Tarrawonga Coal Project

Environmental Assessment

SECTION 5

REHABILITATION AND LANDSCAPE MANAGEMENT STRATEGY

Resource Strategies

Tarrawonga Coal Pty Ltd

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5 REHABILITATION

This section summarises the approach to rehabilitation and landscape management for the Project. It describes how the Project would be progressively rehabilitated and integrated into the adjoining landscapes, and the measures that would be put in place for the long-term protection and management of the site following the cessation of mining.

5.1 EXISTING REHABILITATION MONITORING AND MANAGEMENT AT TARRAWONGA COAL MINE

A summary of rehabilitation activities undertaken at the Tarrawonga Coal Mine and the rehabilitation monitoring results are documented annually in the AEMR.

The Tarrawonga Coal Mine MOP describes site activities and the progress toward environmental and rehabilitation outcomes required under the mining lease conditions and the Development Consent (DA 88-4-2005).

5.2 REHABILITATION AT TARRAWONGA AND OTHER WHITEHAVEN COAL MINES

Rehabilitation activities at the existing Tarrawonga Coal Mine commenced in 2007 and have focused on the western slopes of the Northern Emplacement. An area of approximately 27.5 ha has been rehabilitated to date.

The objective of the current rehabilitation is to re-profile the available finalised Northern Emplacement batters to a stable overall slope of approximately 10^{o}, and to revegetate the completed landform to open native woodland with flora species characteristic of the local area. Fauna habitat features (e.g. tree trunks) are incorporated into the rehabilitation areas.

Rehabilitation monitoring results at the Tarrawonga Coal Mine indicate that the initial cover crop has been successful in stabilising the rehabilitation areas, with a 95% cover recorded (Geoff Cunningham Natural Resource Consultants, 2010).

Tube stock establishment has also been largely successful to date with a survival rate of approximately 75% (TCPL, 2010). Several fauna species have been observed on the rehabilitated western slopes of the Northern Emplacement, including: the Nankeen Kestrel, Galah, Crested Pigeon, Australian Magpie, Australian Raven, Apostlebird, Black-shouldered Kite, Euro, House Mouse, Variegated Dtella and Tree-crevice Skink (Countrywide Ecological Services; 2009a, 2009b 2010).

Whitehaven is also progressively rehabilitating several of its other mines in the region, including the Canyon Coal Mine, Rocglen Coal Mine and Sunnyside Coal Mine, which are located to the south of the Tarrawonga Coal Mine (Figure 1-1).

As described in Attachment 3, Whitehaven maintains the Canyon Coal Mine site, which ceased operations in 2009, in accordance with the *Canyon Open Cut Coal Mine Closure Plan* (Whitehaven, 2009), Development Consent (DA-8-1-2005) and EPL 10094. The rehabilitation activities conducted at the Canyon Coal Mine site have included reshaping of the final void and overburden emplacements, topsoil placement, installation of water management control measures, establishment of a cover crop, planting of tube stock, and monitoring and maintenance of rehabilitated areas.

The Canyon Coal Mine site has been successfully returned to a mixture of open pasture areas and established woodland, and is the model on which all Whitehaven rehabilitation projects are currently based. Photographs depicting the progressive implementation of several of the rehabilitation stages at the Canyon Coal Mine are provided in Plates 5-1 to 5-6. Photographs of the progressive rehabilitation of the Northern Emplacement at the Tarrawonga Coal Mine are provided in Plates 5-7 to 5-10.

5.3 REHABILITATION AND MINE CLOSURE GOALS FOR THE PROJECT

The Project would require the progressive removal of approximately 334 ha of woodland and forest habitat and approximately 223 ha of grassland habitat. This includes approximately 145 ha of native vegetation in the Leard State Forest.

Table 5-1 describes the rehabilitation and mine closure goals for the Project. The rehabilitation and revegetation concepts described within this section build upon, and are consistent with, these goals.

Plate 5-1 Canyon Coal Mine - Prior to Reshaping

Plate 5-2 Canyon Coal Mine - Following Reshaping

Source: Whitehaven (2011)

TARRAWONGA COAL PROJECT

PLATES 5-1 and 5-2

Canyon Coal Mine Rehabilitation

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Plates 5-3 Canyon Coal Mine - Cover Crop Establishment

Plate 5-4 Canyon Coal Mine - Cover Crop Establishment

Source: Whitehaven (2011)

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PLATES 5-3 and 5-4

Canyon Coal Mine Rehabilitation

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Plates 5-5 Canyon Coal Mine - Rehabilitation Under Maintenance

Plate 5-6 Canyon Coal Mine - Rehabilitation Under Maintenance

Source: Whitehaven (2011)

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PLATES 5-5 and 5-6

Canyon Coal Mine Rehabilitation

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Plates 5-7 Tarrawonga Coal Mine - Northern Emplacement Reshaping and Fauna Habitat Placement

Plate 5-8 Tarrawonga Coal Mine - Northern Emplacement Cover Crop Establishment

Source: Whitehaven (2011)

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PLATES 5-7 and 5-8

Tarrawonga Coal Mine Rehabilitation

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Plates 5-9 Tarrawonga Coal Mine - Northern Emplacement Reshaping and Cover Crop Establishment

Plate 5-10 Tarrawonga Coal Mine - Northern Emplacement Tube Stock Establishment

Source: Whitehaven (2011)

TARRAWONGA COAL PROJECT

PLATES 5-9 and 5-10

Tarrawonga Coal Mine Rehabilitation

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Table 5-1
Rehabilitation and Mine Closure Goals for the Project

Short-term	Medium to Long-term
• Minimise active disturbance areas by progressively rehabilitating, and by restricting clearing to the minimum required for operations. • Recover vegetation and habitat resources during clearing activities and re-use in rehabilitated areas to provide habitat resources for fauna (e.g. trees, hollows). • Use soil resources stripped from disturbance areas directly for rehabilitation, but if this is not possible, minimise the time soil is stored in temporary stockpiles before being re-used. • Install erosion and sediment control measures prior to the commencement of soil stripping and rehabilitation activities. • Plant cover crops on newly rehabilitated mine landform areas (and topsoil stockpiles) as soon as possible after completing earthworks, to minimise the potential for soil erosion. • Stabilise new infrastructure disturbance areas (e.g. road and dam embankments) as soon as possible by topsoiling and seeding. • Plant vegetation screens in key areas ahead of Project disturbance activities, to allow growth and screening to occur prior to the commencement of disturbance activities. • Progressively backfill the open cut with overburden and interburden and reshape completed areas to their final landform shape so that they can be progressively rehabilitated.	• Create a physically and chemically stable mine landform that integrates with the adjoining hilly topography of the Willowtree Range and the southern extent of the Boggabri Coal Mine waste rock emplacement. • Re-profile the Southern Emplacement and partially infill the adjoining services corridor so that it integrates with the Northern Emplacement. • Construct the final top surface of the Northern Emplacement so that it drains in a stable manner to Goonbri Creek via a series of terraces with drop structures on the intervening batters. • Partially backfill the final void to the extent required to minimise long-term drawdown and water quality effects on local groundwater aquifers, so that their beneficial use is not compromised. • Revegetate the mine landforms to a combination of native woodland/forest and agricultural land uses that meet community and regulatory expectations in consideration of existing land uses and conservation values. • Construct the low permeability barrier and permanent Goonbri Creek alignment such that they achieve their design objectives (Section 2.10.3), and the low flow channel is revegetated with riparian and floodplain vegetation, by using species characteristic of the Bracteate Honeymyrtle *(Melaleuca bracteata*) community. • Enhance the habitat values and biodiversity of the 3 km section of Goonbri Creek downstream of MLA 2, through revegetation, stock exclusion, and remedial earthworks if required.

TCPL's mine closure goal for the Project is that the status of the Tarrawonga Coal Mine at relinquishment will be to the satisfaction of the relevant Minister(s) and that all relevant mining tenement and Project Approval conditions will have been met. Disturbed land would be considered suitable for surrender when the nominated standards and/or completion criteria for land use, landform reconstruction, landform stability, revegetation, and beneficial water use have been met or if the relevant Minister(s) otherwise accept the rehabilitation status.

5.4 REHABILITATION OF THE PROJECT

This section describes the rehabilitation concepts for each of the key final landforms. At the completion of mining, the key final landforms and features at the Tarrawonga Coal Mine would include the:

- Northern Emplacement and open cut infill area;
- Southern Emplacement;
- open cut final void;
- permanent Goonbri Creek alignment;
- Goonbri Creek enhancement area;
- water management infrastructure; and
- mine facilities area.

The Project final landform and revegetation program will provide for a combination of approximately 752 ha of native woodland/forest and some 210 ha of Class 3 agricultural suitability land.

5.4.1 Northern Emplacement and Open Cut Infill Area

The Northern Emplacement and open cut infill area would be rehabilitated to create a final mine landform that merges into the undisturbed hilly topography of the Willowtree Range to the north-east in Leard State Forest. It would be constructed predominantly with batter slopes of 10^{o} or shallower and to a maximum elevation of 370 m AHD, which is consistent with the elevation of hills that existed in the Project area prior to the commencement of mining (Section 4.3.1).

The Northern Emplacement would be designed to gently slope up from the natural ground surface on the western edge of ML 1579. The top surface of the emplacement would be approximately 1,500 m wide, and would be designed with a slight dish shape so that incident rainfall could drain from it via wide swale drains that gradually slope to the north-east and east (Figure 5-1).

To the east of the top surface of the Northern Emplacement (i.e. where it merges into the open cut infill area), a series of terraces would be constructed that would step down to the south and merge with the undisturbed natural topography at around 270 to 280 m AHD on the southern edge of MLA 2. Surface water would drain down the terraces through meandering vegetated swale drains (Figure 5-1). Engineered drop structures would be installed on the batters between the terraces with shallow stilling ponds at the base of each. These would be used to slow runoff and direct it into the next swale drain. The runoff from these drainage paths would eventually enter Goonbri Creek.

The existing Northern Emplacement would be extended to the north and east within MLA 3 to integrate with the southern extent of the Boggabri Coal Mine waste rock emplacement (Section 2.5.1).

The final landform design concept for the Boggabri Coal Mine waste rock emplacement is described in the *Continuation of Boggabri Coal Mine Environmental Assessment* (BCPL, 2010). In summary, the Boggabri Coal Mine waste rock emplacement would generally have an east-west orientation, similar slope angles to the Tarrawonga Northern Emplacement (i.e. 10^{o} or shallower), and a maximum height of 395 m AHD.

A conceptual cross-section of the Northern Emplacement illustrating its integration with the Boggabri Coal Mine waste rock emplacement is shown on Figure 2-12. As illustrated on Figure 2-12, the top surface of the Northern Emplacement would be approximately 25 m lower than the proposed Continuation of Boggabri Coal Mine waste rock emplacement.

The existing sediment dams downstream and to the west of the Northern Emplacement, plus any new sediment dams constructed as part of the Project, would be retained until the revegetated surface is stable and runoff water quality is similar to runoff from similar landforms outside the Project area (Section 5.4.6).

The majority of the Northern Emplacement (i.e. western and southern batters, top surface, and the upper terraces within Leard State Forest) would be revegetated with native tree, shrub and grass species to achieve a native woodland/forest post-mining land use.

The lower terraces on the open cut infill area (i.e. to the east of the Northern Emplacement, and outside of Leard State Forest) would be revegetated so that these areas can be used for agricultural purposes following mine closure (Section 5.5.4).

Figure 5-2 is a simulation of the rehabilitated Project area once the open woodland/forest and agricultural land use areas have become established.

5.4.2 Southern Emplacement

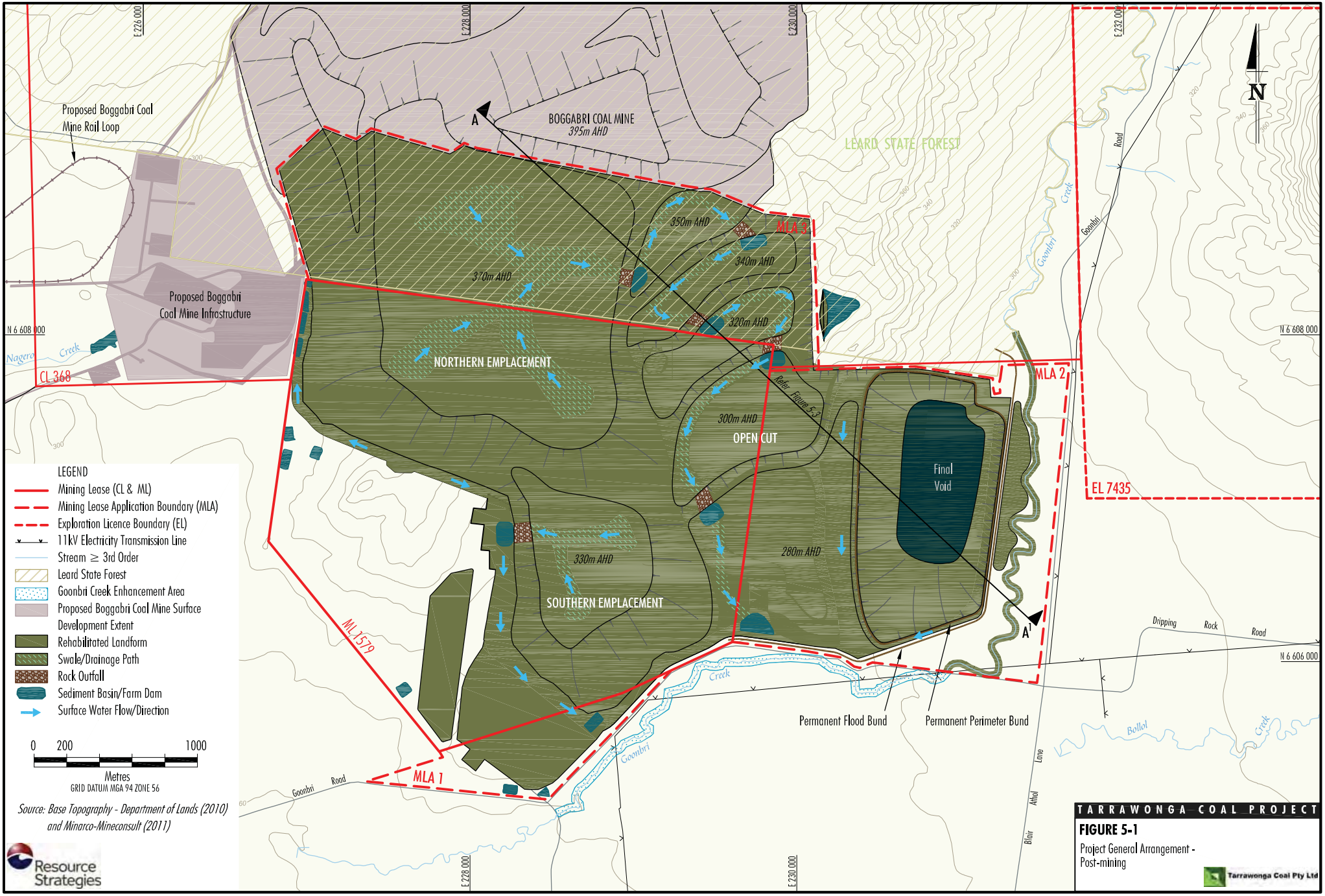
The existing Southern Emplacement would be extended to the south and east (Figures 2-1 and 2-4), and its top surface would be temporarily raised to 360 m AHD in the first one to two years of the Project (Section 2.9.1).

Once the open cut extension in MLA 3 begins to advance to the east, the mined-out section behind the working area would become available for in-filling, and overburden and interburden placement in the Southern Emplacement would no longer be necessary. Consequently, the batters of the Southern Emplacement would be stabilised and revegetated by Year 4 of the Project (Figure 2-5).

TCPL would reshape the Southern Emplacement and the lower portions of the open cut infill area to create the final mine landform in the final years of operations and in the year following the cessation of mining. This would involve development of the lower terraces on the eastern side of the Northern Emplacement (Section 5.4.1) and overburden re-handling to reduce the height of the Southern Emplacement to approximately 330 m AHD.

The waste rock taken from the Southern Emplacement would also be used to partially backfill the services corridor once it is no longer required, which would assist in the integration of the Northern and Southern emplacements post-closure (Figure 5-1).

Overburden from the Southern Emplacement may also be used to assist in the partial backfill of the final void, following the completion of mining activities (Section 5.4.3).



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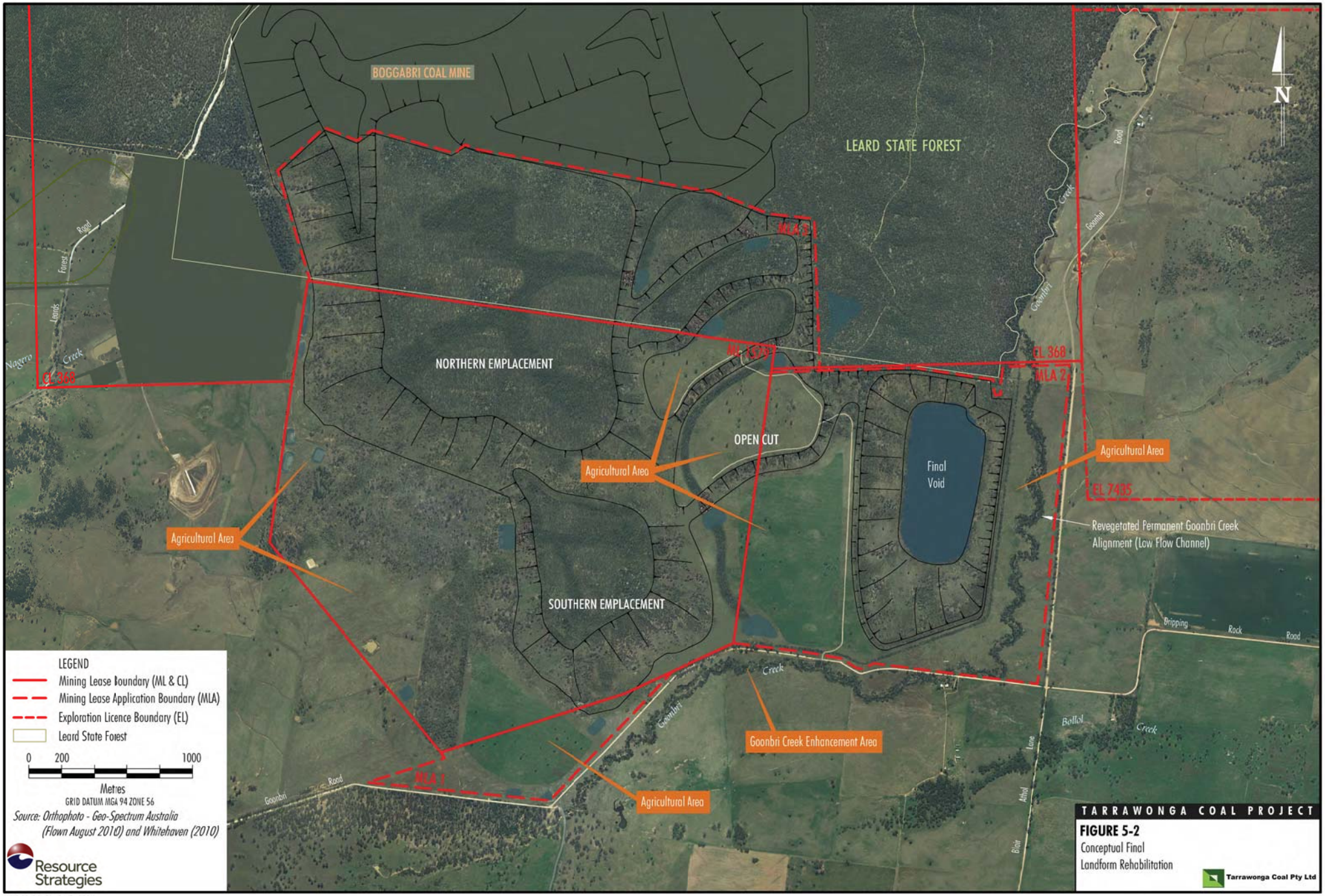

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The final shape of the Southern Emplacement would be similar to the Northern Emplacement (i.e. dish-shaped surface, outer batters predominantly with slopes of 10° or shallower). It would, however, be smaller and have a lower final top surface (i.e. 330 m AHD). Figure 5-1 shows the lowered Southern Emplacement and its proposed integration with the Northern Emplacement and open cut infill area in the final mine landform.

The Southern Emplacement would be revegetated with native tree, shrub and grass species to achieve a native woodland/forest post-mining land use.

Figure 5-2 is a simulation of the integrated Southern and Northern emplacements.

5.4.3 Open Cut Final Void

At the completion of mining, the final landform would include a void located in the east of the Project area (Figure 5-1). The 'highwall' on the eastern and northern sides of the void would be at an angle of approximately 60°, whereas the western and southern sides would have shallower overall slopes (i.e. 10 to 15°) and stepped profiles due to the partial in-filling of the open cut during operations.

The catchment area of the final void would be defined by permanent perimeter bunds and/or diversion channels (Figure 5-1) and is expected to be approximately 155 ha.

Inflows into the final void would comprise incident rainfall, runoff and groundwater (including waste rock emplacement infiltration). Once mining operations and backfilling activities in the open cut cease, inflows to the final void would no longer be collected and pumped out, and as a result, the void would gradually begin to fill with water.

One of the rehabilitation and mine closure goals for the Project is to minimise the long-term drawdown and potential water quality effects on local groundwater aquifers, so that their beneficial use is not adversely impacted (Table 5-1).

The approach that would be used to meet this goal would centre around adjusting the final void batter angles and/or placing additional backfill in the final void in a configuration such that a permanent waterbody would form and reach an equilibrium level close to, but slightly below, the local pre-mining groundwater level in the coal measures. This would create a localised groundwater sink which would prevent salts or poorer quality groundwater from migrating out from the Project area and adversely impacting the beneficial use of local groundwater aquifers. Having the equilibrium level of the final void waterbody close to, but below the pre-mining groundwater level would also minimise the long-term groundwater drawdown associated with the final void.

Based on the pre-mining groundwater table levels to the south-west and down-gradient of the Project area, TCPL propose to target a final void water equilibrium level of approximately 240 to 260 m AHD (Appendix A).

A final void water recovery analysis has been conducted as part of the Surface Water Assessment (Appendix B). The assessment included simulations with and without additional backfill of the final void, and is based on predicted groundwater inflows developed as part of the Groundwater Assessment (Appendix A). The final void water recovery analysis also included simulations of the long-term salinity of the final void waterbody (Appendix B).

Figure 5-2 is a simulation of the rehabilitated Project area showing the open cut final void once the waterbody has established and reached equilibrium.

The results of the final void recovery simulations indicated that in order to achieve an equilibrium water level of approximately 240 to 260 m AHD, the evaporative surface area of the final void waterbody would need to be approximately 55 ha. Under these circumstances, the void would slowly fill and reach an equilibrium water level in the target range of 240 to 260 m AHD after a period of approximately 350 years (Appendix B). The salinity of the final void waterbody is predicted to slowly increase over time, reaching some 5,000 mg/L at the end of the recovery simulation (Appendix B). The final void waterbody is not predicted to spill under any of the simulated climatic sequences.

An adaptive management approach to the final void design and mine closure planning would be adopted during the life of the Project. This would involve TCPL periodically reviewing and evaluating alternative methods for achieving the rehabilitation and mine closure goals for the Project (e.g. new technology and/or rehabilitation methods may become available that would achieve the goals more efficiently).

Final void design and mine planning would be undertaken by TCPL in consultation with relevant government agencies as a component of the Rehabilitation Management Plan and MOP (Section 5.6). This would include model verification and re-simulation of the behaviour of the final void waterbody using the results of the groundwater and surface water monitoring programs.

Appropriate safety bunds and/or fencing and signage would be installed around the perimeter of the void to restrict access.

Figure 5-3 is a cross-section showing the major Project landforms, including the open cut final void.

5.4.4 Permanent Goonbri Creek Alignment

Construction of the permanent Goonbri Creek alignment is scheduled to occur in Year 12 of the Project, which would allow approximately two to three years for vegetation establishment prior to it being commissioned in approximately Year 15.

A Goonbri Creek Management Plan would be developed prior to the commencement of construction activities (Section 4.5.3). It would contain:

- detailed design specifications for the permanent Goonbri Creek alignment;
- a construction program describing how the low permeability barrier, flood bund and low flow channel works would be staged and integrated with mining operations;
- revegetation objectives and activities;
- water quality, ecological, hydrological and geomorphic performance and completion criteria for the permanent Goonbri Creek alignment based on baseline conditions; and
- a monitoring/maintenance program for water quality, ecological, hydrological and geomorphic integrity of the permanent Goonbri Creek alignment.

Water monitoring sites would be established on Goonbri Creek as a component of the Project Surface Water Monitoring Program upstream and downstream of the permanent Goonbri Creek alignment (Section 4.5.3). The monitoring data would be used to inform the detailed design and monitor the hydrological performance of the permanent Goonbri Creek alignment.

The low flow channel of the permanent Goonbri Creek alignment (and approximately 40 m either side of its banks) would be revegetated to mimic the current higher quality Goonbri Creek riparian and floodplain vegetation, by using species characteristic of the Bracteate Honeymyrtle *(Melaleuca bracteata*) community (Section 4.9.3).

The low flow channel within the permanent Goonbri Creek alignment would be designed to follow a meandering path that mimics the existing channel alignment (Figures 5-1 and 5-2) and provides in-stream and riparian vegetation and fauna habitats. The low flow channel would include the creation of a pool-riffle system, and construction of leaky weirs using logs or loose rocks. These would be keyed into the banks to create a series of semi-permanent pools along the alignment. These 'weirs' would be designed to slow water flow and to facilitate some build-up of sediment and vegetation in the base and banks of the creek.

The Goonbri Creek Management Plan would include details of the monitoring program that would be designed and implemented to track the progress of the revegetation (in terms of plant growth, species diversity and fauna usage) in both in-stream and riparian habitats of the permanent Goonbri Creek alignment. Monitoring results would be summarised in the AEMR.

5.4.5 Goonbri Creek Enhancement Area

A riparian vegetation enhancement program would be implemented along a 3.2 km section of Goonbri Creek within the "Templemore" property (Section 4.9.3), which is owned by Whitehaven. The works would extend from where Goonbri Creek crosses the southern boundary of MLA 2, to the point where it intersects the sized ROM coal transport route (Figures 5-1 and 5-2).

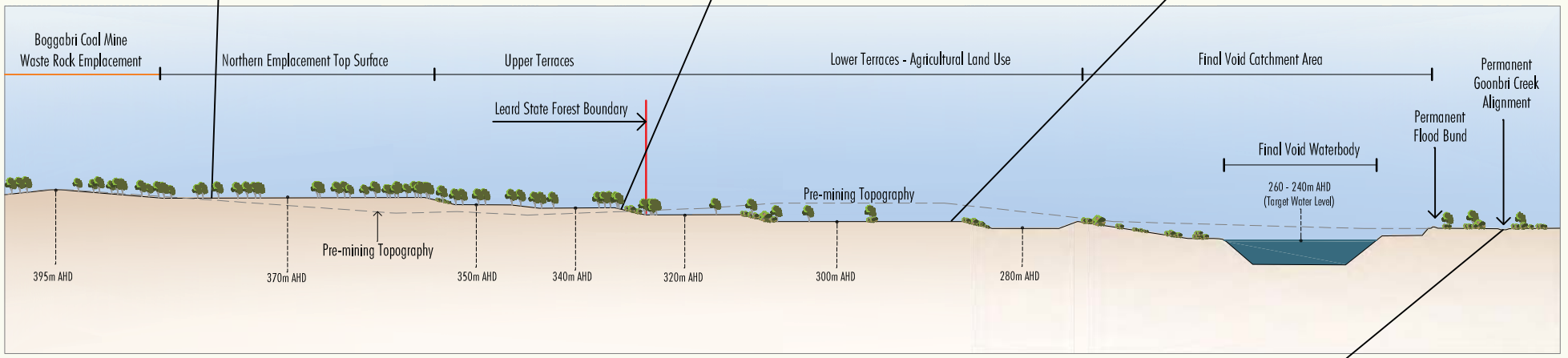
Fencing would be installed approximately 40 m either side of Goonbri Creek, with some access points provided for stock access. The fenced area would be revegetated using species characteristic of the Bracteate Honeymyrtle (*Melaleuca bracteata*) community. Minor remedial earthworks would also be undertaken within the fenced area, where necessary, to rectify any significant areas of existing erosion.

The Goonbri Creek enhancement activities would be documented in the Goonbri Creek Management Plan (Sections 4.3.3 and 4.10.3).

Woodland/Forest Post-mining Land Use

Open Woodland/Woodland Post-mining Land Use

Agricultural Post-mining Land Use



Not to Scale

Section A-A[1]

(Refer Figure 5-1)

Permanent Goonbri Creek Alignment Low Flow Channel

Source: Whitehaven (2011); FloraSearch (2011) and Gilbert & Associates (2011)

TARRAWONGA COAL PROJECT

FIGURE 5-3

Cross-section of the Rehabilitated Project Mine Landform

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5.4.6 Water Management Infrastructure

At the cessation of mining activities and once they are no longer required the mine water dams would be emptied by pumping to the final void. Any dam liners would then be removed and appropriately disposed of, and any contaminated soils would be removed and/or treated. The dams would then be either retained for future use as water storages, or they would be filled and/or reprofiled and revegetated.

Sediment dams would be retained pending the achievement of long-term acceptable water quality in runoff from rehabilitated landforms, after which point they would be removed and rehabilitated. Some sediment dams may be kept for livestock watering, if suitable.

5.4.7 Mine Facilities Area

Mine facilities and infrastructure that would be removed at the end of the Project life would include:

- coal and gravel crushing, screening and loadout infrastructure;
- administration and workshop buildings and stores;
- heavy vehicle servicing, parking and washdown facilities;
- sewage treatment facilities; and
- hydrocarbon and dangerous goods storage facilities.

During the decommissioning phase, the priority would be to dismantle fixed equipment and infrastructure for removal from site and re-use at another location or recycling.

Non-salvageable/non-recyclable infrastructure would be disposed of at suitable off-site disposal areas, or on-site, subject to demonstration that no land contamination risk would be posed and relevant approvals are obtained.

Land contamination assessments would be conducted and any contaminated soil would be remediated in accordance with the relevant guidelines (including guidelines under section 145C of the EP&A Act and the NSW *Contaminated Land Management Act, 1997* [CLM Act]).

Some concrete hardstands, site access roads, sheds, buildings and sediment dams may be retained for alternate post-mining uses, if agreed with the relevant regulatory authorities.

Once all the equipment and infrastructure components have been removed and any land contamination has been remediated, the mine facilities area would be deep ripped, topsoiled and seeded for agricultural land uses (Section 5.5.4).

5.5 GENERAL REHABILITATION PRACTICES AND MEASURES

The following sub-sections summarise the rehabilitation practices and measures that would be implemented at the Project.

The success of progressive rehabilitation activities would be regularly evaluated throughout the Project life and the results would be used to inform future rehabilitation initiatives.

5.5.1 Vegetation Clearing Measures

Vegetation clearance for the Project would be undertaken progressively and the area cleared at any particular time would generally be no greater than that required to accommodate the mine's needs for the following twelve months (Section 4.9.3). Areas to be cleared would be delineated, restricting clearing to the minimum area necessary to undertake the approved activities.

Vegetation clearance protocols would be documented in the Biodiversity Management Plan and would be used to minimise impacts on flora and fauna. Key components of the vegetation clearance protocols would include aspects such as the clear delineation of areas to be cleared of native remnant vegetation, timing and methods to be used, pre-start clearing inspections by suitably qualified ecologist to confirm no impact on threatened species, and re-use of cleared vegetation debris in revegetation programs.

5.5.2 Soil Stripping Areas and Handling Measures

Soil Management Strategies

As described in Section 4.3.3, the following management measures would be implemented during the stripping of soils at the Project:

- Areas of disturbance would be stripped progressively, as required, to reduce potential erosion and sediment generation, and to minimise the extent of topsoil stockpiles and the period of soil storage.
- Areas of disturbance requiring soil stripping would be clearly defined following vegetation clearing.

- Topsoil and subsoil stripping during periods of high soil moisture content (i.e. following heavy rain) would be avoided to reduce the likelihood of damage to soil structure.

Any long-term soil stockpiles generated during the life of the Project would be managed to maintain long-term soil viability through the implementation of the following management practices:

- Topsoil and subsoil stockpiles would be limited to a maximum height of 3 m, with slopes no greater than 1:2 (V:H) and a slightly roughened surface to minimise erosion.
- Topsoil stockpiles would be constructed to minimise erosion, encourage drainage, and promote revegetation.
- Where additions such as lime, gypsum and fertiliser are needed to improve the condition of cut soil, they would be applied to the stockpiles in-between the application of separate layers from the scrapers.
- Wherever practicable, soil would not be trafficked, deep ripped or removed in wet conditions to avoid breakdown in soil structure.

Soil Reserves

A preliminary material balance calculation was conducted by McKenzie Soil Management (2011) to determine the quantity of soil available for rehabilitation (Appendix I). The results of these calculations are summarised in Table 5-2. They indicate that there would be sufficient soil available to meet the rehabilitation concepts described in this EA, based on a soil re-application depth of 1.5 m on the agricultural land use areas, and 0.2 m on other disturbance areas (Appendix I).

Details of available soil resources, stripping and reapplication schedules, and stockpiling inventories would be included in the MOP, and a summary of soil management activities would be provided in the AEMR.

5.5.3 Selection of Native Plant Species for Revegetation

Areas to be revegetated with native vegetation and fauna habitat would initially be stabilised with a non-persistent crop cover. Native tube stock and/or seeds would then be planted/seeded into the rehabilitation areas.

Native species would be selected on a site by site basis depending on nearby remnant vegetation associations, soil types, aspect and site conditions. Drought tolerance would also be a consideration in native species selection.

The list of suitable native plant species to be used in the revegetation of mine landforms and other Project disturbance areas would be determined in consultation with the relevant government agencies and would be documented in the Rehabilitation Management Plan and MOP.

Prior to the commencement of revegetation activities in the portion of the Northern Emplacement that extends into Leard State Forest, TCPL would consult with Forests NSW with regard to the revegetation species list, and in particular, the inclusion of tree species that would be suitable for harvesting as timber products in the future.

Revegetation of native woodland/forest areas would include the planting of species characteristic of the Box-Gum Woodland EEC/CEEC (e.g. White Box overstorey as well as appropriate understorey) in areas with suitable soil, slope and aspect.

Table 5-2
Preliminary Project Soil Balance

Recommended Stripping Depth	Approximate Stripping Area	Approximate Volume
0.1 m	405 ha	405,000 m^3
0.25 m	30 ha	75,000 m^3
3 m	80 ha	2,400,000 m^3
Currently Stockpiled	-	1,293,400 m^3
Total Area/Available Soil Volume	**515 ha**	**4,173,400 m^3**

Source: After Appendix I.

The low flow channel of the permanent Goonbri Creek alignment and the Goonbri Creek enhancement area, would be revegetated with native species to mimic some of the values of the current Goonbri Creek riparian and floodplain vegetation. This would include species characteristic of the Bracteate Honeymyrtle *(Melaleuca bracteata*) community.

5.5.4 Establishment of Agricultural Land

The assessment of the physical and chemical properties of the soils within the Project area (Appendix I) has established that the soils generally located within the open cut on the southern parts of MLA 2 near Goonbri Creek would be a suitable rehabilitation medium for agricultural land uses post-mining. These soils are considered to be suitable for this purpose by McKenzie Soil Management (2011) as they have:

- favourable pH values;
- are non-saline;
- their exchangeable sodium percentage values are low enough to be treated easily with coarse-grade gypsum;
- their cation exchange capacity allows for natural decompaction through shrink-swell processes; and
- the favourable properties of these soils would not be modified greatly during stripping, stockpiling and re-spreading.

As described in Section 5.4.1, the lower terraces on the open cut infill area would be revegetated for agricultural purposes.

These lower terrace areas would be prepared with a total soil profile depth of approximately 1.5 m overlaid on mine waste rock. The underlying mine waste rock is expected to have high porosity/permeability and is therefore expected to allow for beneficial deep drainage and deep root growth beyond a depth of 1.5 m (Appendix I). This soil profile would provide root zone chemical and physical conditions that are at least as favourable for cereal and pasture production as the existing agricultural areas near Goonbri Creek (McKenzie Soil Management, 2011).

Based on the available soil quantities and the soil profile described above, approximately 160 ha of agricultural land capable of being used for a combination of pasture production for grazing and occasional cropping (i.e. Class 3 agricultural suitability) would be re-established on the lower terraces on the open cut infill area (Appendix I).

The mine facilities area would also be revegetated to an agricultural post-mining land use suitable for grazing and occasional cropping (i.e. Class 3 agricultural suitability). This agricultural area would occupy approximately 40 ha, and when combined with the 160 ha agricultural land use area on the Northern Emplacement, plus approximately 10 ha located on the temporary soil stockpile near the permanent Goonbri Creek alignment, would provide a total of 210 ha of rehabilitated land suitable for ongoing agricultural use.

5.5.5 Erosion and Sediment Control Works

As described in Section 4.5.3, the site sediment and erosion control system would be managed through the Erosion and Sediment Control Plan, which would be progressively developed and approved (as part of the Water Management Plan) over the life of the Project. The sediment and erosion control system would be updated periodically to address changes over the Project life. The effectiveness of the system would be assessed through regular monitoring.

The operational sediment and erosion control works would be retained and maintained during the revegetation establishment phase. As described in Section 5.4.6, following the establishment of self-sustaining, stable final landforms, key elements of the operational sediment control structures would either be left as passive water control storages or would be removed.

5.6 REHABILITATION AND REVEGETATION MONITORING

Ongoing monitoring and maintenance of rehabilitation areas at the Tarrawonga Coal Mine is conducted to assess:

- progression of rehabilitated land; and
- effectiveness of rehabilitation techniques used (i.e. evidence of erosion/sedimentation, success of initial cover crop, success of tree and shrub plantings, adequacy of drainage controls, and the general stability of the rehabilitation site).

Monitoring of rehabilitation activities at the Tarrawonga Coal Mine is currently undertaken through the implementation of programs outlined in the MOP, and a summary of activities and performance is provided in the AEMR.

The rehabilitation monitoring program for the Project would be designed to track the progress of revegetation and to determine the requirement for intervention measures such as thinning to reduce the density of revegetated areas, or additional plantings in areas where vegetation establishment has been sub-optimal. The Project rehabilitation monitoring program would be documented in the Rehabilitation Management Plan and would describe the methods that would be used to:

- evaluate the coverage and application of topsoil prior to seeding;
- monitor drains and assess water quality to determine whether substantial silting of inverts and/or any localised failure of drain embankments has occurred;
- evaluate recently topsoiled areas after rain events (particularly on sloping ground) to assess whether significant rilling or loss of topsoil has occurred;
- evaluate the behaviour of placed topsoil over time (i.e erosion or dispersion, compaction, salting or hard setting);
- assess the initial germination success in revegetation areas (including recording of diversity and abundance);
- monitor revegetation success over time (e.g. survival rate, plant growth, species diversity, weed content, fauna usage);
- evaluate potential threats to rehabilitated areas (e.g. weed invasion, pest species, dispersive soils or PAF-LC materials, erosion); and
- record key rehabilitation information (e.g. photographic records, surveys, file notation, etc.).

Annual revegetation surveys would be undertaken by an appropriately qualified and experienced person to identify the success of rehabilitation and identify any additional measures required to achieve ongoing rehabilitation success. A detailed monitoring report would be prepared annually that includes a summary of previous monitoring reports, results of the current year's monitoring and planned remedial works, if required. The monitoring results would be summarised in the AEMR.

Key rehabilitation completion criteria for the Project are proposed in Table 5-3. These criteria have been developed with regard to *Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on the Coal Mines in the Hunter Valley,* Australian Coal Association Research Program Project C13048 (Australian Centre for Minerals Extension and Research, 2005).

Key completion criteria would be reviewed and refined as part of the Mining, Rehabilitation and Environmental Management Process (MREMP) (Section 6.4).

Table 5-3
Proposed Key Rehabilitation Completion Criteria

Project Component	Key Completion Criteria
Final Landforms	• Safe, stable, adequately drained post-mining landforms consistent with the surrounding landscape as evidenced by comparative photography, water quality monitoring and geotechnical surveys. • Geomorphic stability of drainage features comparable to existing natural drainage features as evidenced by cross-section and long-section surveys and monitoring of erosion.
Final Voids	• Surface water inflows to the final voids minimised through appropriate landform design as evidenced by revision of the water balance based on final as-built mine landforms. • Final void profiled for long-term stability as evidenced by geotechnical surveys of high walls/end walls. • Perimeter bunding formed.
Rehabilitation and Revegetation Areas	• Open woodland/forest and riparian revegetation areas on a trajectory of forming a self-sustaining ecosystem and/or ecosystem function equivalent to reference sites (e.g. vegetation cover, landform stability, species diversity). • Agricultural areas demonstrated to be capable of grazing and cropping, in accordance with the general limitations that apply to Class 3 agricultural land.

The specific rehabilitation parameters and completion criteria would be determined in consultation with relevant government agencies and documented in the MOP and Rehabilitation Management Plan.

5.7 REHABILITATION MANAGEMENT PLAN

A Rehabilitation Management Plan would be developed and implemented for the Project. It is anticipated that the content requirements for the Rehabilitation Management Plan would be confirmed in consultation with the relevant Government agencies during the assessment of this EA, and that they would be specified in the Project Approval for the Project.

Notwithstanding the above, it is expected that the Rehabilitation Management Plan for the Project would include the following:

- a description of the nature and timing of the progressive rehabilitation works (i.e. new areas) and rehabilitation management activities (i.e. maintenance of existing areas) that would be undertaken within the Project area;
- a description of how the planned rehabilitation works have been developed in consideration of the rehabilitation and mine closure goals for the Project (Table 5-1);
- rehabilitation performance objectives, parameters and completion criteria;
- the rehabilitation monitoring program to be used to evaluate the performance of rehabilitation against the completion criteria;
- the mechanisms to be used to regularly report on the status of the rehabilitation works and the rehabilitation monitoring results; and
- a description of how the Rehabilitation Management Plan integrates with the other management plans required for the Project (i.e. Biodiversity Management Plan, Goonbri Creek Management Plan, Farm Management Plan and MOP).

The Rehabilitation Management Plan would be prepared in consultation with the relevant government agencies, and in accordance with the relevant DRE rehabilitation and mine closure guidelines.