BMC Dragline Move Rehabilitation Management Plan

14 July 2017

Document Status	
Revision: 1	**Document Owner:**

Revision History			
0	01/12/16	Original Rehabilitation Management Plan part of approval application	
1	14/07/17	Revision of Soil Management and Seed mix (Appendix – Further Specification for GRM-SWC Dragline Move; Rehabilitation Activities	
Rev	**Date**	**Description**	**Author**

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1.0 Introduction

1.1. Purpose

The primary purpose of this ***Dragline Move Rehabilitation Management Plan*** is to ensure effective processes and activities are implemented as part of the Dragline Move Project to rehabilitate disturbed lands following the relocation of the dragline.

1.2. Scope

The ***Dragline Move Rehabilitation Management Plan*** covers rehabilitation objectives, methods and monitoring of rehabilitation along the dragline corridor. In an integrated approach, it combines both operational and environmental requirements into a single document.

2.0 Project Description

2.1 Overview of Operations

BHP Billiton Mitsui Coal (BMC) is proposing to relocate a dragline from Goonyella Riverside Mine (GRM) to South Walker Creek Mine (SWC) along a route approximately 77km in length. The dragline move is planned to take place so that the dragline can be operational during 2017. The relevant dragline is a Marion 8050 dragline weighing approximately 3500 tonnes. It has a boom length of 99 metres (m) and width of 28m. The dragline will be travelling with the boom up and the bucket removed. It will be approximately 68m high with an additional 5m for the transporter.

As part of the Project, BMC proposes to:

- Decommission the current dragline operations at Goonyella Riverside Mine as part of current approved mining activities
- Transport the dragline along a temporary special purpose track or roadway, established through the implementation of vegetation clearing, fill placement and related civil work activities in areas within the proposed dragline move corridor where ground conditions are inadequate to enable the dragline to advance
- Rehabilitate the dragline move corridor
- Commission and operate dragline at South Walker Creek Mine as part of current approved mining activities.

The dragline transport route is located in the vicinity of the towns of Moranbah, Nebo and Coppabella within the Isaac Regional Council Local Government Area of Queensland. The proposed alignment of the relocation route generally follows the alignment used for a previous dragline move from South Walker Creek Mine to the Goonyella Riverside Mine carried out in 2000. However, the alignment has changed in certain locations due to changes in land use since 2000. The Project will involve the construction of a temporary unsealed roadway, 40m to 80m wide, and the transport of the dragline on a specialised transporter, followed by rehabilitation of disturbed areas.

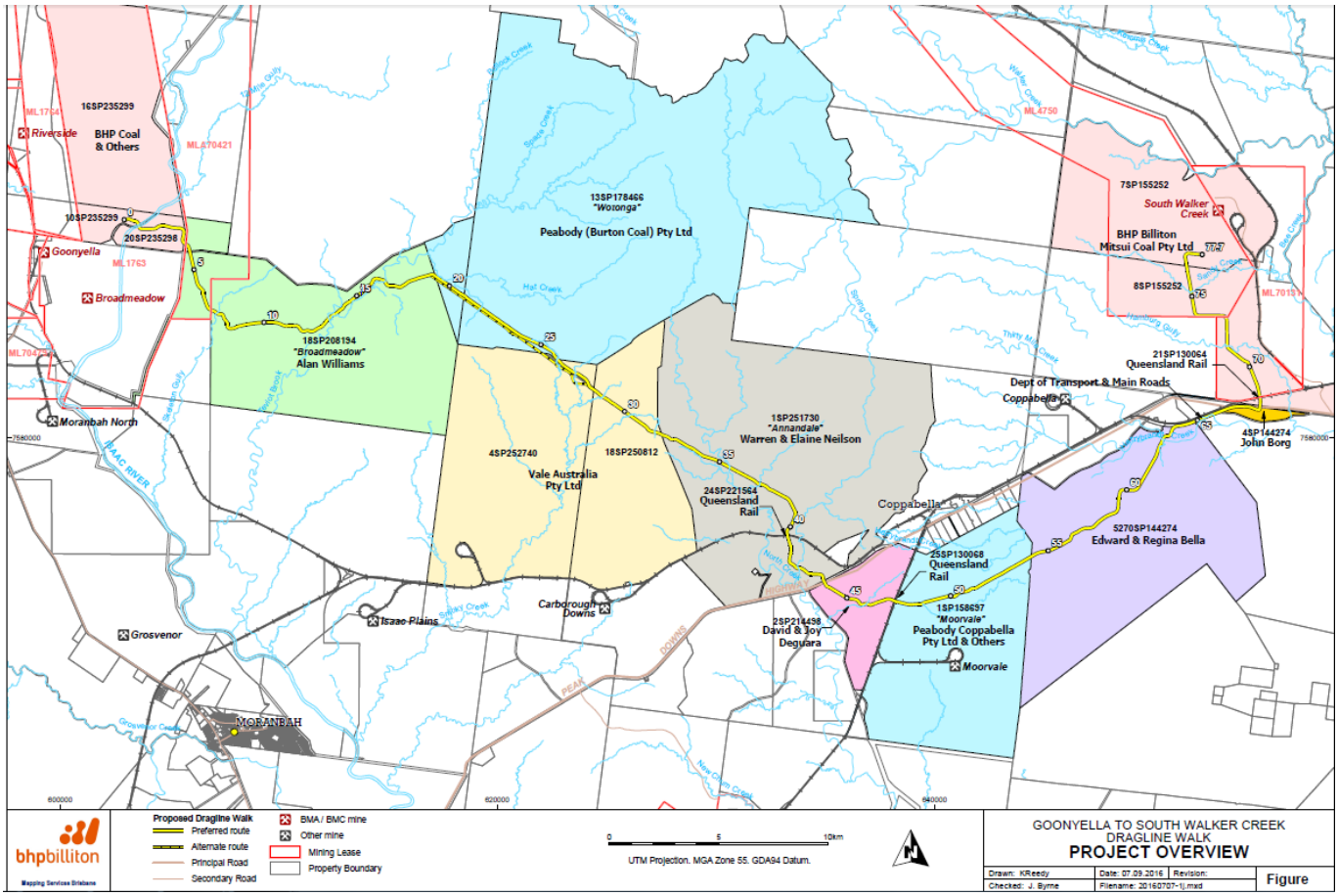
2.2 Project alternatives

BMC considered alternative routes for the dragline move to the north and further south of the Carborough Range (which is not able to be traversed by dragline transporters). However, all these alternatives involved greater clearing of native vegetation, and longer routes.

The selected route predominately follows the path of a previous dragline move and maximises use of previously cleared areas.

2.3 Alignment

The proposed alignment of the dragline move route generally follows the alignment used for a previous dragline move between South Walker Creek Mine and Goonyella Riverside Mine carried out in 2000. However, the alignment has changed in certain locations due to changes in land use since 2000. The proposed alignment and intersected properties are illustrated in Figure 1.



3.0 Existing Environment

3.1 Flora and Fauna

The proposed corridor traverses vegetation landscapes consisting mainly of pasture grasslands and woody vegetation (remnant and regrowth), mostly composed of dry sclerophyll species.

Woody vegetation encountered along the corridor is primarily comprised of:

- Eucalyptus woodland and open forest
- Acacia woodland and shrubby woodland
- Acacia and/or Casuarina open forest

The Project area contains both minor and major drainage channels of the Fitzroy Catchment. Specifically, the dragline transport corridor intersects watercourses on 42 occasions.

The dragline transport corridor intersects with six areas of mapped Essential Habitat. Four of these areas are associated with records of Squatter Pigeon (southern subspecies), and the remaining two are derived from past records of Ornamental Snake.

State significant biodiversity corridors intersect the dragline transport corridor at the western and eastern extents. The western corridor (part of the Denham Range Corridor) is associated with habitats within and between the Burton Range and Isaac River riparian habitat immediately to the north of the study area. The dragline transport route transects the eastern biodiversity corridor (part of the Carborough Range Corridor) at the southern extent of the Kerlong and Carborough Ranges. This corridor then continues in an easterly direction and incorporates Dipperu National Park, riparian habitats of Denison and Funnel Creeks, towards the western slopes of the Connors Range and linking with the Great Eastern Ranges Corridor.

3.2 Hydrology

The watercourses intersected by the corridor are ephemeral, the Isaac River being the largest. Watercourses are expected to be dry or with pools of stagnant water at the time of Project execution.

3.3 Soils

From a geological perspective, the route can be divided into three sections, namely:

- 0 – 17 km Tertiary sediments comprising sandstone, mudstone and conglomerate and their weathered derivatives
- 17 – 43 km Triassic lithic sandstone, green to reddish brown mudstone and minor conglomerate
- 43 - 77 km Tertiary colluvial and residual clay, silt sand and gravel developed over older land surfaces

Except for an isolated area of volcanic rock, the bedrock geology along the route is similar comprising low strength sedimentary strata (sandstone, siltstone and mudstone) overlain be alluvial, colluvial and residual soils.

Greater variability can be seen in the soils mapping with the soils comprising four groups:

- Shallow rocky soils (Du)
- Texture contrast soils comprising a leached sandy surface layer overlying a clayey subsoils (Co, Mo)
- Uniform red and yellow low medium plasticity sandy clay and clayey sand (J)

- High plasticity, potentially expansive heavy clay soil with some gilgai (Bl, Da, & Hu)

The expected soil types and estimated lengths along the route are provided below:

- **Bl**: Brigalow plains and cracking clay soils on weathered Tertiary clay and older rocks along the central axis of the area (2.4km)
- **Co**: Alluvial plains with box on texture-contrast soils throughout the area (5.0km)
- **Da**: Lowlands with Brigalow and cracking clay soils on weathered and fresh Permian shales and lithic sandstone in the north and centre (12.5km)
- **Du**: Hills with lancewood and narrow-leaved ironbark on weathered Tertiary and Permian rocks in the north-west, centre and south-east; shallow rocky soils (3.8km)
- **Hu**: Blackbutt and Brigalow on weathered clay plains occurring in most parts of the area; texture-contrast and cracking clay soils (12.2km)
- **J**: Table lands and plains with narrow-leaved ironbark and red and yellow earths on intact Tertiary land surface throughout the area except in the north-east and extreme south (8.2km)
- **Mo**: Lowlands with box and texture-contrast soils on undissected Tertiary land surface throughout the area except in the extreme south and north-east (33.0km).

4.0 Supporting studies

4.1 Ecological assessment

An ecological assessment was carried out for the purpose of the Project and gave consideration to Matters of National Environmental Significance and Matters of State Environmental Significance. The assessment involved a desktop assessment and field surveys along the full length of the corridor. For further information see referral and BAAM report which is on the EPBC website – Reference *2016/7788*.

4.2 Geotechnical investigations

Geotechnical field testing has been completed, incorporating Dynamic Cone Penetrometer tests at 500m spacing in conjunction with 1.5m auger holes at 1000m spacing along the alignment. Dynamic Cone Penetrometer tests were manually completed by a single operator and drop a hammer from a fixed height, counting the number of blows taken for each 100mm of penetration. These results were then used to estimate an allowable bearing capacity for each layer based on the relationship presented in Determination of Allowable Bearing Pressure Under Small Structures, M.J. Stockwell, New Zealand Engineering, 15 June 1977.

In addition, specific testing has been completed at critical locations including infrastructure and creek crossings, and in the vicinity of diversion roads. This has been completed to ensure adequate bearing conditions are available in abutment locations and suitable select fill is available for crossings.

Soil sampling was completed and sent off for laboratory testing to determine suitability for reuse and to optimise rehabilitation specifications for the alignment. These results have been utilised to determine the rehabilitation specifications outlined 7.0.

The investigations have been completed under the supervision of a Registered Professional Engineer of Queensland (RPEQ) qualified engineer.

5.0 Overview of Disturbance Activity

5.1 Clearing and Soil Stripping

The project will require clearing of all vegetated sections of the relocation route to a minimum 40m width (35m travel width plus 5m side clearance. The required corridor width will be greater than the minimum 40m in some sections of the alignment due to ground conditions (i.e. for stockpiling of stripped topsoil). In vegetated areas, the required corridor width will in some cases be 60m or 80m to allow for vehicular traffic past the dragline and cleared vegetation stockpiling on the edges of the roadway. However, in ecologically sensitive areas involving MNES, the minimum 40m width corridor will be applied for the majority of cases in order to limit disturbance. In those areas, "breakout" stockpiling areas of cleared vegetation are required when the 40m wide section of corridor is 500m long or more. These vegetation stockpiling areas have been chosen wherever possible to avoid MNES but will increase the corridor width locally. This approach will result in a lesser total disturbance to MNES than a standard rule involving a breakout area every 500m or so.

5.2 Waterway Crossings

To avoid the likelihood of the watercourse conveying flow during the dragline crossing, the transportation will occur outside of the wet season. To support the dragline and achieve the required vertical geometry, the watercourse will be filled to provide a 35m wide crossing point. Low flow culverts will be provided at larger crossings such as the Isaac River, Skeleton Gully, Teviot Brook and Thirty Mile Creek to convey any incidental water flow while the crossings are in place.

Construction of the water crossings will be scheduled such that they are completed just prior to the dragline crossing occurring, and then removed immediately to minimise the amount of time that the watercourses are filled. The dragline will only cross a watercourse when no water is flowing in the watercourse.

6.0 Rehabilitation Strategy

6.1 Rehabilitation Objectives and Outcomes

Once the dragline move is complete, the pathway will be decommissioned. As the route is located predominantly within lands not owned, leased or managed by the proponent, plans for vegetation restoration will be subject to agreement with the various land owners.

The rehabilitation objectives for the Dragline Move Corridor include:

- Encourage the regeneration of existing vegetation communities
- Maintain ecosystem functioning and retain ecosystems in the landscape, particularly in connectivity areas through the respread of cleared vegetation and seeding.
- Erosion and sediment control measures/devices will be installed, where/as required by ground conditions (e.g. ripping of slopes, placement of rocks/gravel, erosion control blankets, hydromulching, etc.)
- Restore watercourses ground profile to original state

- Reinstatement of cleared riparian vegetation. Subject to local ground conditions, this may include placement of cleared vegetation over the disturbed area (including seedbank), seeding (e.g. hydroseeding), planting of seedlings

The outcomes are:

- The resultant corridor is safe, stable, non-polluting and sustainable;
- Watercourses are stable and water quality is preserved.

7.0 Rehabilitation Specifications7.1 Background

The Dragline Move Rehabilitation Plan (December 2016), included preliminary Rehabilitation Specifications addressing topsoil re-instatement and a seed mix for revegetation. The rehabilitation plan anticipated further consultation with stakeholders. The Rehabilitation Specifications have been revised to promote an improved rehabilitation outcome. As such this Further Specification document Appendix A) has been developed to document revised:

- Soil compaction treatments and
- The species selection for pasture, remnant and riparian zones.

These revisions are reflected in this current version of the rehabilitation management plan.

7.2 Removal of Fill

7.2.1 General Fill

Any placed and compacted general fill shall be removed and returned to the borrow/excavated area. All borrow areas shall be locally shaped to maintain existing drainage lines and excavated areas returned to the original lines and levels prior to commencement of works.

7.2.2 Imported Fill

Any placed and compacted imported fill shall be removed and stockpiled at an area designated by the Company. The stockpile shall not exceed a height of 3m and shall be locally shaped to maintain existing drainage lines.

7.3 Topsoil and Revegetation

The Contractor shall complete the following rehabilitation works:

- Stripped top soil will be evenly spread across disturbed area, prior to ripping
- Compacted zone will be deep ripped (up to 900mm)
- Ripped surface will be broken down using offset discs, to form seedbed. This will ensure disturbance area is trafficable by the landowner and livestock. This treatment will also facilitate mixing of gypsum and fertiliser.
- Erosion prevention/control measures where required. As per the design Drawings topsoil fertilizer and subsoil amelioration shall be provided as per the requirements in Table 1.

Table 1: SMU & Rehabilitation Requirements

SMU	Land System	Topsoil	Subsoil Amelioration
A	Junee	Apply DAP fertiliser at 200 kg/ha plus Gypsum at 1 t/ha	Gypsum at 1 t/ha
B	Durandell		Gypsum at 2 t/ha
C	Blackwater, Connors, Daunia		Gypsum at 3 t/ha
D	Humboldt, Monteagle		Gypsum at 4 t/ha

- Embankments steeper than 1V:4H shall be seeded by hydromulching with a Bonded Fibre Matrix (BFM), EnviroStraw BFM or equivalent, product at a rate of 4t/ha.
- The general alignment can be seeded by:
  - Direct Drilling;
  - Broadcasting and harrowing; or
  - Hydromulching at a rate of 4t/ha.
- Seed shall be a mix of native and non-native species selected from species lists specified in Further Specification (Table 2, and 4).
  - A grass seed mix of 14 grass species is provided below in Table 2a, to be applied at a total rate of 45kg of seed per hectare.
  - Seed mix is based on coated seed for all species.
  - A native seed mix of 8 native tree species is provided below in Table 2b, to be applied at a total rate of 14kg of seed per hectare
  - No cover crop is required.

Table 2a: Grass Seed Mix

Common Name	Species	Native/Non-Native
Black Spear Grass	*Heteropogon contortus*	Native
Kangaroo Grass	*Themeda triandra*	Native
Curly Windmill Grass	*Enteropogan acicularis*	Native
Forest Bluegrass	*Bothriochloa bladhii*	Native
Aztec siratro	*Macroptilium atropurpureum*	Non Native
Secca stylo	*Stylosanthes scabra*	Non Native
Bissett creeping Bluegrass	*Bothriochloa insculpta*	Non-Native
Reclaimer Rhodes Grass	*Chloris gayana*	Non-Native
US Buffel	*Cenchrus ciliaris (sub sp USA)*	Non-Native
Gayndah Buffel	*Cenchrus ciliarus (sub sp Gayndah)*	Non-Native
Verano Stylo	*Stylosanthes hamata*	Non Native
Butterfly pea	*Clitoria ternatea*	Non Native
Floren Bluegrass	*Dicanthium aristatum*	Non-Native

Table 2b: Native Seed Mix

Common Name	Species
Forest red gum	*Eucalyptus tereticornis*
River red gum	*Eucalyptus camaldulensis*
Narrow-leaved ironbark	*Eucalyptus crebra*
Moretonbay Ash	*Eucalyptus tesselaris*
Yellowwood	*Terminalia oblongata*
Whitewood	*Atalaya hemiglauca*
Brigalow	*Acacia harpophylla*
Belah	*Casuarina cristata*

- Gypsum (calcium sulphate $CaSO_4$) shall meet the following parameter requirements:
  - A minimum of 80% of Gypsum
  - A moisture content of < 15%
  - Have a total content (x-ray fluorescence test) of:
    - > 20% Calcium (C)
    - > 15% Sulphur (S)
    - < 2 % Sodium Chloride (NaCl)
  - Have a particle size distribution of:
    - 100% by weight to pass a 6mm sieve
    - 80% by weight to pass a 4mm sieve
    - 50% by weight to pass a 2mm sieve
  - If manufactured, have a total content of heavy metals:
    - < 0.001% Cadmium (Cd)
    - < 0.01% Lead (Pb)

7.3 Waterway Rehabilitation

In addition to the general rehabilitation requirements detailed above and species list (Appendix A), the Contractor shall ensure the following works are completed at waterway crossings.

- Blend the landform in with the adjacent embankments and be shallower than 1V:2H
- When reinstating the upper subsoil layer, incorporate gypsum at rate of 4t/ha.
- Reinstate the topsoil at the surface above the upper subsoil.

7.4 Reinstatement

To promote connectivity cleared vegetation will be respread where practicable. Weeds will be sprayed following the movement of the dragline.

As the route is located predominantly within lands not owned, leased or managed by the proponent, plans for reinstatement will be subject to agreement with the various land owners.

8.0 References

Advisian (2016). BMC Dragline Move Project SPA Application. Approval document prepared by Advsian on behalf of BHP Billiton

Advisian (2016). BMC Dragline Move Project EPBC Referral Application. Approval document prepared by Advsian on behalf of BHP Billiton

BAAM (2016). BMC Dragline Move Project Terrestrial Ecology MNES Assessment. Unpublished report prepared by Biodiversity Assessment and Management Pty Ltd (BAAM) for Advisian on behalf of BHP Billiton Mitsui Coal.

Landloch (2016). BHP Billiton Dragline Mobilisation Project: Goonyella – Riverside Mine to South Walker Creek, Land Assessment for Soil Management and Rehabilitation, Unpublished report prepared by Landloch for Hatch on behalf of BHP Billiton

Appendix A - Further Specifications for GRM-SWC Rehabilitation Activities

Further Specifications for

GRM-SWC Dragline Move: Rehabilitation Activities

14 July 2017

Document Status	
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Revision History			
0	14/07/17	Soil Management and seed mix revision	Craig Bancroft
Rev	**Date**	**Description**	**Author**

Project details	
Project	Dragline DRE27 Relocation GRM-SWC
Country	Australia
Commodity	Coal
Business	South Walker Creek

1 Introduction

The Commonwealth Environment Protection and Biodiversity Conservation Act (EPBC) Approval (EPBC 2016/7788) Condition 7 addresses the requirement for the proponent to implement a rehabilitation management plan. In the approval the rehabilitation management plan means BHP Billiton 2016, BMC Dragline Move Rehabilitation Management Plan (1 December) or any revised version approved by the approval holder.

As part of the study phase of the project, during the EPBC assessment process, geotechnical site investigations were completed along the proposed transport alignment. These investigations included a review of both the topsoil and subsoil conditions and development of rehabilitation specifications for each of the four (4) identified Management Units (SMU), as detailed below in Table 1.

Table 1: Soil Management Units

SMU	Land System
A	Junee
B	Durandell
C	Blackwater, Connors, Daunia
D	Humboldt, Monteagle

The Dragline Move Rehabilitation Plan (December 2016), included preliminary Rehabilitation Specifications addressing topsoil re-instatement and a seed mix for revegetation. The rehabilitation plan anticipated further consultation with stakeholders. The Rehabilitation Specifications have been revised to promote an improved rehabilitation outcome. As such this Further Specification document (an appendix to the Drag Line Move Rehabilitation Plan) has been developed to document revised:

- Soil compaction treatments and
- The species selection for pasture, remnant and riparian zones.

1.1 Construction Methodology (Soil Compaction Treatment)

Detailed soil testing has revealed that additional compaction of sub-soils is required to ensure the travelling area meets the compaction specifications for transporting the dragline. This has resulted in the requirement for a revised compaction treatment during rehabilitation.

1.2 Landholder Consultation (Species Selection)

Prior to the planned commencement of rehabilitation works affected landholders were further consulted regarding the original species list. The landholders raised the following concerns relating the proposed species selection:

- Some species were unknown.
- Some are species not native and/or endemic to the area and there was concern they may introduce a new pest risk.
- Two of the species were considered non-desirable pest species in this area.
- Competitive, rapidly establishing species were the most desired from an erosion perspective, and this needs to be balanced with nutrition, palatability and suitability. Some proposed species did not deliver on these requirements.
- Buffel grass was a desirable species to all landholders and was absent from the list.
- Questions were raised as to availability of some species. This was to be confirmed during the rehabilitation planning stage.

2 Revised Rehabilitation Specifications

The specifications provided below replace the equivalent specifications proposed in 2016. Specifications listed in the Rehabilitation Management Plan (2016) not referenced in this Further Specification document remain in place. These are repeated in the 2017 version.

2.1 Preparation of Ground Surface

2.1.1 Proposed Treatment

Additional treatment of subsoils to achieve compaction specifications may result in deeper compaction layers.

The following treatments will be implemented during rehabilitation:

- Stripped top soil will be evenly spread across disturbed area, prior to ripping
- Compacted zone will be deep ripped (up to 900mm)
- Ripped surface will be broken down using offset discs, to form seedbed. This will ensure disturbance area is trafficable by the landowner and livestock. This treatment will also facilitate mixing of gypsum and fertiliser.
- Erosion prevention/control measures where required.

2.1.2 Rationale for Improvements

Deep ripping of the compacted zone will:

- Increase moisture retention
- Minimise the risk of a compacted sublayer contributing to accelerated erosion

Breaking down the ripped surface with offset discs will produce a more suitable seed bed.

2.2 Pasture Rehabilitation

2.2.1 Preliminary Grass Seed Mix – Preliminary Design Phase

The preliminary grass seed mix was developed based on classification of the intersected topsoil and subsoil types identified during the site investigation. The adopted list was based on a mix of warm season perennials that are drought tolerant and suited to a range of soil types, light conditions and soil moisture ranges.

A seed mix of 11 (2 native) grass species was provided to be applied at a total rate of 45kg of seed per hectare. Specifications required that the seed mix should include at least 7 of the 11 species with the rates adjusted accordingly to total 45kg seed per hectare.

The seed mix was based on coated seed for all species except green couch and assumed no cover crop was required.

2.2.2 Improved Grass Seed Mix – Detailed Design Phase

Based on landholder consultation and further review of rehabilitation works in the local area, a revised grass seed mix has been developed for rehabilitation of cleared pasture areas.

The revised list includes a seed mix of 14 grass species (4 native), provided below in Table 2. These are to be applied at a total rate of 45kg of seed per hectare. Subject to availability, an even ratio of the 14 species will be used in the seed mix. The Table 2 grass seed mix is to be applied to cleared pasture areas.

Table 2: Revised Grass Seed Mix

Common Name	Species	Native/Non-Native
Black Spear Grass	*Heteropogon contortus*	Native
Kangaroo Grass	*Themeda triandra*	Native
Curly Windmill Grass	*Enteropogan acicularis*	Native
Forest Bluegrass	*Bothriochloa bladhii*	Native
Strickland Digitaria	*Digitaria milanjiana*	Non-Native
Aztec siratro	*Macroptilium atropurpureum*	Non Native
Secca stylo	*Stylosanthes scabra*	Non Native
Bissett creeping Bluegrass	*Bothriochloa insculpta*	Non-Native
Reclaimer Rhodes Grass	*Chloris gayana*	Non-Native
US Buffel	*Cenchrus ciliaris (sub sp USA)*	Non-Native
Gayndah Buffel	*Cenchrus ciliarus (sub sp Gayndah)*	Non-Native
Verano Stylo	*Stylosanthes hamata*	Non Native
Butterfly pea	*Clitoria ternatea*	Non Native
Floren Bluegrass	*Dicanthium aristatum*	Non-Native

2.2.3 Rationale for Improvements

The preliminary seed mix was developed solely on the use of grasses considered to be suited to the observed in-situ conditions. Prior to finalising access agreements, limited consideration was able to be given to stakeholder land use; specifically pastoral grazing. Subsequent consultation with pastoral landowners and representatives from affected mining leases identified preferences for specific seeds not originally listed; or avoidance of seeds proposed in the 2016 rehabilitation management plan.

The key considerations relating to the evolution of the proposed seed mix are outlined below. Table 3 provides the environmental and landholder input into the species changed and selected.

2.2.3.1 Original Grass Seed Mix Issues

- The 2016 plan included Keppel Couch (*Bothriochloa pertusa cv. Keppel*); many local cattle producers consider this species a weed that can potentially reduce productivity. Goonyella Riverside Mine (GRM) has made a commitment not to use this species.
- Rehabilitation trials utilising the recommended mix have shown that slow establishment propagates parthenium weed. The areas are prone to competition from more vigorous buffel grass varieties which create an undesirable monoculture.
- Some 2016 proposed seed mix species are slow to establish suitable groundcover and therefore would require a significant period without stocking. The disturbed area is unable to be isolated from stock and will be subject to early grazing.
- Many areas of the alignment are subject to grazing and the stocking rates applicable to large areas of developed pasture. It is impractical to de-stock areas to enable rehabilitation.

2.2.3.2 Revised Grass Seed Mix Benefits

- The addition of a wider variety of grass species will reduce the risk of required volumes of seed not being commercially available.
- The pasture species selected are more vigorous in all conditions and will more readily establish to provide the required groundcover.

The revised grass seed mix considers soil type and existing grass species on the alignment. Rehabilitation sign off from the landowners requires reinstatement of the soil and pasture to the condition of the adjoining land or better. Adding the legume to the seed mix will assist with sustaining pasture condition beyond the compensation period and provide ongoing soil conditioning to benefit all of the grass species under expected stocking rates.

Table 3: Rationale for change to species selection

Common Name	Species	Environmental Aspects	Landholder Concerns	Recommendations
Keppel Couch	*Bothriochloa pertusa cv. Keppel*	Endemic to area. Widely accepted as a weed species to Graziers	Widely accepted as a weed species, not a favourable species to use	Remove
Tolgar-Rhodes Grass	*Chloris gayana*	Is suitable species as far as revegetation is concerned, however it is not native and is not endemic.	Generally, graziers are not against Rhodes Grasses, however as this grass does not currently exist in this area there is a perceived risk with using it. Based on the information researched, this species will be viewed favourably by graziers	Remove
Strickland Digitaria	*Digitaria milanjiana*	Non Native, is currently found in this area Suitable species for revegetation on alignment in regards to environmental conditions. Intolerant of poor drainage.	Generally, not used as an improved pasture by graziers in this region	Retain
Forest Bluegrass	*Bothriochloa bladhii*	Native, suitable for revegetation	Generally not used as an improved pasture by graziers in this region.	Retain
Brunswick grass	*Paspalum nicorae*	Non Native, Will struggle with the lack of rainfall in this region.	Due to the grazing regimes implemented on some properties (ie. Broadlea have a 6-9 month spelling period), this grass will not be grazed until maturity is reached. If this occurs, it will become unpalatable to stock.	Remove
Digit grass - Pangola	*Digitaria eriantha*	A good pasture species, however it is not suitable due to environmental conditions in most of the alignment, (apart from some small sections of riparian zones).	Graziers plant this species using Runners.	Remove
Creeping Bluegrass (hatch bluegrass)	*Bothriochloa insculpta*	Non-Native, Suitable species regarding environmental conditions, however it takes time to establish (normally it is not until the 2nd year after seeding that it becomes evident) and needs to be left ungrazed in order to establish.	Accepted by graziers as an improved pasture, however after winter most years the leaf becomes covered in rust and becomes non-palatable. (this is why most graziers have turned to Bissett Bluegrass, with the added rust resistance)	Remove
Green Couch	*Cynodon dactylon*	Non-Native, generally accepted as a weed species in agricultural applications		Remove

		Extract from http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Cynodon_dactylon_(Couch_Grass).htm Holm et al. (1977) have categorised *Cynodon dactylon* as the second most important weed in the world (after nut-grass - *Cyperus rotundus*). *C. dactylon* can rapidly invade cultivated land, cause serious yield losses and it is extremely difficult to eradicate (Bogdan 1977). It can be toxic to livestock and is a host of pathogens and pests. *Cynodon dactylon* has been included in the Global Invasive Species Database (GISD 2010).		
Floren Bluegrass (Angleton Grass)	*Dichanthium aristatum*	Non-Native, Endemic to area. Suitable species in regards to environmental conditions.	Not generally used as an improved pasture by graziers however is not expected to be rejected as unsuitable by graziers.	Retain
Saraji	*Urochloa mosambicensis*	Non- Native, endemic, not suited to clays, which occur over the majority of the alignment.	Palatable when mature. Expected to find a mixed reaction from landholders, based on initial discussions.	Remove
Qld Bluegrass	*Dichanthium sericeum*	Native, suitable species to some parts of the alignment, particularly the heavy black clay regions of Broadlea. Not suitable for many other areas of the alignment due to soil conditions	Suitable species, however may not be viewed favourably by landholders due to Environmental issues, particularly confusion with (*D.Queenslandicum*.)	Remove

2.3 Remnant and Riparian Vegetation Rehabilitation

Following completion of the 2016 Rehabilitation, further consideration has been given to the optimisation of rehabilitation specifications for disturbed remnant and riparian zones.

2.3.1 Remnant

As a result, areas that currently support remnant vegetation will be rehabilitated to encourage regeneration of the original vegetation community types.

Rehabilitation will also involve the following activities, as required:

- Removal of any fill sourced externally,
- Respreading of topsoil in order to encourage the regrowth of native vegetation from the existing seedbank.
- Reseeding with grasses (Table 2) and addition of native tree species seeds (Table 4) to the mix,
- Planting of Native species tubestock (if appropriate), and
- Erosion prevention/control measures where required

The species listed in the native seed mix, provided in Table , are recommended species for the rehabilitation of cleared areas of remnant vegetation. Seed selection and application rates will be subject to the availability of seeds. As a guide, the approximate seed application rate for trees is 14kg/ha.

The native seed mix represents species found during the project ecological assessments and some are known habitat species for confirmed or likely Matters of National Environmental Significance (MNES) within the project area.

Table 4: Native Seed Mix

Common Name	Species	Alignment Area
Forest red gum	*Eucalyptus tereticornis*	Peabody/Fitzroy Area (KP 18.5 – KP 26.0)
River red gum	*Eucalyptus camaldulensis*	Peabody/Fitzroy Area (KP 18.5 – KP 26.0)
Narrow-leaved ironbark	*Eucalyptus crebra*	Peabody/Fitzroy Area (KP 18.5 – KP 26.0)
Moretonbay Ash	*Eucalyptus tesselaris*	Peabody/Fitzroy Area (KP 18.5 – KP 26.0)
Yellowwood	*Terminalia oblongata*	South Walker Creek Area (KP 70.0 – KP 77.5)
Whitewood	*Atalaya hemiglauca*	South Walker Creek Area (KP 70.0 – KP 77.5)
Brigalow	*Acacia harpophylla*	South Walker Creek Area (KP 70.0 – KP 77.5)
Belah	*Casuarina cristata*	South Walker Creek Area (KP 70.0 – KP 77.5)

2.3.2 Rationale for Improvements

Based on soil types these species will be most likely to succeed and stabilise the disturbed areas, providing cover to enable natural reestablishment of the surrounding communities

2.4 Riparian Zones

The project is also required to rehabilitate watercourses and drainage lines to ensure bank stability and revegetation. Rehabilitation activities will be implemented to reinstate cleared riparian vegetation. Subject to local conditions, this may include placement of cleared vegetation over the disturbed area (including seedbank), seeding and/or planting seedlings.

The species listed in the grass seed mix (Table 2), and tubestock species list (Table 5) are recommended species for the rehabilitation of riparian vegetation. Seed selection and application rates will be subject to the availability of seeds (as per section 2.2.1). Tubestock will be used in the riparian zones of the major creeks (Isaac River, Skeleton Gully, Teviot Brook, North Creek, Thirty Mile Creek, Sandy Creek and Humbug Gully). Tubestock will be planted with approx. 2m spacing between plants and rows.

The native tubestock mix represents species found during the project ecological assessments and known habitat species for confirmed or likely Matters of National Environmental Significance (MNES) within the project area.

Table 5: Native Tubestock Mix

Common Name	Species	Alignment Area
Weeping Bottlebrush	*Callistemon viminalis*	All Riparian Zones
Black Wattle	*Acacia silicone*	All Riparian Zones
Black Tea Tree	*Melaleuca bracteates*	All Riparian Zones
Soap Bush	*Alphitonia excelsa*	All Riparian Zones
Forest Red Gum	*Eucalyptus tereticornis*	All Riparian Zones
Narrow-leaved ironbark	*Eucalyptus crebra*	All Riparian Zones
Moretonbay Ash	*Eucalyptus tesselaris*	All Riparian Zones
River Red Gum	*Eucalyptus camaldulensis*	All Riparian Zones

2.4.1 Rationale for Improvements

Based on soil types these species will be most likely to succeed and stabilise the disturbed areas, providing cover to enable natural reestablishment of the surrounding communities

Tubestock will enable tree species to compete with grass species and enable rapid establishment of riparian vegetation, in turn improving bank stability.