership of the mines in 2002. To March 2007, 184 ha had been rehabilitated at Narama, including 116 ha of pasture and 68 ha of tree corridors, with approximately 20 ha rehabilitated each year. Prior to mining the land was used for grazing of cattle.

Some of the rehabilitation techniques used at this site to facilitate effective rehabilitation for pasture include:

- minimising the area of disturbance
- transferring topsoil directly from pre-strip areas to rehabilitation areas to avoid any topsoil storage period
- fencing of rehabilitation areas into suitable paddock sizes
- planning of dams for sediment control and cattle watering
- on designated pasture areas topsoil is spread to a depth of 10-20 cm by a track dozer. The area is then re-ripped, rock raked and seeded with a variety of species using a tractor drawn spreader.

The impacts of grazing are being monitored in terms of soil characteristics, pasture feed quality, weed growth and land capability assessment.

A number of transects are monitored in rehabilitated pasture areas, unmined pasture areas, and unmined pasture areas on alluvial plains. Cattle carrying capacity has been comparable on the rehabilitated pasture relative to the unmined pasture areas.

The site has experienced a drought, with evidence of selective grazing reducing the occurrence of pastures such as kikuyu, setaria and perennial pastures in both the rehabilitation and unmined pasture areas. The areas of bare ground have increased due to the drought, but not to excessive levels. Careful management of stock levels, including temporary removal of stock from some areas, as well as broadcasting of perennial grass seeds, has been undertaken to manage the rehabilitation areas during the drought.

Collinsville

Collinsville Mine is located in the Bowen Basin, 80 km southwest of Bowen. Cattle grazing trials are being conducted on waste dumps at the site with established (6 year old) rehabilitation. The site comprises tussock grasses (mainly buffel grass) and tree lines.

The impacts of grazing are being monitored by EFA. Monitoring is undertaken on an annual basis with a transect on the grazed section of waste dump, a transect on a similar, but ungrazed section of waste dump and a transect on an adjacent unmined property.

Results have shown erosion on the grazed areas is not significantly different to the ungrazed areas and adjacent unmined property (Landloch Pty Ltd 2008). The stocking rates and weight gain are similar to that of the adjacent property.

25.6 REFERENCES

Bisrat, A, Mullen B, Grigg A and Shelton, H. Net primary productivity and rainfall use efficiency of pasture on reconstructed land following open-cut coal mining in central Queensland, Australia, in *Tropical Grasslands*, Volume 38, p47-55.

Carroll, C and Tucker, A, 2000, Effects of pasture cover on soil erosion and water quality on central Queensland coal mine rehabilitation, in *Tropical Grasslands*, Volume 34, p254-262.

Grigg, A., Emmerton, B.R. and McCallum, N.J., 2001, *Completion criteria for pasture-based rehabilitation in the Bowen Bas*in, ACARP Project C8038*,* Australian Coal Association Research Program, Centre for Mined Land Rehabilitation, University of Queensland.

Grigg, A., Mullen, B., Hwat, H.B., and Shelton, M, 2006, *Sustainable Grazing on Rehabilitated Lands in the Bowen Basin – Stages 1 and 2*, ACARP Project C9038, Australian Coal Association Research Program, Centre for Mined Land Rehabilitation, University of Queensland.

Grigg, A., Shelton M., and Mullen, B., 2000, The nature and management of rehabilitated pastures on open-cut coal mines in central Queensland, in *Tropical Grasslands,* Volume 24, p242-250.

Landloch Pty Ltd, 2008, *Ecosystem Function Analysis (EFA): Rehabilitation monitoring on Collinsville Coal Mine, Queensland*. Report prepared for Xstrata Coal Pty Ltd.

Maczkowiack, B., 2008, *A risk assessment model for the custodial transfer of mined land to grazing, Stage 2*, ACARP Project 14053, Australian Coal Association Research Program, The University Of Queensland.

Maczkowiack, B., Slaughter, G., and Mulligan D., 2007, *Integrating economic, social & biophysical factors to assess risks of grazing as a final end use of rehabilitated mine land in Central Queensland, Stage 1*, ACARP Project 14053, Australian Coal Association Research Program, The University Of Queensland.

Neil Nelson Agvice Pty Ltd, 2005, *Ravensworth Operations Narama and Ravensworth West Pasture and Soils Evaluation*, Singleton, NSW.

Queensland Department of Primary Industries & Fisheries, 2004, *Stocktake – Grazing resources monitoring package, workshop notes*. QDPI&F Publications, Brisbane.

S Bisrat, P Horn, K Yatapange ACARP Project 9038 Sustainable grazing on rehabilitated lands in the Bowen Basin