Spoil Disposal Revegetation and Rehabilitation Plan

Queensland Curtis LNG

[Enter QGC Doc Reference XXXXX-xxxx-xxx-xxx-xxxxxx]

Rev [x]

January 2010

Uncontrolled when printed

DOCUMENT INFORMATION SHEET	
TITLE: Enter QGC table text BOLD	
PURPOSE AND SCOPE: **[The purpose of this document is to…]** **[It applies to….]**	
DOCUMENT VERIFICATION	
Responsible:	
Signature:	**Position:**
Name:	**Date:**
Accountable:	
Signature:	**Position:**
Name:	**Date:**
Consulted:	
Enter name/position of those required to review the document	
[Name]	**[Position]**
Informed:	
Enter name/position of those to receive the completed document	
[Name]	**[Position]**
Endorsed:	
Signature:	**Position:**
Name:	**Date:**

RACIE Terms

R	**Responsible:**	the person who actually produces the document
A	**Accountable:**	the person who has to answer for the success or failure of the quality and timeliness of the document
C	**Consulted:**	those who must be consulted before the document is published
I	**Informed:**	those who must be informed after the document is published
E	**Endorsed:**	the person who must approve the document before publication

Revision Record

Issue	Date	Reason for Issue	Responsible	Accountable

Table of Contents

1.0 INTRODUCTION

This Spoil Disposal Revegetation and Rehabilitation Plan (SDRRP) sets out procedures to control and manage the potential impacts of spoil disposal areas at the proposed liquefied natural gas (LNG) facility on Curtis Island.

An independent environmental consultant will formally review the plan every three years. Results of this review will be submitted to the Department of Infrastructure and Planning (DIP) and the Department of Environment and Resources Management (DERM). An independent environmental consultant will also undertake an informal review of the plan annually, in conjunction with QGC, to ensure that all actions are being undertaken and that QGC are fulfilling their commitments.

1.1 Project Description

The proposed location of the LNG Facility is six km north east of Gladstone on the south-western side of Curtis Island, immediately north of China Bay and south of Graham Creek.

Development of the LNG infrastructure on Curtis Island will involve the disposal of approximately one million m³ of stripped soil at three locations within the LNG Facility boundary (hereafter referred to as the Spoil Areas), as indicated in *Figure 1.1.*

This SDRRP applies to the revegetation and rehabilitation of these three spoil areas.

1.2 Aims and Objectives

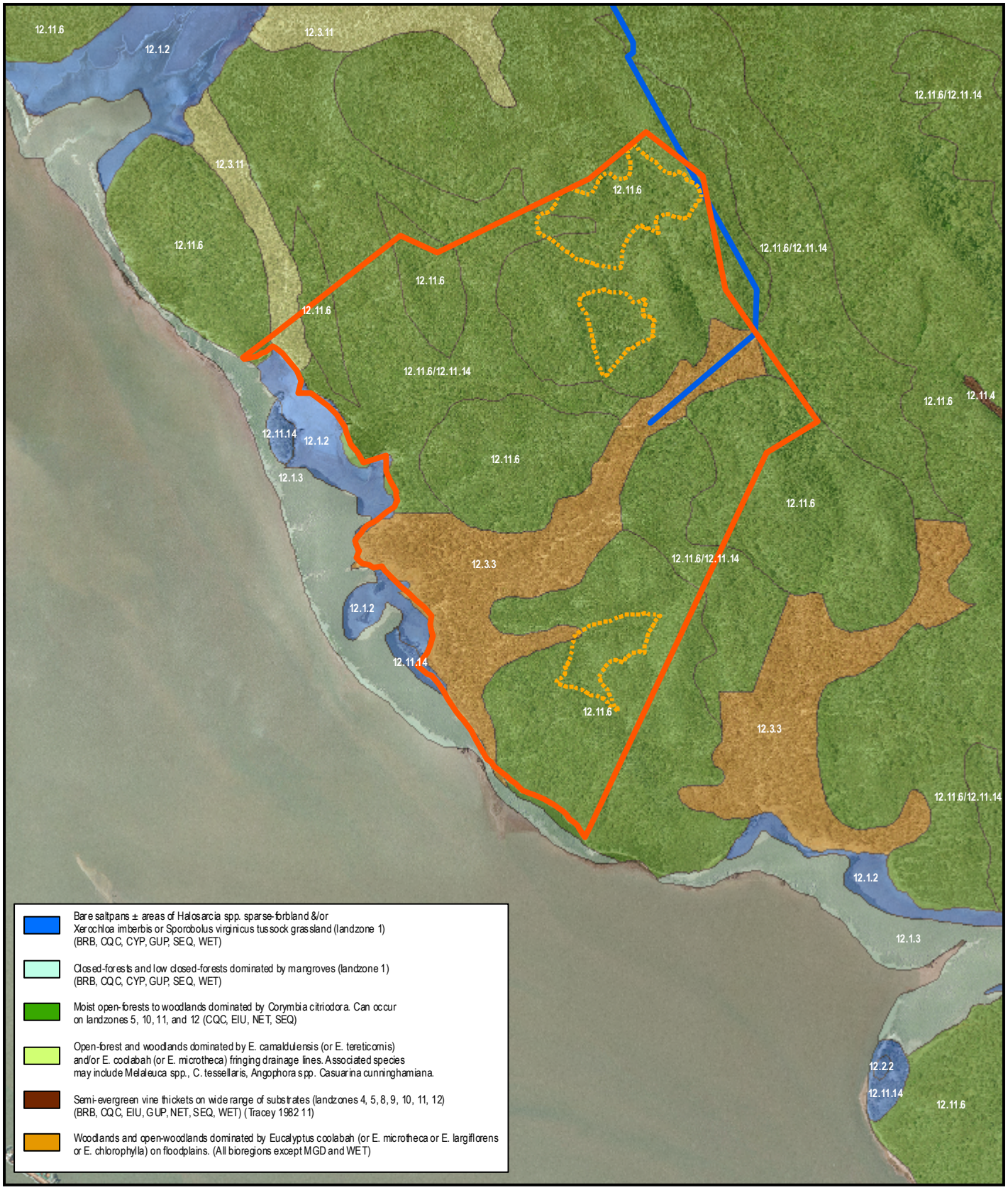
This SDRRP provides a detailed plan to manage the revegetation and rehabilitation of spoil disposal areas at the LNG Facility. Objectives include:

- no weed species are introduced;
- a weed management plan is implemented;
- there are no impediments to revegetation from altered soil conditions;
- revegetation is in keeping with surrounding vegetation;
- soil erosion controls are put in place; and
- the spoil disposal areas are suitably landscaped to complement the surrounding environment.

1.3 Document Structure

This SDRRP has been broken down into a number of sections:

- Legislation and regulatory requirements;
- Existing environment;
- Site clearing procedure and spoil disposal;
- Rehabilitation elements;
- Soil Management ;
- Topography and landforms;
- Weed management;
- Erosion and sediment control;
- Species selection and planting;
- Habitat rehabilitation; and
- Project management.



Legend

- Proposed QCLNG Site Boundary
- Proposed Export Pipeline
- Spoil Disposal Area

Source Note:

Aerial photo -Department of Infrastructure and planning for QCLNG Project

Projection: UTM MGA Zone 56 Datum: GDA 94

0 125 250 500 m

Disclamer: Positional Accuracy of RE Data mapped at a scale of 1:100,000 is 100 metres. Survey and Mapping of 2003 Remnant Vegetation Communities and Regional Ecosystems of Queensland, Version 5.0, EPA (Dec 2005), Certified Regional Ecosystem Map Amendments under the Vegetation Management Act (1999), EPA, 20/08/2008. Field Assessments undertaken by Unidata as reported in "Revised Regional Ecosystem Mapping"

N

QUEENSLAND CURTIS LNG
A BG Group business

Project: Queensland Curtis LNG Project

Client: QGC - A BG Group business

Title: Spoil Areas and Vegetation Communities at the LNG Facility

ERM
Environmental Resources Management Australia Pty Ltd

Drawn	JB	sEIS Appendix 11.3	Figure 1.1
Approved	SO	File No:	0086165b_SUP_GIS010_S11.3.1.1
Date	19.01.10	Revision	0

2.0 LEGISLATION AND REGULATORY REQUIREMENTS

2.1 Licences / Permits

No licences or approvals are required for the rehabilitation and revegetation of the spoil disposal areas.

2.2 Guidelines / References

Relevant guidelines include but are not limited to the following:

- *Queensland Vegetation Management Act (1999),* Section 4.3.26 (2).
- Revegetation Methods (1995) Environment Protection Authority, Queensland Government.
- Assessment of Revegetation (1995) Environment Protection Authority, Queensland Government.
- Approaches and techniques for the rehabilitation of native vegetation in South-east Queensland (2004) The Australian Network for Plant Conservation.
- Tropical Grasslands (1997) Priorities for revegetating landscapes disturbed by mining and other activities Volume 31, 282–284.

2.3 Commitments

The Environmental Impact Statement for the proposed QCLNG Project has set out several commitments for the management of rehabilitation. **Error! Reference source not found.** identifies these key commitments.

Table 2.1 Rehabilitation and Revegetation Commitments

Section	Requirement/Commitment
Volume 5, Section 7.9.1	Rehabilitation and revegetation plans for areas that are disturbed for access during construction phases, will be developed prior to commencement of construction.
Volume 5, Section 7.9.1	Ongoing management for the duration of all phases of the QCLNG Project will include implementation of revegetation and rehabilitation plans, sediment management plans; weed management plans; and pollution and storm water runoff management plans.
Volume 5, Section 7.9.2.1	Where the pipeline alignment or site periphery areas are to be revegetated the following measures will be undertaken: • vegetation will be monitored for re- establishment; and • monitoring for weed infestations will be undertaken quarterly for a period of two years following construction and appropriate control measures implemented.

2.3.1 Roles and Responsibilities

The roles and responsibilities of key parties with respect to the implementation of the SDRRP are listed in *Table 2.2* below.

Table 2.2 Roles and Responsibilities

Role	Responsibility
The Proponent (QCG)	Manage EPC Contractor.
EPC Contractor	Manage all contractors on site and ensure all specifications are met.
Independent Consultant	Assist and monitor any environmental activities including compiling an inventory of soil degradation and erosion sites,and develop specific guidelines for contractors on vegetation removal.
Landscaping Contractor	Implement revegetation and rehabilitation activities and ensure required specifications are met.
Bush-regeneration Contractor	Implement weed management activities and ensure required specifications are met.
Department of Infrastructure and Planning (DIP)	Enforce relevant legislation in relation to Infrastructure and Planning in Queensland.
Department of Environment and Resources Management (DERM)	Enforce relevant legislation in relation to the Environment Protection and Biodiversity Conservation Act 1999
Note: Details of activities are provided in *Tables A.1 – A.4*.	

3.0 EXISTING ENVIRONMENT

Curtis Island, north of Graham Creek, comprises Curtis Island National Park and Curtis Island Conservation Park. Vegetation in the National Park is a mosaic of coastal heath, grassland, paperbark woodland, open eucalypt forest and dry rainforest. The National Park is undeveloped and attracts a limited amount of local tourism (ERM 2009).

The LNG Facility site and adjoining areas are subject to grazing by free-ranging Cattle (*Bos taurus*), feral Horse (*Equus caballus*) and, to a lesser extent, by feral Pig (*Sus suscrofa*). The area is undeveloped and displays a history of disturbance as a product of grazing and altered fire regimes.

3.1 Landforms and Soils

The dominant underlying geology of the study area is the Wandilla Formation of the Curtis Island Group consisting of mudstone, quartz greywacke, and pale grey chert. The estuary environments associated with Graham Creek and Port of Gladstone consist of Holocene sediments of gravel, silt and clay alluvium and associated mangrove swamps, mud flats and salt pans (ERM 2009)

There has been no comprehensive assessment for the occurrence of acid sulphate soils (ASS) on the southern sections of Curtis Island. However, areas of Quaternary Holocene mud and sand on the mainland directly adjacent to the proposed Curtis Island study area have been identified as having ASS with a depth ranging to 5 metres. The same geological features of Quaternary Holocene mud and sand have been identified on the estuarine sections of Curtis Island, particularly areas surrounding Graham Creek. It is therefore considered likely that ASS are located in areas of Curtis Island below 5 metres AHD (ERM 2009).

No parts of the study area have been identified on either the Queensland Environmental Management Register (EMR) or Contaminated Land Register (CLR).

3.2 Topography

The LNG Facility site has an elevation of between 10 m and 25 m Australian Height Datum (AHD) throughout the majority of the site. The site rises from sea level (along its western boundary) to more than 80 m near the eastern site boundary. The LNG Facility is located within a basin-like structure with hills on the southern, northern and western boundaries. The highest ground elevation within the footprint of the LNG Facility is approximately 50 m AHD on its eastern side. The western margin of the site is flanked by intertidal mangrove flats ranging from approximately 0.5 m to 3 m above sea level and extends approximately 100 m to 250 m from the line of lowest astronomical tide (LAT) – *see Figure 3.1.*

The three Spoil Areas located at the LNG Facility are located at varying elevations,as discussed below:

- *Spoil Area A* rises from an elevation of 35 m AHD along the south-west boundary to 45-55 m AHD along the north-east boundary of the spoil area.
- *Spoil Area B* falls from an elevation of 40 to 50 m AHD along the western boundary to 30m AHD in the centre of the spoil area.
- *Spoil Area C* rises from an elevation of 20 m AHD along the northern boundary to 35 m AHD along the southern boundary of the spoil area.

3.3 Drainage and Waterways

Two main watercourses (ephemeral flow only) flow, from north-east to south-west, through the LNG Facility. There are also several smaller first and second order watercourses flowing into the main creeks from the elevated areas on the south and north of the site. The creeks observed across the site generally range in width between 2 m and 5 m, with typical depths of 0.5 m-1.5 m, but ranging up to more than 5 m in one watercourse in the upper slopes of the site towards the eastern site boundary.

There are no perennial fresh surface water bodies in the vicinity of the LNG Facility site. However, there are a number of overland flow paths and ephemeral streams, which serve as drainage channels during intermittent rainfall events. The three Spoil Areas within the LNG Facility contain a number of drainage lines within their designated boundaries (*see Figure 3.1*):

- Spoil Area A contains one main drainage channel with seven tributaries;
- Spoil Area B contains one main drainage channel which forks to the east and west towards the northern boundary; and
- Spoil Area C contains two main drainage channels with two tributaries heading south off the northern drainage channel.

3.4 Vegetation

Vegetation within the LNG Facility site ranges from open woodland, with individual eucalypts and iron bark trees to closed medium density undergrowth of eucalypt saplings. Open woodlands occupy approximately 65 per cent of the site, with medium density saplings occupying the remaining 35 per cent. The sapling understorey occupied areas consist of larger trees distributed relatively evenly throughout (see *Figure 1.1).*

The dominant vegetation types consist of *Corymbia citriodora* woodland (Lemon-scented Gum), *Eucalyptus tereticornis* woodland (Red Gum) with *Eucalyptus crebra* (Narrow-leaved Ironbark).

Vegetation at the spoil areas consists of Regional Ecosystem (RE) 12.11.6, Lemon-scented Gum, Narrow-leaved Ironbark open forest on metamorphics ± interbedded volcanics listed as Not of Concern under the provisions of the Queensland VM Act.

3.5 Weeds

Generally, weeds are in low abundance within the LNG facility site. The weeds species that most commonly occur are herbaceous and non-problematic. Three declared weed species occur within the LNG facility site. These are:

- Cryptostegia grandiflora (Rubber Vine) Class 2;
- Opuntia sp. (Prickly Pear) Class 1; and
- Lantana camara (Lantana) Class 3.

The most abundant of these is Prickly Pear, which is most prevalent around the marine fringes. *C. grandiflora* and *L. camara* are listed on the Weeds of National Significance (WoNS) list, which was developed in 1999 in an attempt to classify Australia's most prominent weed threats and to prioritise regional, state and national actions.

The non-declared weed *Praxelis clematidea* (Praxelis) also occurs within the LNG Facility site. This weed is rapidly spreading throughout parts of Northern Queensland and is currently listed on the 'Alert List for Environmental Weeds' collated by the Department of the Environment Water Heritage and the Arts.

Legend

- Proposed QCLNG Site Boundary
- Proposed Export Pipeline
- Spoil Disposal Area
- Drainage
- Contours (10m Interval)

Source Note:

Aerial photo -Department of Infrastructure and planning for QCLNG Project

Projection: UTM MGA Zone 56 Datum: GDA 94

0 125 250 500 m

Disclamer: Positional Accuracy of RE Data mapped at a scale of 1:100,000 is 100 metres.
Survey and Mapping of 2003 Remnant Vegetation Communities and Regional Ecosystems of Queensland, Version 5.0, EPA (Dec 2005), Certified Regional Ecosystem Map Amendments under the Vegetation Management Act (1999), EPA, 20/08/2008.
Field Assessments undertaken by Unidel as reported in "Revised Regional Ecosystem Mapping"

N

QUEENSLAND CURTIS LNG
A BG Group business

Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business

Title: **Topography and Drainage at the LNG Facility**

ERM
Environmental Resources Management Australia Pty Ltd

Drawn	JB	**sEIS Appendix 11.3**	**Figure 3.1**
Approved	SO	File No:	0086165b_SUP_GIS011_S11.3.3.1
Date	19.01.10	Revision	0

Disclaimer:
Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only.
ERM does not warrant he accuracy of any such Maps and Figures.

4.0 SITE CLEARING AND SPOIL DISPOSAL

The three designated Spoil Areas within the LNG Facility site are situated at elevations of 35 to 50 AHD and contain up to seven drainage channels within each of the designated areas. Vegetation at all three Spoil Areas consists of Lemon-scented Gum, Narrow-leaved Ironbark open forest on metamorphics ± interbedded volcanics. These areas will be used to stockpile approximately 600,000 m^3 of excess cut material plus 170,000 m^3 of site strip (primarily topsoil) within the LNG Facility boundary.

Some of the topsoil will be temporarily stockpiled, to be used at the LNG Plant as a growing medium in grassed areas. The remainder of the topsoil will be hauled to the designated Spoil Areas. The height of the Spoil Areas will not exceed the highest natural topographical point in that location.

The LNG Facility site will require approximately 180 ha of vegetated land to be cleared during the site preparation phase of construction activities. Erosion containment facilities will be installed as the clearing proceeds. Initial areas to be cleared will include temporary work areas, spoil disposal areas, and the initial cut/fill areas.

5.0 REHABILITATION ELEMENTS

Reconstructive landscaping will be designed to integrate natural bushland with the built environment. This involves selecting species that will not invade the surrounding natural bushland but that will provide fauna habitat. This is particularly important at the interface of the development and native bushland.

Progressive rehabilitation of the Spoil Areas will take place during and after construction activities, with the techniques and timing at each stage dependent on their practicability.

This SDRRP specifies the actions and strategies to achieve the following:

- topsoil cover reestablishment;
- no impediment to revegetation from altered soil conditions;
- landform reestablishment;
- creeklines and drainage lines disturbed by construction returned to a stable condition;
- drainage patterns managed in accordance with a Stormwater Management Plan;
- sediment and erosion control measures installed in erosion prone areas;
- no introduction or spread of weed or pest species; and
- rehabilitation of disturbed habitats.

These objectives are considered further in *Chapter Six* to *Chapter 11*. Each chapter includes an overview of the aims and overall approach in relation to each objective. Detailed management actions including priority, timing and responsibilities to achieve the specific objectives have been tabulated and are provided as *Annex A.*

6.0 SOIL MANAGEMENT

Although revegetation can be achieved on various substrates, topsoil is almost always an essential factor in successful rehabilitation programmes particularly during the period of initial plant growth. Subsoil conditions become more important in the longer term. Topsoil (or weathered surface material) generally contains seeds, nutrients and micro-organisms that are essential to plant growth and if they are lost, then the system will generally take a longer time to re-establish.

6.1 Objectives

The main objectives of soil management at the site are:

- topsoil cover to be re-established;
- no impediments to revegetation from altered soil conditions; and
- no weed species are introduced.

6.2 Pre-earthworks Soil Assessment

In general, the term 'topsoil' refers to the "A" horizon of the soil which is usually darker than the underlying soil because of an accumulation of organic matter. However, soils covering a particular area may be quite diverse and not all of them may be of value in rehabilitation for the following reasons:

- unsuitable or infertile soil type, e.g. duplex soils with an extremely thin A1 horizon underlain by a thicker, but very infertile A2 horizon;
- presence of a high proportion of stone or gravel in the profile, e.g. lithosols or skeletal soils on steep slopes or ridge crests, and
- topsoil destroyed or removed by erosion, or affected by salinity.

Prior to the commencement of earthworks, topsoil will be removed and stockpiled from areas to be excavated or covered by fill material. This soil will then be used in later rehabilitation activities. Samples of the topsoil will be submitted to an approved Soils Laboratory in order to ascertain the type and amount of chemicals/fertilisers to be mixed with it prior to future seeding.

6.3 Clearing and Vegetation Management Prior To Soil Removal

Land disturbance will be minimised by incorporating a number of post–clearing strategies (from O'Brien (2008) and the NSW Minerals Council (2007)), including:

- proposed erosion and sediment control measures will be implemented in advance of, or in conjunction with clearing and grubbing operations;
- depth of stripping will be determined in accordance with a soils distribution and stripping depth plan;
- prior to stripping operations, the stripping area will be delineated on a plan and in the field (use survey pegs). Topsoil limits will be shown on the pegs;
- stockpiles will be stabilised using suitable materials such as mulch to reduce loss through wind or water borne erosion; and

- the period of storage will be minimised in order to reduce the detrimental effects of storage on any native seed in the soil.

If stockpiling of topsoil cannot be avoided, then the following will be considered:

- plan to use the topsoil as soon as possible;
- stockpiles will be deep ripped to 500 mm, fertilized and immediately sown with at least a cover crop using native grasses such as Bunch Speargrass (*Heteropogon contortus*);
- a strict timetable of weed control and maintenance fertilizing is required as part of a stockpile management program;
- stockpile locations and design will be selected for ease of access, minimisation of rehandling, segregation from other construction activities and minimisation of soil structure degradation; and
- stockpiles will be clearly identified by a sign and a ditch or berm around the immediate stockpile area to reduce the likelihood of contamination and soil loss.

6.4 Topsoil Re-spreading and Seedbed Preparation

Handling topsoil at optimum moisture content will reduce damage to soil structure, achieve a higher standard of revegetation and reduce maintenance requirements. Prior to collecting topsoil from the stockpile, any weeds will be carefully scalped off the topsoil. If weeds are present then the top 5cm deep weed-infected layer will be removed and to prevent its transfer to the rehabilitated areas. Topsoil will be spread to the determined depth along the contour of regraded spoil to aid runoff control, minimise erosion and increase moisture retention by dumping at the top of slopes and grading downwards and across the contour (NSW Minerals Council 2007).

Re-spread topsoil will be levelled to achieve an even surface, avoiding a compacted or over-smooth finish. The topsoil will then be incorporated into the overburden, by contour cultivation with a tined implement in preparation for sowing. This operation will leave the soil surface in a roughened condition. Tining or ripping off topsoiled areas creates a “key” between the soil and the spoil (NSW Minerals Council 2007).

6.5 Management Actions

See *Table A.1* for prescribed management actions relating to the supporting actions at the site.

6.6 Performance Indicators

- Natural regeneration occurring within 12 months of revegetating within Spoil Areas.
- No erosion of soils and no sedimentation of waterways.
- No weeds recorded in the Spoil Areas within 18 months of revegetation.

7.0 TOPOGRAPHY AND LANDFORMS

Topography and natural landforms are essential components in the overall planning and design of any development. Elements such as drainage paths, contour drains, ridgelines, and emplacements should be shaped in undulating informal profiles in keeping with natural landforms of the surrounding environment (EPA 1995b).

7.1 Objectives

The main objectives of topography and landform management at the site are to ensure:

- drainage patterns are reinstated in accordance with a drainage and stormwater management plan; and
- waterways disturbed by the spoil areas are returned to a stable condition as soon as practicable after construction.

7.2 Pre-Earthworks Assessment

As discussed in *Chapter 3*, the LNG Facility site elevation and drainage lines have been previously surveyed and recorded. The three designated Spoil Areas are situated at elevations of 35 to 50 AHD and contain up to seven drainage channels within each of the designated areas.

7.3 Topography and Landforms

The topography and landforms at the spoil areas will:

- provide opportunities for a greater diversity of plant species over time; and
- allow drainage lines to collect surface runoff from revegetation and disturbed areas.

Drainage patterns will be managed in accordance with a Stormwater Management Plan. The following methods will be undertaken prior to, during and after excavations to ensure land is appropriately restored:

- all proposed erosion and sediment control measures will be implemented in advance of, or in conjunction with clearing and grubbing operations;
- temporary drainage systems will be used throughout the excavation period;
- the height of the spoil areas will not exceed the highest natural topographical point in that location;
- topsoil will be placed on the spoil areas in a slightly moist condition; and
- prior to excavation, drainage lines and ridgelines will be clearly identified on a plan.

7.4 Management Actions

See *Table A.1* for prescribed management actions relating to the supporting actions at the site.

7.5 Performance Indicators

- Waterways disturbed by the spoil areas are stable.
- No erosion of soils and no sedimentation of waterways.

8.0 WEED MANAGEMENT

A weed can be defined as any plant growing where it is not wanted. .Potential weed sources include transfer during construction through the movement of vehicles and disturbance of soils. Weed species is generally introduced to an area and a number of these species are declared, legally obliging the landowner to control or remove them. Weeds which are currently known or expected to to occur at the LNG Faciltiy site are provided in *Table 8.1*.

Table 8.1 Weeds known or expected to occur within the LNG Facility site

Common Name	Scientific Name	WONS	Declared Weeds (Class)
Pond Apple	*Annona glabra*	X	2
Mother of Millions	*Bryophyllum delagoense* syn. *B. tubiflorum, Kalanchoe delagoensis*	-	2
Rubber Vine	*Cryptostegia grandiflora*	X	2
Harrisia Cactus	*Harrisia* sp. syn. *Eriocereus* sp.	-	1
	H. martinii, *H. tortuosa* and *H. pomanensis* syn. *Cereus pomanensis*	-	2
Lantana	*Lantana camara*	X	3
Prickly Pear	*Opuntia* sp.	-	1
Praxelis	*Praxelis clematidea*	-	Non declared

WONS = Weeds of National Significance as identified in Revised National Weed Strategy:
Declared Weeds Class as per *Land Protection (Pest and Stock Route Management) Act 2002.*

8.1 Objectives

The main objectives of weed management at the site are to ensure:

- existing weed species are controlled; and
- no weed species are introduced.

8.2 Potential Impacts

Weeds can cause many problems, such as:

- seriously impede native vegetation establishment;
- compete with tree seedlings for water and nutrients;
- reduce overall biodiversity; and
- increase fire hazard.

8.3 Control / Management

Weed management will be a key component in ensuring the success of all rehabilitated areas and is dealt with comprehensively in the draft QCLNG Weed and Pest Management Plan. An annual review of the plan will be undertaken to assess the effectiveness of the weed control measures implemented during the preceding year and detail any necessary changes to weed control measures.

8.4 Management Actions

See *Table A.2* for prescribed management actions relating to the supporting actions at the site.

8.5 Performance Indicators

- Weed and Pest Management Plan prepared and implemented.
- No weeds recorded in the Spoil Areas within 18 months of revegetation.

9.0 EROSION AND SEDIMENT CONTROL

Wind erosion and sedimentation of streams and drainage lines has the potential to occur in areas where native vegetation has been removed and as a result of excavation and stockpiling operations. Erosion removes the nutrient-rich topsoil and exposes the subsoil, reducing the productive capacity of soil and limits plant growth. When redeposited, eroded soils can also smother plants and result in the loss of some species. High sediment loads can reduce water quality and lead to increased levels of turbidity and a loss in aquatic and semi-aquatic flora and fauna (Engineers Australia 2009).

9.1 Objective

The main objective of erosion and sediment control is to ensure:

- no impediments to revegetation from altered soil conditions;
- sediment and erosion control measures are installed in erosion prone areas;
- waterways disturbed by the spoil areas are returned to a stable condition as soon as practicable after construction; and
- drainage patterns are reinstated in accordance with a drainage and stormwater management plan.

9.2 Control / Management

A detailed erosion and sediment control plan for the site will be prepared prior to commencement of construction.

9.3 Management Actions

See *Table A.3* for prescribed management actions relating to the supporting actions at the site.

9.4 Performance Indicators

- No erosion of soils and no sedimentation of waterways.
- Waterways disturbed by the spoil areas are stable.
- No impediments to revegetation from altered soil conditions.

10.0 SPECIES SELECTION AND PLANTING

Native seeds will be acquired to facilitate the recreation of the structural and floristic diversity of the existing vegetation at the areas earmarked for rehabilitation.

10.1 Objectives

The main objectives of seed selection and planting at the site are to ensure:

- local native vegetation is re-established;
- no weed species are introduced; and
- disturbed habitats are rehabilitated.

10.2 Seed Acquisition

A suitably qualified organisation (such as Greening Australia) will be appointed to acquire a representative selection of native tree species that occur at the site.

Table 10.1 provides a list of suggested species for enhancement and re-establishment of the Spoil Areas.

Table 10.1 Recommended list of plant species for RE 12.11.6, for revegetation of Spoil Areas

Species name	Common name
Canopy 15 - 20 m (70%*)	
Corymbia citriodora	Lemon Scented Gum
Corymbia clarksoniana	Clarkson's Bloodwood
Eucalyptus crebra	Narrow-leaved Ironbark
Mid-Storey (10%)	
Acacia disparrima ssp *disparrima*	Ironbark Wattle
Corymbia tessellaris	Moreton Bay Ash
Eucalyptus exserta	Queensland Peppermint
Exocarpos latifolius	Broad-leaved Scrub Cherry
Planchonia careya	Cocky Apple
Pleiogynium timorense	Burdekin Plum
Shrub Layer (90%)	
Acacia disparrima ssp *disparrima*	Ironbark Wattle
Acacia julifera ssp *julifera*	Catkin Wattle
Alphitonia excelsa	Soapy or Red Ash
Alstonia constricta	Bitter bark Quinine Tree
Alyxia ruscifolia	Prickly Alyxia
Exocarpos latifolius-	Broad-leaved Scrub Cherry
Mallotus philippensis	Red Kamala
Planchonia careya	Cocky Apple
Understorey <1m (Grass 70% + Bare ground 15% + Litter 10% + Rock 5%)	
Heteropogon contortus	Bunch Speargrass
Pogonolobus reticulates	Medicine Bush
** - % represents target final cover*	

The following is a recommended method for revegetation of Spoil Areas:

- re-spread topsoil with a nominal 10 cm thickness and prepare the seedbed, as discussed in *Chapter 6*;
- sow target grasses, shrubs and trees; and
- install erosion and sedimentation controls on the outer perimeter of the Spoil Areas.

In areas that are identified as having a high erosion potential, such as within or immediately adjacent to diversion drains, Jutemat (fine) matting or mulch material available on-site is to be used to assist in erosion control and promote vegetation growth as required.

10.3 Ongoing Maintenance

Effective weed control prior to revegetation is particularly important in areas to be direct seeded. Weed control will be undertaken within revegetated areas in accordance with the site Weed and Pest Management Plan.

An initial inspection will be made in areas of direct seeding four to six weeks after seeding, having given plants time to establish (It should be noted that some species may take a number of months or years to germinate). Once plants have become established, their growth will be monitored and any plant losses replaced as soon as conditions permit.

10.4 Management Actions

See *Table A.4* for actions relating to revegetation at the site.

10.5 Performance Indicators

- Individual plants are in good condition, dead plants are replaced.
- No weeds are present in revegetated areas.

11.0 PROJECT MANAGEMENT

11.1 Review and Monitoring

This SDRRP will be reviewed (on a frequency to be determined) in keeping with the overall Project auditing program.

11.2 Responsibility for Implementation of this Plan

The EPC Contractor will:

- engage suitably qualified contractors and consultants where necessary to implement this plan;
- ensure contractors and staff are aware of this plan and its requirements; and
- ensure that monitoring and maintenance regimes are followed in accordance with this plan.

12.0 REFERENCES

Bechtel (2009) **Site Clearing Procedures** Unpublished

Corbett M (2009) **Revegetation of Land in the Wet-dry tropics of northern Australia** Online Resource http://www.environment.gov.au/ssd/publications/ssr/pubs/ssr150.pdf Accessed 14/09/10

Engineers Australia (2009) **Soil Erosion and Sediment Control Engineering Guidelines** Online Resource http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file_uuid=B524806B-AA24-DF02-F0D3-CCF14219D3C8&siteName=ieaust Accessed 01/10/09

Environment Protection Authority (EPA) (1995a) **Assessment of Revegetation** Online Resource http://www.epa.qld.gov.au/register/p01206bb.pdf Accessed 14/09/09

Environment Protection Authority (EPA) (1995b), **Revegetation Methods** Online Resource http://www.epa.qld.gov.au/register/p01206ba.pdf Accessed 17/09/09

Environmental Resources Management (ERM) (2009a) **Queensland Curtis LNG Project Draft Environmental Impact Statement**, ERM Sydney Australia.

ERM (2009b) **Vegetation Clearance Strategy for Supplementary EIS** prepared for BG Group by Environmental Resources Management Australia Pty Ltd.

Florabank (1999) **Guidelines Seed Collection from woody Plants for Local Revegetation.**

Maroochy Shire Council (2009) **Planning Scheme Policy No. 3 Rehabilitation Plans** Online Resource http://ww.maroochy.qld.gov.au/site/home_data/round_2/psp/psp_no3_rehabilitation_plans.pdf Accessed 18/09/09

NSW Minerals Council Ltd (2007) **New South Wales Minerals Council Rehabilitation by Design Practice Notes** NSW Minerals Council Ltd, Maitland.

O'Brien M (2008) **Soil Management Factsheet** Online Resource http://yourdevelopment.org/factsheet/view/id/50 Accessed 01/10/09

Queensland Curtis LNG (QCLNG) (2009) **Environmental Impact Statement** Online Resource http://qclng.com.au/eis/draft-eis Accessed 10/09/09

Queensland Government (2009) **Earthworks and imported topsoil** Online Resource http://www.goldcoast.qld.gov.au/gcplanningscheme_0509/attachments/policies/policy11/SS4_earthworks_and_imported_topsoil.pdf Accessed 01/10/09

Roe PA (1997) **Priorities for revegetating landscapes disturbed by mining and other activities** Online Resource http://www.tropicalgrasslands.asn.au/Tropical%20Grasslands%20Journal%20archive/PDFs/Vol_31_1997/Vol_31_04_97_pp282_284.pdf Accessed 14/09/09

The Australian Network for Plant Conservation (2004) **Approaches and techniques for the rehabilitation of native vegetation in South-east Queensland** Australian National Botanic GardensACT.

Vegetation Management Act (1999) Section 4.3.26 (2). Online Resource http://www.legislation.qld.gov.au/LEGISLTN/ACTS/1999/99AC090.pdf Accessed 28/09/09

ANNEX A – MANAGEMENT ACTION TABLES

A.1 Phases

This annex provides the management action tables for the SDRRP. The following phases are referred to in the management tables:

- Pre-construction: refers to the period prior to any clearing or construction works occur;
- Construction: refers to the period of initial overburden stripping and construction of bunds, dam construction and plant and related infrastructure construction;
- Rehabilitation: refers to actions to be undertaken when revegetation / rehabilitation is being undertaken ; and
- Ongoing: refers to an action that should be ongoing for the life of the management plan.

Table A.1 Management Actions: Soil Management and Landforms

Phase		Action	Purpose	Priority	Timeframe
Preconstruction	**1.**	**Stripping area will be delineated on a plan** and in the field (use survey pegs). Topsoil limits will be shown on the pegs.	Ensure correct layer topsoil is stripped and stockpiled.	Priority 1 – High	Prior to excavation
Preconstruction – Construction	**2.**	**Existing topsoil removed and stockpiled** from areas to be excavated, covered by fill material or covered by proposed earthworks.	Maximise seed bank in rehabilitation areas.	Priority 1 – High	Immediately Prior to and during excavation
Preconstruction – Construction	**3.**	**All proposed erosion and sediment control measures** implemented in advance of, or in conjunction with clearing and grubbing operations.	Reduce sedimentation and erosion.	Priority 1 – High	Immediately Prior to and during excavation
Preconstruction – Construction	**4.**	**Stockpile locations** strategically selected.	Ease of access, minimisation of rehandling, segregation from other construction activities and minimisation of soil structure degradation	Priority 1 – High	Immediately Prior to and during excavation
Preconstruction – Construction	**5.**	**Topographical heights and waterways** will be clearly identified prior to stockpiling in the field (use survey pegs).	Complement surrounding natural landforms.	Priority 1 – High	Immediately Prior to and during excavation
Construction	**6.**	**Height of stockpiled materials** at Spoil Areas will not exceed the highest topographical point in that location.	Complement surrounding natural landforms.	Priority 1 – High	At all times
Construction	**7.**	**Implement a Sediment and Erosion Control Plan**	Reduce sedimentation and erosion.	Priority 1 – High	During excavation
Construction – Regeneration	**8.**	**Period of storage of topsoil** kept to a practical minimum.	Reduce the detrimental effects of storage on any native seed in the soil	Priority 2 – Moderate	During excavation and rehabilitation
Construction – Rehabilitation	**9.**	**Stockpiles clearly identified and segregated** for stockpiling	Reduce the likelihood of contamination and soil loss.	Priority 2 – Moderate	During excavation and restoration
Construction	**10.**	**Stockpiles deep ripped** to 500 mm, immediately sown with at least a cover crop and fertilized.	Ensure topsoil viability.	Priority 1 – High	During excavation
Construction – Rehabilitation	**11.**	**Implement weed control** (in accordance with the Weed and Pest Management Plan) and maintenance fertilizing.	Part of a stockpile management program to reduce weed invasion.	Priority 1 – High	At all times

Phase		Action	Purpose	Priority	Timeframe
Rehabilitation	**12.**	**Topsoil unable to be used immediately will be stockpiled** for later rehabilitation of disturbed areas. These stockpiles will be kept to a limited size and seeded to ensure topsoil quality.	Ensure stabilisation and preservation of topsoil quality	Priority 1 – High	At all times
Rehabilitation	**13.**	**Signs indicating that rehabilitation work is occurring** will be erected (e.g. 'No access – rehabilitation in progress') next to spoil areas.	To advise construction workers and other people accessing the site of works being carried out	Priority 1 – High	At all times
Rehabilitation	**14.**	**Prior to collecting topsoil** from the stockpile, any weeds will be carefully scalped off the topsoil.	Avoid the introduction of weeds to the regenerated areas.	Priority 1 – High	Rehabilitation
Rehabilitation	**15.**	**Topsoil spread to the determined depth** along the contour of regraded spoil by dumping at the top of slopes and grading downwards and across the contour.	To aid runoff control, minimise erosion and increase moisture retention.	Priority 1 – High	Rehabilitation
Rehabilitation	**16.**	**Re-spread topsoil levelled** to achieve an even surface, avoiding a compacted or over-smooth finish.	Leave the soil surface in a roughened condition to avoid run-off and prepare for planting.	Priority 1 – High	Rehabilitation
Rehabilitation – progressive rehabilitation	**17.**	**Topsoil to be used to top-dress Spoil Areas** to an average depth of 10 cm on completion of other relevant works..	To achieve the greatest benefits from the seedbank and soil	Priority 1 – High	Immediately Prior to and during clearing
Rehabilitation – progressive rehabilitation	**18.**	**Rehabilitation will include shaping of the spoil areas** to provide drainage and irregular features for integration with the surrounding landscape.	Ensure minimal soil erosion throughout the site	Priority 1 – High	Immediately Prior to and during clearing

Table A.2 Management Actions: Weed Control

Phase	Action	Purpose	Priority	Timeframe
Post-construction ongoing	**1. Provide site workers with information on appropriate hygiene practices**.	Prevent the spread of weeds at the site.	Priority 1 - High	During site induction
Post-construction	**2. Undertake Baseline weed survey and Weed Control Program:**	Ensure effective weed control is carried out with minimal impact to the environment.	Priority 1 - High	Within 1 month of clearing and grubbing
	a. Undertake weed control in a manner that minimises soil disturbance. This reduces opportunities for weeds to re-establish (thus reducing overall weed management costs.			
	b. Minimise the use of herbicides. If herbicides are used, selective application (i.e. spot spraying) is preferable to broad scale spraying.			
	c. Ensure vehicles move from non-contaminated areas to weed-contaminated whilst undertaking weed control activities.			
	d. Avoid moving through weed infestations whenever possible, particularly when weeds are flowering or in seed.			
	e. Remove and dispose of any weed seed and plant parts found on clothing. This will help prevent new weed infestations and the spread of existing weeds.			
	f. Minimise areas of bare soil and re-establish vegetation as soon as possible on bare ground to prevent conditions favouring weed establishment.			
	g. Inspect and clean vehicles of weed and their seeds at weed-contaminated sites. This includes removing mud and dirt from vehicles/ machinery.			
Ongoing-progressive rehabilitation	**3. Undertake short term monitoring of weed control success** to identify any outbreaks following weed removal or suppression.	Ensure outbreaks of weeds do not occur, affecting native species growth	Priority 1 - High	Within 1 month Post weed control
Ongoing-progressive rehabilitation	**4. Monitor Existing weed populations by survey every 6 months and eradicate new weeds immediately**. Weed distribution and abundance will be re-mapped and control methods and timing updated accordingly.		Priority 1 - High	Every 6 months from completion of first weed control

Phase	Action	Purpose	Priority	Timeframe
Post Construction	**5. Provide relevant contractors with a map showing the location of waterways and associated soaks and drains.**	Ensure minimal impact to the environment whilst works are carried out.	Priority 1 – High	Within 1 month of clearing and grubbing
	a. Minimise the use of herbicides near waterways, take particular care in riparian areas to avoid herbicides entering watercourses.			
	b. Stage weed removal activities to minimise erosion and facilitate the successful establishment of native plant species.			
	c. Use non-herbicide measures of weed control (e.g. manual removal) near waterways where possible.	Ensure minimal impact to the environment whilst works are carried out.	Priority 1 – High	Within 1 month of construction
	d. Assess the risk to non-target organisms based on herbicide mobility, persistence and toxicity.			
	e. Avoid treating dense beds of submerged weeds in a single application as this may cause deoxygenation when they rot.			
	f. Treat weeds overhanging a waterway or growing within the channel as an aquatic situation.			
	g. Spray when heavy rain is not expected for some time (a minimum of several days).			
	h. Choose the application method that minimises the amount of herbicide used and its dispersal.			
	i. If spraying towards a waterway clearly mark the edge beforehand.			
	j. Carry herbicides in secure containers when undertaking weed management activities around waterways.			
	k. Mix chemicals and rinse equipment well away from waterways and direct herbicide spray away from the waterway if at all possible.			
	l. Apply the minimum amount of spray required to achieve the degree of wetting specified on the label.	Ensure minimal impact to the environment whilst works are carried out.	Priority 1 – High	Within 1 month of construction

Table A.3 Management Actions: Erosion and Sedimentation

Phase	Action	Purpose	Priority	Timeframe
Pre-construction	1. **Develop and Implement an Erosion and Sediment Control Plan.**	Minimise soil degradation and erosion and damage to waterways.	Priority 1 – High	Prior to construction
Pre-construction	2. **Install adequate erosion control structures** on slopes (e.g. spur drains/ contour banks at suitable intervals).	Minimise erosion due to construction activity.	Priority 1 – High	1 month from commencement of construction
Pre-construction	3. **Install sediment fences** or traps on slopes adjacent to drainage lines.	Prevent sedimentation of drainage lines.	Priority 1 – High	1 month from commencement of construction
Pre-construction - Ongoing	4. **Apply appropriate soil conservation measures** when undertaking any earthworks that involve soil disturbance.	Minimise soil degradation and erosion and damage to waterways.	Priority 1 – High	At all times

Table A.4 Management Actions: Native Vegetation, Species Selection and Planting

Phase	Action	Purpose	Priority	Timeframe
Pre- Construction	1. **Consultant to develop specific guidelines for contractors on vegetation removal** (for example appropriate placement of stockpiles, machinery and location of digging).	To avoid soil compaction and damage to the roots, stems and branches of trees to be retained	Priority 1 – High	3 months
Pre- Construction	2. **Pre-clearance surveys** of all trees to be removed, to be undertaken by an appropriately qualified person.	To ensure no animals are in the trees when removed	Priority 1 – High	Immediately Prior to clearing in all stages
Construction	3. **An appropriately qualified person to be on site while trees are removed** so that any fauna inhabiting the trees can be captured and relocated.	To ensure survival of all fauna on site during clearing	Priority 1 – High	Immediately During clearing in all stages

Phase	Action	Purpose	Priority	Timeframe
Preconstruction	4. **Clearing the LNG Facility site to be carried out post spring-summer**, to be timed after flowering and seed-set by the native grasses.	To maximise stores of seed in the soil and encourage native revegetation	Priority 1 – High	Immediately Prior to clearing in all stages
Preconstruction	5. **Contract a qualified rehabilitation and revegetation consultant** (e.g. Greening Australia) to acquire native seeds and undertake on-ground planning for rehabilitation works across the site	To ensure success of rehabilitation works	Priority 1 - High	Immediate
Construction - Ongoing	6. **Drainage to convey water** from areas of disturbed ground to sedimentation ponds	To prevent sediment laden runoff leaving the site.	Priority 1 - High	Within 1 month of clearing and grubbing beginning
Rehabilitation	7. **Direct establishment of tree, shrub and groundcover species characteristic of RE.12.11.6** at all three Spoil Areas.	Restore pre-clearance habitats	Priority 2 - Moderate	Within 1 month of completion of construction activities
Rehabilitation	8. **Tubestocks to be used during revegetation of the Spoil Areas**	To ensure success of rehabilitation works	Priority 2 - Moderate	Within 1 month of completion of construction activities
Rehabilitation	9. **Direct Seeding to be used on slopes where** Jutemat is considered for high erosion areas.	To ensure success of rehabilitation works	Priority 2 - Moderate	Within 1 month of construction beginning
Rehabilitation	10. **Signs indicating that rehabilitation work is occurring** will be erected (e.g. 'No access – rehabilitation in progress') along the fence line.	To advise construction workers and other people accessing the site of works being carried out	Priority 1 – High	At all times
Ongoing – progressive rehabilitation	11. **Site maintenance** to be carried out. This will include watering schedules, progressive revegetation / rehabilitation, halo spraying, and re-placement planting if required.	To ensure survival rate of revegetation	Priority 2 - Moderate	At all times