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Contract No. 897315	GLNG GAS TRANSMISSION PIPELINE		
	Company Doc. No. 3380-SAIP-4-3.3-1832		
	Document Title: Acid Sulfate Soil Management Plan, Gas Transmission Pipeline Route and Launch Pad		

ACID SULFATE SOIL MANAGEMENT PLAN
Gas Transmission Pipeline Route and Launch Pad

0	APPROVED FOR CONSTRUCTION (AFC)	Olivi, F	Chetty,S	Rapiti, D	17/09/12
A	ISSUED FOR REVIEW (IFR)	Olivi, F	Chetty,S	Rapiti, D	30/08/12
Revision	Reason For Issue	Prepared	Checked	Approved	Date

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COMPANY REVIEW CODE		
Code	Description	Tick
1	No comment. Proceed to AFC.	
2	Revise as noted and re-submit.	
3	Revise as directed and re-submit. Works may NOT proceed.	
4	Information Only. Re-submission not required.	
5	Approved for Construction (AFC)	
Signed:		Dated:
Contractor remains responsible for the due and proper performance in accordance with the Contract. Comments do not limit or relieve Contractor of any obligation or liability under the Contract or give rise to any claim.		

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Santos

PETRONAS





TOTAL

KOGAS



KOGAS GAS CORPORATION

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1. INTRODUCTION

This Acid Sulfate Soils Management Plan (ASS MP) has been prepared by Golder Associates Pty Ltd (Golder) at the request of Saipem Australia Pty Ltd on behalf of GLNG, to provide details on management of ASS during the construction of the proposed GLNG pipeline route through the Kangaroo Island Wetlands and Curtis Island in Gladstone. It focuses on the construction of the gas transmission pipeline (GTP) through the creek crossing section of the pipeline route and the Launch Pad that will house the tunnel boring operations. It encompasses Kilometre Points (KPs) KP406 on the mainland section of the pipeline route through to KP414.5 on Curtis Island (refer Figure 1). A separate ASS MP will be prepared to address the tunnel boring operations.



A Phase 1 'preliminary' ASS investigation has been undertaken on the creek crossing section of the pipeline route to provide some basis for ASS management strategies during construction within this area (refer Figure 1). The investigation was undertaken by Golder in May 2012 (refer Golder report 127683005-005-R-RevA, dated May 2012).

The Phase 2 ASS Investigation was undertaken by Golder in July 2012 (refer Golder report 127683005-008-R-Rev0, dated August 2012) and concentrated on the proposed site to be excavated and filled during the construction of the Launch Pad (refer Figure 2).

During a consultation meeting with the Department of Environment and Heritage Protection (DEHP, formerly the Department of Environmental Resource Management-DERM) on 6 July 2012 regarding the proposed Phase 2 ASS investigation it was agreed by DEHP (John Ross/Angela Hendry/Peter Bourke) that no further ASS investigations were required to be undertaken at the Tunnel Boring Exit Pad.

Based on the results of the Phase 1 and Phase 2 ASS investigations and the size of the proposed development, management of the net acidity at the site is classified as **Extra High level of treatment (Category XH)** as per the State Planning Policy 2/02 Guideline¹ (SPP 2/02) Table 4. As such, the SPP 2/02 Guidelines require that a 'stand alone' ASS Environmental Management Plan (EMP) must be prepared. This ASS MP has been written in accordance with the SPP 2/02 Guidelines and to satisfy the Environmental Authority Conditions (Schedule D- Acid Sulfate Soils) and further conditions stipulated by Department of Environment and Heritage Protection. A summary table which discusses how each condition has been addressed is included in Appendix A.

¹ State Planning Policy SPP 2/02 "Planning and Managing Development Involving Acid Sulfate Soils."



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2. DEFINITIONS AND ABBREVIATIONS

2.1. DEFINITIONS

Environmental Protection Act 1994

- Environmental Harm** - Any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value, and includes environmental nuisance.
- Environmental Nuisance** - Any unreasonable interference or likely interference with an environmental value caused by
- (a) noise, dust, odour, light; or
 - (b) an unhealthy, offensive or unsightly condition because of contamination; or
 - (c) another way prescribed by regulation.
- Material Environmental Harm** - Is environmental harm (other than environmental nuisance)
- (a) that is not trivial or negligible in nature, extent or context; or
 - (b) that causes actual or potential loss or damage to property of an amount of, or amounts totalling, more than the threshold amount but less than the maximum amount; or
 - (c) that results in costs of more than the threshold amount but less than the maximum amount being incurred in taking appropriate action to
 - (i) prevent or minimise the harm; and
 - (ii) rehabilitate or restore the environment to its condition before the harm.
- “Maximum amount” means the threshold amount for serious environmental harm.
- “Threshold amount” means \$5000 or, if a greater amount is prescribed by regulation, the greater amount.
- Serious Environmental Harm** - Is environmental harm (other than environmental nuisance)
- (a) that causes actual or potential harm to environmental values that is irreversible, of a high impact or widespread; or that causes actual or potential harm to environmental values of an area of high conservation value of special significance; or
 - (b) that causes actual or potential loss or damage to property of an amount of, or amounts totalling, more than the threshold amount; or



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- (c) that results in costs of more than the threshold amount being incurred in taking appropriate action to
- (i) prevent or minimise the harm; and
 - (ii) rehabilitate or restore the environment to its condition before the harm.

“Threshold amount” means \$50,000 or, if a greater amount is prescribed by regulation, the greater amount.

2.2. GLOSSARY

ANZECC	- Australian & New Zealand Environmental Conservation Council
ARMCANZ	- Agricultural and Resource Management Council of Australia and New Zealand
ASS	- Acid Sulfate Soils
AASS	- Actual Acid Sulfate Soil
ASS MP	- Acid Sulfate Soil Management Plan
DEHP	- Queensland Department of Environment and Heritage Protection
DERM	- Former Queensland Department of Environment and Resource Management; now DEHP
DO	- Dissolved Oxygen
EIS	- Environmental Impact Statement
EMP	- Environmental Management Plan
GLNG	- Gladstone Liquefied Natural Gas
GTP	- Gas Transmission Pipeline
KP	- Kilometre Point
LNG	- Liquefied Natural Gas
NRM	- [Queensland] Department of Natural Resource and Mines
PASS	- Potential Acid Sulfate Soil
ROW	- Right of Way
SS	- Suspended Solids

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3. OBJECTIVES

The objectives of the ASS MP are to:

- Protect life, health and well being of human and other forms of life;
- Protect the local amenity;
- Base the environmental management of ASS material from the development in accordance with the principles of Ecologically Sustainable Development (ESD);
- Inform staff, contractors and consultants of appropriate safeguards and control measures to be implemented to minimise the environmental impact caused by Actual and Potential ASS (AASS and PASS respectively) material;
- Comply with all statutory environmental requirements in relation to ASS material;
- Provide strategies aimed at minimising environmental harm during the construction stage potentially caused by ASS material; and
- Provide an Environmental Management System of ASS material, generally based on the key elements of AS/NZS ISO 14001-1996 Environmental Management Systems – Specification with Guidance for use.



A copy of the ASS MP and associated forms and registers will be kept at the site office during earthworks / construction.

4. SITE DESCRIPTION

The mainland section of the proposed pipeline corridor for this project is approximately 3 km in length (KP406 –KP409) and includes the tidally inundated Creek and Marshland sections between the eastern end of the Phillipies Landing Road Section and Friend Point on the western side of the Narrows. There are two major creek systems which are crossed within this section of the pipeline, being Humpy and Targinie Creeks.

The surrounding vegetation is primarily comprised of native and improved grasses within a patchwork of open woodland and woodland (eucalypts being predominant species), with some sections having been partially cleared for grazing.

The launch pad, which marks the start of the GTP marine crossing, is located south of the mudflats of the Kangaroo Island Wetlands and is anticipated to comprise an area of approximately 74,690 m². The northern and eastern boundaries of the launch pad area are boarded by tidal mudflats which are interspersed with tidal creek crossings. The site slopes gently from a small ridge located along the eastern boundary (approximately 15 m AHD) to low lying discontinued creek sections to the west of the site (approximately 5 m AHD).

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From the launch pad (KP409) the pipeline will go underground (to be achieved by tunnel boring operations), beneath a low lying intertidal mudflat section through the Kangaroo Island Wetlands fringed by coastal mangrove species and further extending across the sea bed and to Curtis Island (refer Figure 1). The pipeline re-emerges at the location of the receptor pad on Curtis Island (KP413). The stretch of pipeline section on Curtis Island up to KP414.5, are again generally woodland areas comprised of primarily eucalypt species.

4.1. Receiving Environment

The aquatic receiving environment comprises the adjacent Targinie and Humpy Creeks, the immediate Targinie Channel and the fringe of the Pacific Ocean, including Seagrass meadows, with regional receiving waters including the Great Barrier Reef Marine Park. The Great Barrier Reef Marine Park is located on the eastern coast of Curtis Island. General Use, Island Cay, and Marine National Park and Habitat Protection Zones, declared Fish habitats also exist within about 15 km of the project area (to the south).

During construction, excavations in shallow Holocene sediments could result in oxidation of PASS and the migration of acidic fines into receiving waters. Additionally, any significant depths of filling over any thick deposits of soft Holocene sediments will need to be managed to prevent displacement of PASS above the water table causing in-situ generation of acid, which would have an immediate adverse impact on the receiving environment.



Where disturbance of confirmed ASS is required, specific management measures [included herein] need to be followed, in order to prevent or minimise the generation of acid run off. In areas confirmed as containing ASS, the quality of any retained water is to be monitored and if necessary the water treated to comply with adopted water quality 'acceptance criteria' before release off-site.

5. PROPOSED DEVELOPMENT

Santos GLNG is proposing to develop coal seam gas (CSG) resources in the Surat and Bowen Basins in Queensland. The CSG field will supply gas for the liquefied natural gas (LNG) liquefaction and export facility (LNG facility) on Curtis Island. A high pressure gas transmission pipeline is proposed to be constructed to link the CSG field to the LNG facility.

This ASS MP addresses the Marine Crossing section of the Santos GLNG gas transmission pipeline (GTP) (refer Figure 1) which includes construction of the following components:

- Establishment and construction of the construction launch pad (Mainland) and tunnel launch shaft, comprising an area of approximately 74,690 m².
- Establishment and construction of the construction site pad (Curtis Island) and the tunnel receptor shaft, comprising an area of approximately 22,252m². It is estimated that the total volume of spoil from the tunnel boring launch and reception shafts in addition to the tunnel spoil itself is in the vicinity of 80,000-100,000m³.

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- Conventional open cut trenching for the final 2.5 kilometres to the Mainland GTP (between reference points KP406 and KP409) and 900 metres of trenching on Curtis Island to join with the Curtis Island GTP section of the project (between reference points KP413.6 and KP414.5). For the purposes of the ASS investigation it has been assumed that the trenching for the pipeline will have an average depth of cover of 1.2 m (1.5 m watercourses) and that the pipeline is 1.067 m in diameter. This translates into an average trench invert level of around 2.5 m.
- Ancillary work within the Marine Crossing GTP Right of Way (RoW) (30 m wide) includes the establishment of access tracks for trenching work, pipe stringing areas and designated laydown areas within the RoW.

6. OVERVIEW OF ENVIRONMENTAL ISSUES

This section provides a brief overview of the environmental issues associated with the construction of the GTP in conjunction with the tunnel boring launch and exit pads on the mainland and Curtis Island.

6.1. Acid Sulfate Soil Investigation

6.1.1. Phase 1 Investigation

Results from the preliminary Phase 1 investigation indicate the presence of some soils with existing acidity (actual plus retained) and potential acidity at various creek crossing locations along the Kangaroo Island Wetlands section of the proposed pipeline route (BH1 to BH7) as per Figure 1 while the soil samples analysed from the Curtis Island locations indicated the presence of soils with existing acidity only (BH8 to BH10).

Based on the testing carried out to date, soils with actionable levels of actual acidity appear to be limited to BH1, BH7 and BH8, and soils with potential acidity appears limited to moderate levels in BH3 and BH4. However, there appears to be sufficient acid neutralizing capacity within the soils at BH3 to neutralise the potential acidity. It should also be noted that the soils with actual acidity also recorded negligible levels of potential acidity, suggesting the acidity in these soils is naturally inherent and not of a sulfidic origin.

Liming rates have been calculated in kg Aglime /m³ using a factor of safety and fineness factor of 1.5 and an assumed bulk density of 1.8 tonne/m³ and an assumed neutralising value of 97%. Liming rates are presented in Table 1 and are applicable in any instance where soils are to be disturbed in the vicinity of each location. The 95 percentile treatment rates are not available to be utilised within the creek crossing section due to the reduced number of samples analysed within this area.



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Table 1; Liming Rates: Creek Crossing Section

Location	Depth	Soil Type	Treatment Rate
BH01	0 - 0.5m BGL	Gravel with trace Sand and Silt	4 kg Aglime/m ³
BH04	0.5 - 1.0 m BGL	Sandy Clay, generally grey, highly plastic	27 kg Aglime/m ³
BH08	0 - 0.5 m BGL	Silt Clay grey brown, medium plastic	9 kg Aglime/m ³
	0.5 - 1.25 m BGL	Gravelly Silt Clay pale grey, low plastic	5 kg Aglime/m ³



6.1.2. Phase 2 Investigation

The Phase 2 ASS investigation of the proposed Launch Pad indicates the presence of soils with actual acidity at all locations across the area with some minor retained acidity in BH14, BH16, BH17, BH18 and BH20. Based on the testing carried out to date, soils with actionable levels of actual acidity appear to be distributed uniformly laterally and vertically across the site (refer Figure 2). As with soils from Phase 1, soils with actual acidity recorded negligible levels of potential acidity, suggesting the acidity in most of the soils is naturally inherent and not of a sulfidic origin.

While the flora and fauna of the local environment have adapted to these soils in their undisturbed condition, the excavation and placement of these materials can mobilise the acid and result in the release of acid leachate to the surrounding environment. A draft QASSIT discussion paper recommends lime treatment of these soils although thorough mixing of the soil with lime is not required. It is recommended that this approach be adopted for the management of naturally acidic, non-ASS excavated from the Launch Pad area if the naturally acidic, non-ASS will be used on site as 'fill' material. If these soils are to be transported off-site, lime neutralisation with mixing and verification testing, is required to be undertaken at a constructed lime treatment pad.

Where any excavated material is to be re-used on site as 'fill', a liming rate of 5 kg Aglime/m² is required to be adopted and shall be placed as a basal layer under residual soil fill zones. This value has been adopted based on the average net acidity across the site (with a factor of safety of 2.5). This lime guard layer shall be repeated for each fill layer of a thickness of 1 m or part thereof (e.g. where the fill height is 3.5 m, a basal layer of 5kg Aglime/m² and three intermediate layers of 5kg Aglime/m² are required). Further to the application of lime guard layers all fill placed on the site will be compacted under controlled conditions to reduce soil permeability, minimising infiltration and further reducing the potential for mild acid leachate.

Where excavated soil material from the Launch Pad area is designated to be transported 'off-site' nominal lime treatment, mixing and verification is required to be undertaken prior to transportation. Lime treatment rates have been calculated based on the 95th percentile of 'net acidity' results and the maximum 'net acidity' rates (refer to Table 2). Liming rates, based on the 95th percentile

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maximum 'net acidity' results at the Launch Pad have been calculated to be 13 kg Aglime/m³ for the North East corner and 7 kg Aglime/m³ for the remainder of the site (refer Figure 3). Utilising the reduced treatment rates is considered adequate given that the majority of the acidity is natural and not sulfur-derived and that there is negligible oxidisable sulfur in the samples.

Liming rates have been calculated in kg Aglime/t and kg Aglime/m³ using a factor of safety and fineness factor of 1.5 and an assumed bulk density of 1.8 tonne/m³. Liming rates are presented in Table 2 and are only applicable in any instance where soils are to be disturbed within the nominated areas are designated to be transported off site.

Table 2: Liming Rates Launch Pad Area (for off-site disposal)

Location	Depth	Soil Type	Treatment Rate 95 Percentile	Treatment Rate Maximum
North East Corner (BH16, BH17, BH18 and BH19)	0.0 m BGL to depth of excavation	All soil types encountered	13 kg Aglime/m ³ *	16 kg Aglime/m ³
Remainder of Launch Pad	0.0 m BGL to depth of excavation	All soil types encountered	7 kg Aglime/m ³ *	9 kg Aglime/m ³



* Calculated at 95 percentile.

Given the likely volume of soil to be excavated during the proposed development and the preliminary neutralisation rates indicated by ASS investigations, the site would be classified as requiring **Extra High treatment** (> 25 tonnes of agricultural lime (Aglime)) in accordance with Table 4 of the SPP 2/02 Guideline. ASS management procedures for the development are presented in Appendix C.

Provided all relevant issues are identified, and the proposed management technique is effectively implemented and monitored throughout the construction phase of the development, it is considered that there should be limited internal or external environmental impacts attributable to soils with existing or potential acidity.

The relevant issues, which are of significance when considering existing and potential acidity management for the construction phase of this development, are:

- Soils excavated for use as fill on or off site;
- Exposure of dewatered soils in open excavation;
- Temporary stockpile storage;
- Disposal of acidic water into non-acidic waterways; and

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- Transport and handling of AASS/PASS for treatment.

Following construction, the issues relating to soils with existing acidity or potential acidity, which may cause environmental impacts in the long term, are largely related to water quality. The severity of these impacts will often depend on the success of the construction phase management techniques. It is anticipated that with appropriate implementation and monitoring of the ASS MP, there would be little or no detectable long-term impacts in the operational phase.

7. WATER QUALITY

During rainfall events or dewatering activities, uncontrolled runoff leaving the site could potentially cause turbid and acidic water to enter the stormwater system and adjacent waterways. Stockpiles, un-vegetated and unsealed ground are examples of sources with the potential to contaminate stormwater from the exposure of soil material with existing or potential acidity.

In the event that surface water is stored on site and requires discharging, a water quality monitoring program shall be adopted (outlined in Appendix D). A water quality sampling record form is presented as Form 2, Appendix B. Performance criteria for surface water exiting the site have been established using the generally adopted industry standards for surface water discharge into marine environments.

Baseline monitoring of the receiving environment at the release points will be undertaken as per the Receiving Environment Monitoring Program (REMP).



It should be noted that groundwater levels may fluctuate, depending on tides and especially during and following periods of heavy or prolonged rainfall. Groundwater will be monitored using a number of existing groundwater monitoring wells located across the site (Refer Figures 1 and 2).

8. CONTRACTOR MANAGEMENT

Contractors and their staff are required to comply with the provisions of the ASS MP at all times. During the project Environmental Induction and Training, all project personnel will be provided with an understanding of ASS responsibility, as outlined in the project 'Environmental Induction and Training Plan' (3380-SAIP-4-1.3-7002).

The 'Environmental Induction and Training Plan' will aim to instil environmental awareness in personnel and:

- Introduce and explain the duty of care required under the Environmental Protection Act 1994.
- Introduce the ASS MP and responsibilities it places on all contractors and consultants.

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- Explain the various subordinate components of the ASS MP and the reporting and monitoring procedures of the ASS MP and how they work.
- Explain how to use the environmental procedures and plans in the ASS MP.

The content of the induction program will be endorsed and presented by the Environmental representative. The Contractor's environmental performance obligations shall be incorporated into the Contractor's conditions of work for the proposed development.

9. INSPECTION AND MANAGEMENT

ASS inspections will be carried out daily by the field environmental officer. This will be used to identify any areas of non-conformance or opportunities for improvement. Any environmental issues (non conformances) will be reviewed immediately and addressed in the weekly environmental report.

Monitoring is to be documented as outlined in Section 11.1 and monitoring programs will be modified as required based on the findings of site inspections and/or results of testing.



10. AUDITING OF THE ASS MP

10.1. Responsibilities

The pipeline and launch pad construction works will be audited for compliance with the ASS MP and its procedures by the environmental auditor (e.g. Golder). The environmental auditor will be appointed by Saipem.

It is the environmental auditor's responsibility to:

1. Provide an independent assessment of compliance with the Environmental Procedures in Appendices C and D.
2. Report on observed activities that have, or may cause an impact to the environment or non-conformance to regulation.
3. Provide recommendations to Saipem regarding practical initiatives that can be employed to improve the effectiveness of environmental management at the development site.
4. Provide a copy of the Audit Report to Saipem.

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11. DOCUMENTATION AND REPORTING FRAMEWORK

The following documents relate to environmental performance and form part of the ASS MP.

1. Inspection and Monitoring Records (Appendix B of the ASS MP).
2. Environmental Procedures (Appendices C and D of the ASS MP).
3. Environmental Audit Reports.

11.1. Inspection and Monitoring Records

The frequency of Inspection and Monitoring from commencement of pipeline construction activities will be as follows:

- Daily until the excavation works for the pipeline and launch pad are completed.
- Within 24 hours of a significant rainfall event².

The outcome of the daily site walk through will be recorded on the Inspection and Monitoring form attached in Appendix B. Any monitoring that requires more frequent attention will be completed as required and recorded on the Inspection and Monitoring form.

Environmental issues (non-conformances) identified by field environmental officers in their daily inspection and monitoring programme will be reviewed and addressed immediately. Non-conformances identified during an audit are different from the daily inspection and monitoring and will be documented via an audit report. This is addressed in section 10.



The originals of these sheets shall be kept at the site office with copies maintained by the Environmental Administrative Officer. (Form 1 Appendix B).



11.2. Audit Reports

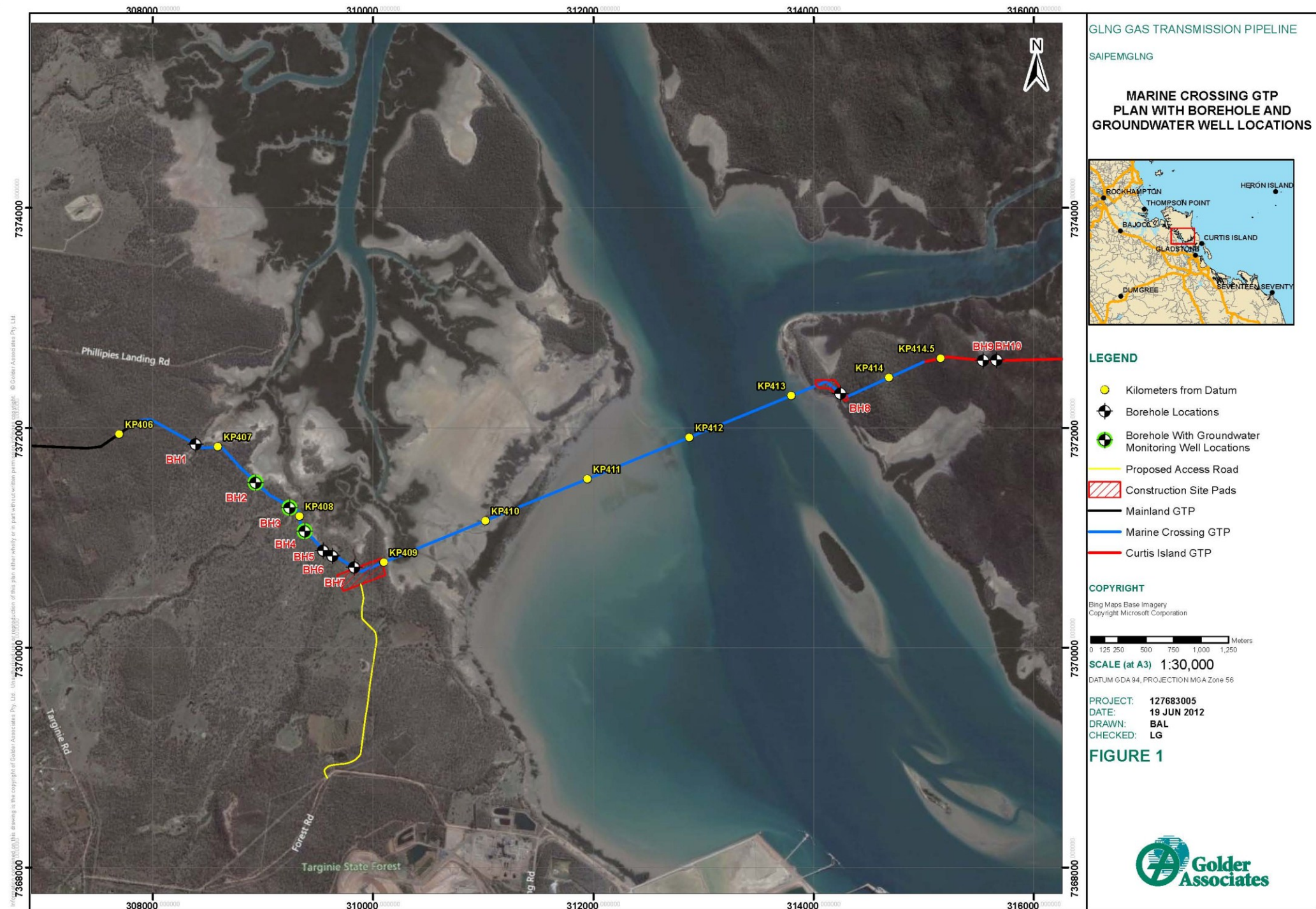
Saipem will conduct internal audits and will appoint an independent auditor to carry out third party audits of the implementation of the ASS MP as required by the conditions set out in Environmental Authority No. PEN103428811.



A copy of the environmental audit report shall be provided to Saipem and a copy will be kept at the Site office and filed for future reference, if required.

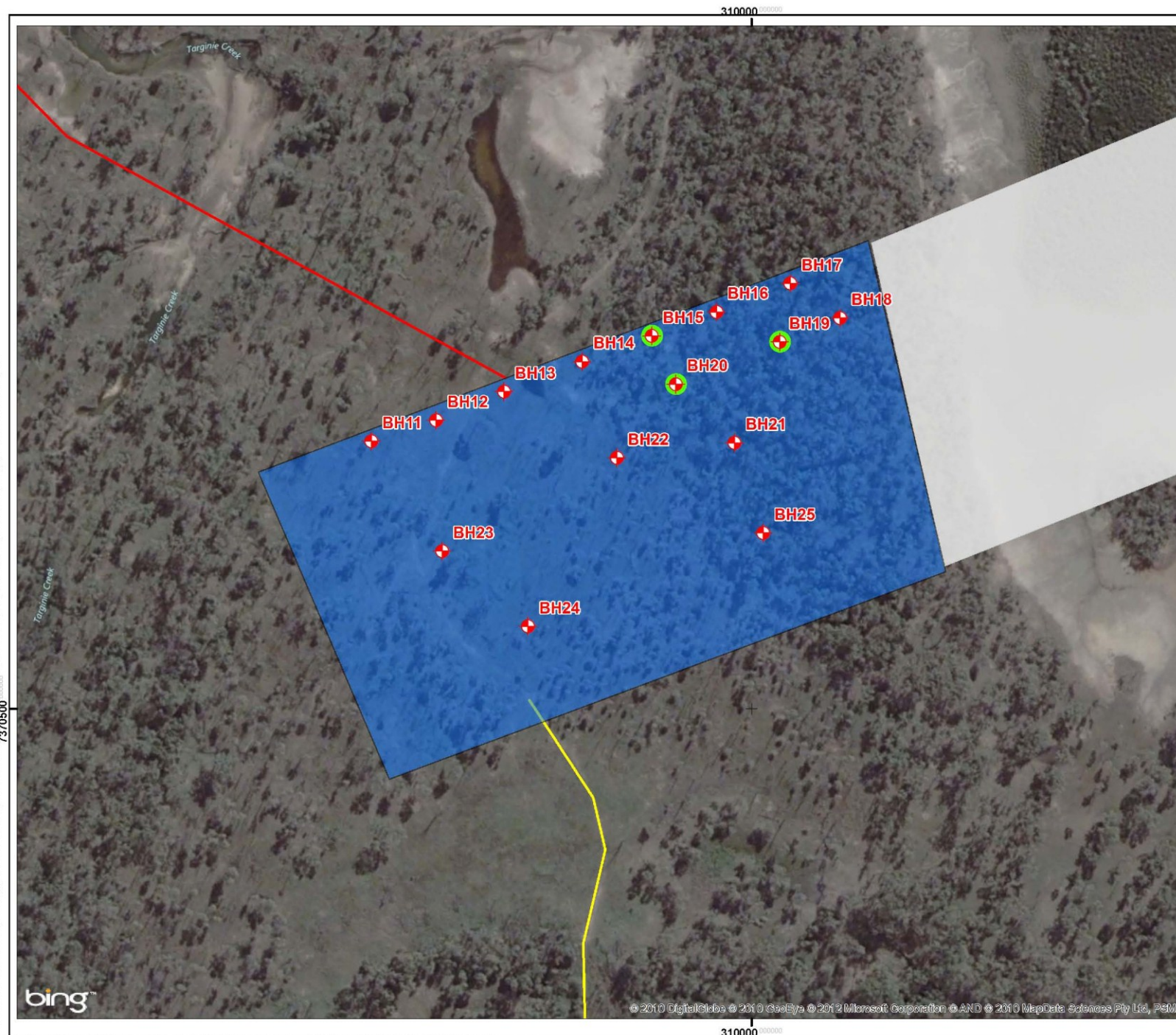
² Greater than 25mm of rainfall in 24 hours.

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GLNG GAS TRANSMISSION PIPELINE
SAIPEMGLNG
SITE LOCALITY PLAN & BOREHOLE LOCATIONS



- LEGEND**
-  Borehole Locations
 -  Monitoring Well Locations
 -  Pipeline Route
 -  Access Tracks
 -  Tunnel Boreing Launch Pad
 -  Tunnel Corridor

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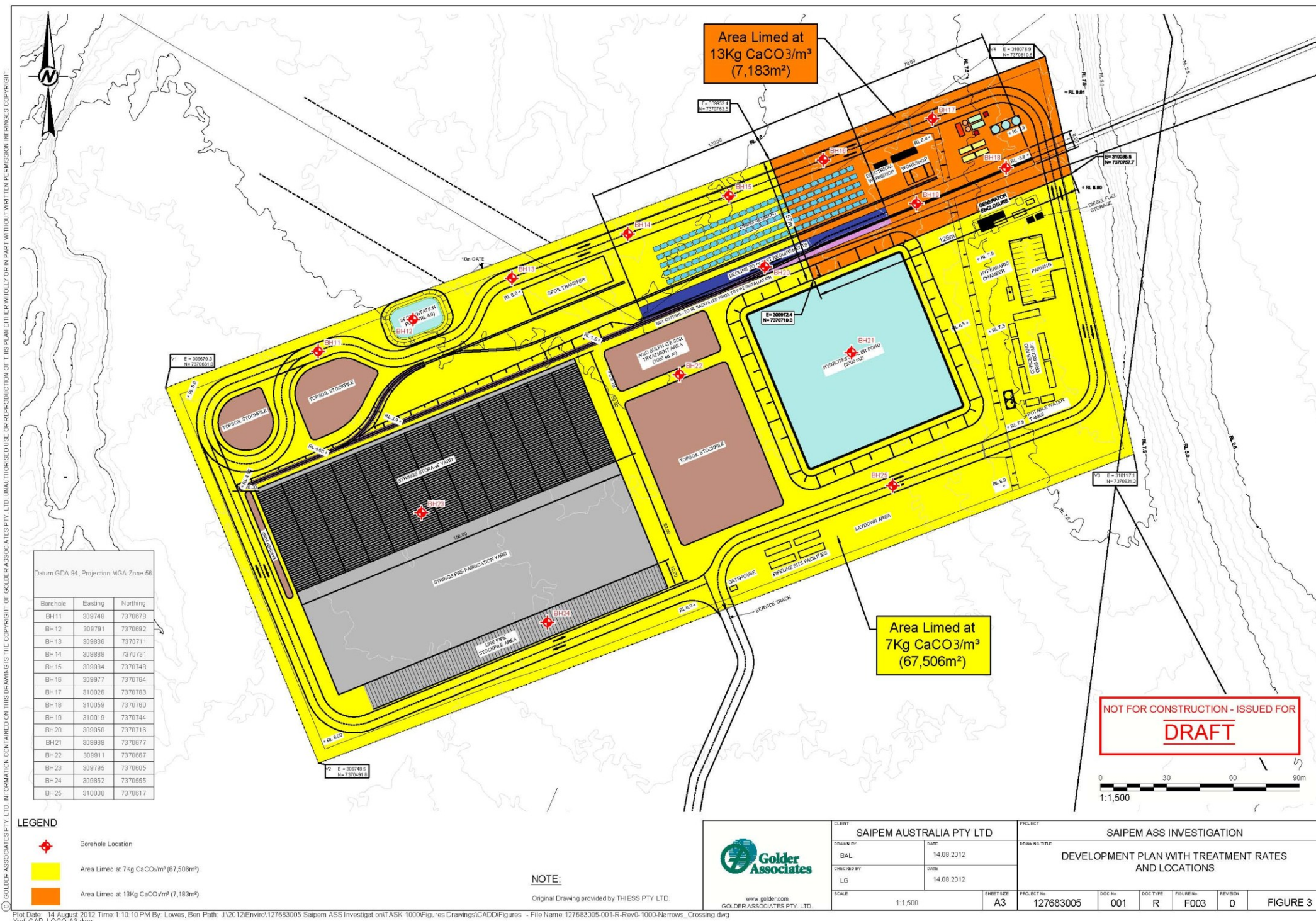
SCALE (at A3) 1:2,500
 DATUM GDA 94, PROJECTION MGA Zone 56



PROJECT: 127683005
 DATE: 14 AUG 2012
 DRAWN: BAL
 CHECKED: LG

FIGURE 2



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APPENDIX A

Petroleum Pipeline Licence (PPL) 167

Environmental Authority Conditions, Schedule D- Acid Sulfate Soils



And

Further Conditions stipulated by Department of Environment and Heritage Protection



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GLNG – Marine Crossing Pipeline: Petroleum Pipeline Licence (PPL) 167, Permit Number; PEN103428811, Schedule D – Acid Sulfate Soils

Item No.	Condition	ASSMP reference
D1	Acid Sulfate Soil Management Plans must be developed and implemented for the construction, decommissioning and rehabilitation of each section of the project as listed in <i>Schedule A – Table 1: Authorised Petroleum Activities</i> .	Doc. No. 3380-SAIP-4-3.3-1832
D2	The Acid Sulfate Soil Management Plans required by Condition (D1) must include, but not be limited to:	
(a)	The final construction methodology for the project based on the detailed design;	To be included once methodology is confirmed
(b)	Management, treatment and disposal of any excavated material potentially containing potential acid sulphate soils (PASS), including management of spilled material from excavation and transport;	Appendix C: C3, C4, C5, C6, C7 and C8
(c)	Management of any material potentially containing PASS that is displaced or dewatered by works to an extent that may result in oxidation through exposure to air or through loss of saturation, including any accidental disturbance of areas containing ASS and vertical or lateral displacement of sediment containing ASS;	Appendix C: C3, C4, C5, C6, C7 and C8
(d)	Management of any material potentially containing PASS excavated or disturbed during decommissioning or rehabilitation;	Appendix C: C3, C4, C5, C6, C7 and C8
(e)	Management of water within pits and trenches during construction, decommissioning and rehabilitation, including any treatment; source of water, treatment location, storage capacity, storage design, monitoring, discharge quality limits, discharge point, discharge management, monitoring, records and reporting to the administering authority;	Appendix D: D3, D4 and D5 Other specifics to be included once details are confirmed
(f)	Where disposal of material containing PASS relies on permanent saturation details of the following; <ul style="list-style-type: none"> I. Location and depth of disposal; II. Handling to prevent spillage or oxidation; and III. Existing or necessary permits and relevant information to support such permits 	Not Applicable
(g)	Where disposal of material containing PASS will be by neutralisation, details of the following; <ul style="list-style-type: none"> I. Location; II. Design; 	Appendix C & Appendix D Specific details



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	<p>III. Neutralisation techniques (guard layer, liming rates, and process, contingencies, verification, records and reporting);</p> <p>IV. Water management (storage capacity, monitoring, discharge quality limits, discharge point, discharge management, monitoring, records and reporting to the administering authority);</p> <p>V. Disposal of treated material;</p> <p>VI. Disposal of drain water; and</p> <p>VII. Final rehabilitation of the site.</p>	are still to be confirmed.
(h)	<p>For PASS treatment pads, provide design drawings for PASS storage and treatment pads and the surrounding area to demonstrate;</p> <p>I. Capacity to contain treated and untreated PASS plus a 100 year ARI daily rainfall event at the location throughout the period of use of the storage and treatment pads; and</p> <p>II. Bund and storm water management system design to prevent failure of the bunds or sediment export resulting from erosion of the bunds or disturbed areas;</p>	<p>Appendix C: C3.</p> <p>To Be Confirmed</p>
(i)	Where disposal of material containing PASS will be by neutralisation, provide a commitment to competent specialist operators and supervision, with periodic strategic third party auditing and reporting to the administering authority.	Section 11.2 & C4, C5, C6, C7 and C8, Appendix C
(j)	<p>A survey of all areas subject to excavation or disturbance consistent with;</p> <p>I. State Planning Policy 2/02 Guideline: Acid Sulfate Soils;</p> <p>II. Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland 1998 (<i>CR Ahern, MR Ahern and B Powell 1998</i>);</p> <p>III. Acid Sulfate Soils Laboratory Methods Guidelines (<i>CR Ahern, AE McElnea, LA Sullivan 2004</i>); and</p>	To Be Confirmed
(k)	The management of acid sulphate soils, as detailed in the Acid Sulfate Soils Management Plans, shall be consistent with the Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines (2002).	The ASS MP has been developed in accordance with Soil Management Guidelines (2002)
D3	The holder of the environmental authority must ensure petroleum activities are undertaken in accordance with the Acid Sulfate Soil Management Plans required by condition (D1)	Appendix C / Appendix D
D4	PASS or ASS material must only be placed in the designated Acid Sulfate Soils Treatment Area	Appendix C / Appendix D
D5	<p>All areas used for storage or treatment of excavated material containing acid sulphate soil must be bunded, constructed, installed and maintained to;</p> <p>(a) Prevent any release of contaminants through the bed or banks of the bunded area to any land or waters including ground water.</p> <p>(b) Ensure a freeboard to retain a 100 year ARI 24 hour rainfall event; and</p>	C3, Item 9 Appendix C



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	(c) Ensure the stability of the bunds during a 100 year ARI 24 hour rainfall event.	
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GLNG – Marine Crossing Pipeline ASS MP: Department of Environment and Heritage Protection (DEHP) Conditions		
Item No.	Condition	ASSMP Reference
14.	At least thirty (30) business days prior to commencement of construction works applicable to this approval the proponent must submit to the administering authority for approval an ASSMP consistent with the following documents: <ul style="list-style-type: none"> a) State Planning Policy 2/02 Guideline: Acid Sulfate Soils; b) Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland 1998; and c) Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines, 2002 	Doc. No. 3380-SAIP-4-3.3-1832
15.	The ASSMP must be approved by the administering authority prior to construction works commencing.	To Be Advised
16.	The ASSMP must be implemented over the full period of construction, and for a period after completion construction as defined by the ASSMP.	To Be Advised
17.	Any amendments made to the ASSMP must be approved by the administering authority prior to implementation, unless the change is essential to prevent environmental harm in which case the administering authority must be notified of the change within 24 hours.	To Be Advised
18.	Construction activities shall not directly or indirectly cause the release of acidic water (pH less than 6.5) from the site to waters as a result of oxidation of potential acid sulphate soils resulting from excavation, displacement, or changes to groundwater levels.	Appendix D: D3



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APPENDIX B
FORMS

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FORM 1: INSPECTION AND MONITORING

Environmental Procedure:		
Responsible Person:		
The following items are to be addressed during the weekly management inspection.		
Date of Inspection:		
Weather during preceding 24 hours (to include mm rainfall):		
Personnel present during inspection:		
ITEM	INSPECTION AND MONITORING/ENVIRONMENTAL ACTIVITY	CHECKED
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		

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FORM 2: WATER SAMPLING RECORD FORM

Date:	
Time:	
Sampled By:	
Location:	
Volume of Discharge:	
Turbidity (NTU)	
Surface Scum / Oil (Visual)	
Suspended Solids (Lab analysis)	
pH	
Conductivity mS/cm	
Temperature °C	
Salinity ppk	
Dissolved Oxygen % sat	
Aluminium (dissolved) mg/L	
Iron Total mg/L	
Iron (dissolved) mg/L	
Comments	
Do these results conform with those outlined within Appendix D Water Quality Monitoring Procedure (Y/N)	
If not, action taken:	

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FORM 3: EXCAVATED MATERIAL LIMING VERIFICATION FORM



Date:	
Time:	
Recorded By:	
Excavation Location:	
Treatment Required	Yes / No (circle)
If 'Yes', treatment Location:	At treatment pad (circle) In basal layers

For soils to be treated at the lime treatment pad, complete form 3A. For soils excavated from the Launch Pad area that will remain on-site, complete Form 3b.

FORM 3A: LIME TREATMENT PAD - LIME TREATMENT AND VERIFICATION FORM



Stockpile Location and Number:	
Volume of stockpile:	
Nominated liming rate:	
Date of Treatment:	
Volume of Aglime added:	
No of verification tests and sample name	
Date verification tests taken	
Results of Verification	
Net Acidity (mole H+/t)	
Required liming rate (lab results)	
Is further liming required (y/n)	
Liming rate required**	

**Further liming rate required = liming rate required (above) multiplied by factor of safety (1.5) by bulk density (1.8 t/m³)*



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FORM 3B: ON- SITE REUSE – LIME APPLICATION TO BASAL LAYERS

Volume of excavated soil:	
Details of long-term location of excavated soil :	
Date of material transfer:	
Dimensions of re-interred material	
Rate of Aglime added:	

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**APPENDIX C
ACID SULFATE SOILS MANAGEMENT PROCEDURES**

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C1. ENVIRONMENTAL VALUES

To avoid potential adverse effects on the natural and built environment (including infrastructure) and human health.

C2. OBJECTIVES



To meet the requirements of State and Local Government Legislation and Regulations, specifically:

1. Environmental Protection Act, 1994.
2. Environmental Protection (Water) Policy, 2009.
3. The ANZECC 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality - 2000'.
4. State Planning Policy 2/02, 'Planning and Managing Development involving Acid Sulfate Soils'.
5. Queensland Acid Sulfate Soil Technical Manual – Soil Management Guidelines 1 (Version 3.8).
6. QASSIT "Guidelines for Sampling and Testing Lowland Acid Sulfate Soils in Queensland - 1998"



C3. ENVIRONMENTAL CONTROL MEASURES

The following provides a list of the environmental control measures for the management of soils with existing or potential acidity at the site.

Environmental Control Measure	Responsibility
1. Saipem is to appoint a full time Environmental Representative to supervise and report on environmental management of the construction works.	Environmental Officer
2. Any complaints, sightings of indicators of acidic soil damage or other environmental incidents, are to be recorded together with any resulting investigation or response and reported to Saipem.	Environmental Officer
3. Site access and all records must be made available to regulators on official business at all times (if requested).	Environmental Officer
4. Induction training/awareness to be provided to all site staff and contractors engaged in pipeline and launch pad construction works. An emphasis should be placed on the field recognition of soils with existing or potential acidity on the site. The scope of training should also include: <ul style="list-style-type: none"> ■ An outline of the sensitivity of the area to environmental harm; ■ The potential for acid generation on the site and its potential impacts; ■ Details of the management strategies in place for soils with existing or potential acidity; ■ Responsibilities of individuals in the implementation of the management strategies; ■ Descriptions of soils with existing or potential acidity and how to identify them on site; 	Environmental Officer

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<ul style="list-style-type: none"> ■ ASS sampling and handling techniques; ■ Steps to be taken if soils with existing or potential acidity are to be disturbed; and ■ Details of reporting and monitoring responsibilities. 	
<p>5. Accurate and current records must be maintained for all testing, treatment and site monitoring undertaken in the management of soils with existing or potential acidity. Records are to consist of:</p> <ul style="list-style-type: none"> ■ Volumes of excavated soil; ■ Laboratory testing results; ■ Liming dosage rates; ■ Location of placement of fill on or off-site; and ■ Surface water and groundwater water testing results. 	Environmental Officer
<p>6. All surface water run-off and groundwater seepage within excavations is to undergo treatment, if required, for quality correction prior to off-site discharge, or reuse on site.</p>	Environmental Officer
<p>7. Maintain an adequate supply of Aglime (CaCO₃) on-site at all times. The supply should be stored in a covered and bunded area to prevent accidental release and located away from any footpaths, stormwater drains and vehicle and pedestrian traffic areas.</p> <p>*A secondary supply of ~10 kg of hydrated lime shall be kept on-site for the treatment of acidic waters (i.e. pH<6). Treatment rate of acidic water is to be in accordance with SPP 2/02. Small amounts of lime should be trialed to prevent over dosing.</p>	Environmental Officer
<p>8. Wherever practical, earthworks handling is to involve transport directly from cut to treatment/fill area.</p>	Environmental Officer
<p>9. Treatment pads are to be contained by bund walls, constructed and maintained with clean material (i.e. not ASS or acidic soils of fully lime treated soils).</p> <ul style="list-style-type: none"> ■ Excavated PASS/AASS soil will be stockpiled on treatment pads for lime treatment and testing. ■ Treatment pads are to be located adjacent to the proposed excavation area (where possible) with any leachate being directed to the sedimentation pond for quality correction prior to off-site discharge or re-use on site. ■ Treatment Pads are to ensure a freeboard to retain a 100 year ARI 24 hour rainfall event (extrapolated from Bureau of Metrology (BoM) <i>Rainfall Intensity Frequency Duration</i> (IFD) program as an intensity of approximately 18mm/hr); and ■ Treatment Pad bund walls should also be constructed and maintained to withstand a 100 year ARI 24 hour rainfall event. 	Environmental Officer
<p>10. Verification Testing and Monitoring - Movement of stockpiles and lime treatment are to be recorded in Form 3 (Appendix A). A copy of this form shall be provided by the Environmental Officer to Saipem on a weekly basis or immediately in the case of emergencies or significant non-conformance. Appropriate management and verification of all soil is to undertaken with appropriated records kept.</p>	Environmental Officer
<p>11. Weekly water monitoring reports are to be maintained on site for review by the regulators, at their request with a copy provided to Company on a weekly basis or immediately in the case of</p>	Environmental Officer

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emergencies or significant non-conformance.

C4. LIME APPLICATION RATES AND METHODOLOGY

The following procedure applies to the treatment of excavated soils on site, either to be exported from the site, or reused as fill.

A number of key assumptions will be considered in calculating liming rates from test results, via:



- Material dry bulk density of 1.8 t/m³
- Use of a minimum safety factor of 1.5.
- Use of a minimum finess factor of 1.5.
- The neutralising value of 97% the selected liming product.

Indicative liming rates, formulated from the results of the Phase 1 and Phase 2 investigations, are provided below and are applicable in any instance where soils are to be disturbed.

Within the creek crossing section of the pipeline route, liming rates are applicable to a 50 m radius of each corresponding borehole location. Excavations outside each radius will require further investigations/analysis to determine liming rates. Excavations that occur below the preliminary investigation depth of 2.0 m BGL will also require additional field testing and laboratory analysis to determine appropriate lime treatment rates.

Liming Rate; Pipeline Route, Creek Crossing Section			
Location	Depth	Soil Type	Treatment Rate
BH01	0 - 0.5m BGL	Gravel with trace Sand and Silt	4 kg Aglime/m ³
BH04	0.5 - 1.0 m BGL	Sandy Clay, generally grey, highly plastic	27 kg Aglime/m ³
BH08	0 - 0.5 m BGL	Silt Clay grey brown, medium plastic	9 kg Aglime/m ³
	0.5 - 1.25 m BGL	Gravelly Silt Clay pale grey, low plastic	5 kg Aglime/m ³

Within the Launch Pad site the following procedures apply to the treatment of excavated soils on site, either to be exported from the site, or reused as fill.

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Where excavated soils are to be re-used on site for 'fill', a liming rate of 5 kg Aglime/m² is required to be adopted and shall be placed as a basal layer under residual soil fill zones. This lime guard layer shall be repeated for each fill layer of a thickness of 1 m or part thereof (e.g. where the fill height is 3.5 m, a basal layer of 5kg Aglime/m² and three intermediate layers of 5kg Aglime/m² are required) (refer figure C4). Further to the application of lime guard layers, all fill placed on the site will be compacted under controlled conditions to reduce soil permeability, minimising infiltration and further reducing the potential for mild acid leachate.

For excavated soils from within the Launch Pad site that are designated to be exported from the site, the indicative liming rates provided below apply.

Liming Rate: Launch Pad (Off-site Disposal)				
Location	Depth	Soil Type	Treatment Rate (95 Percentile)	Treatment Rate (Maximum)
North East Corner (BH16, BH17, BH18 & BH19)	0.0 m to depth of excavation	Silty CLAY generally yellow brown to pale grey, highly plastic	13 kg Aglime/m ³ **	16 kg Aglime/m ³
Remainder of the Launch Pad	0.0 m to depth of excavation	Silty CLAY generally grey to brown, medium to highly plastic	7 kg Aglime/m ³ **	9 kg Aglime/m ³

** Calculated at 95 percentile.

Lime treatment is to be undertaken in accordance with Figure C1, Figure C2, Figure C3, and Figure C4 below.



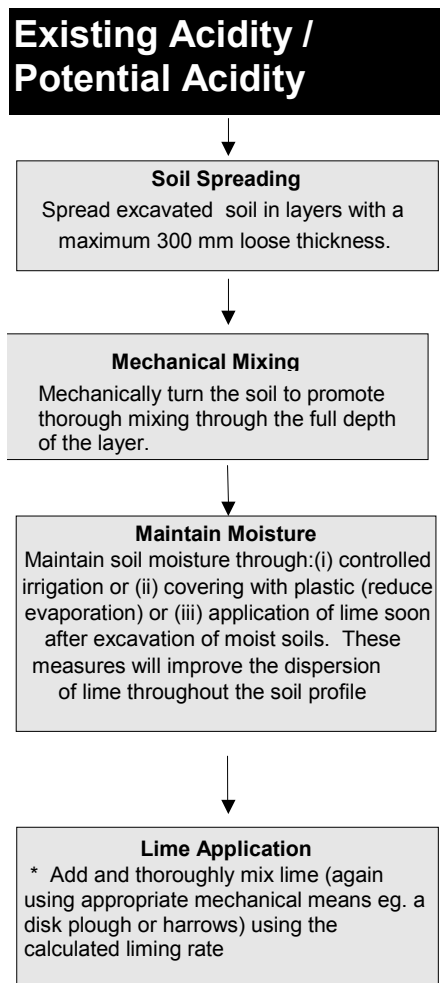
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Figure C1: Lime Application for Soils with Existing Acidity and Potential Acidity



Maximum Exposure Time Before Treatment – 18 hours (overnight)



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Figure C2 Schematic cross-section of a treatment pad, including a compacted clay layer, guard layer, leachate collection system and containment with bund

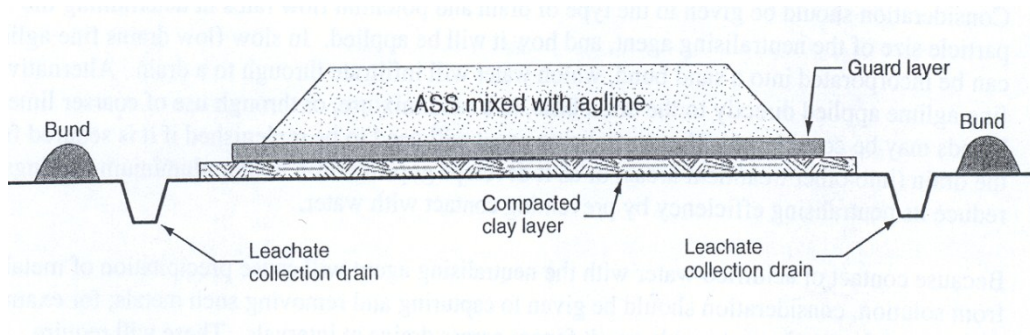
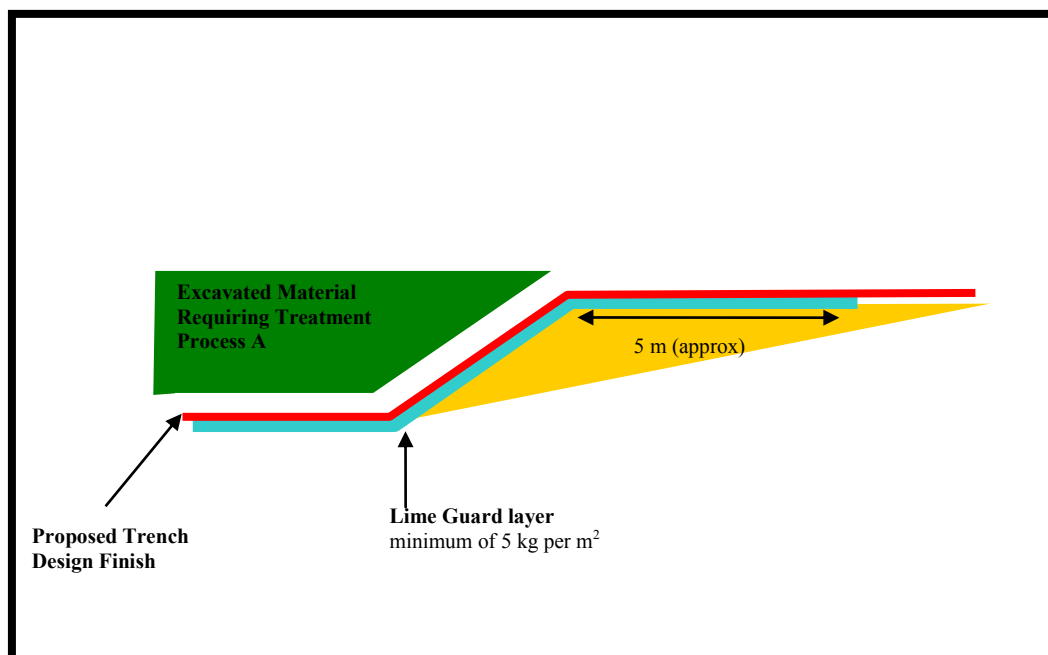


Figure C3 Lime Guard Application – Trenching





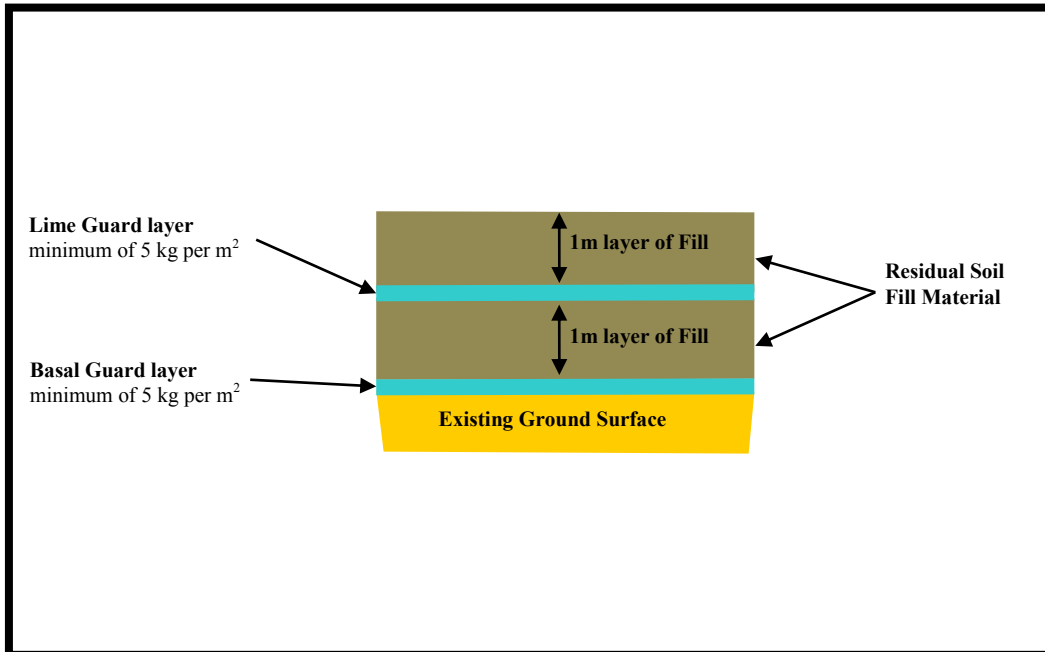


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Figure C4; Application of Lime Guard Layers – Residual Soil Fill





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C5. MANAGEMENT FOR STOCKPILES, HANDLING AND TRANSPORT

The following provides a list of the management strategies, in addition to those detailed in section C3 for the stockpiling and handling of soils with existing or potential acidity at the site.



Management Strategy	Responsibility
<p>1. Wherever practical the earthworks handling should involve transport directly from cut to treatment/fill areas and stockpiling of untreated soils with existing or potential acidity should be avoided. The recommended maximum time period for which soils can be temporarily stockpiled without treatment is 18 hours (overnight).</p>	Environmental Officer
<p>2. Where it is necessary to transport AASS/PASS material to the proposed treatment facility the following management measures must be followed:</p> <ul style="list-style-type: none"> ■ Due care is to be taken when transporting saturated /supersaturated soils and sediments (e.g. wet silty/sandy material). Where practicable a restricted maximum load (i.e. 2/3 of skip) is to be adopted with excavated material (saturated /supersaturated soils) is transported in an appropriately lined and covered muck skip to avoid spilling and sloughing. ■ The transport contractor will be responsible for maintaining the site and the transport route free of spilled and sloughed ASS sediments. All such spilled sediments are to be regularly (daily) collected and transported to the designated treatment area for neutralisation. 	Environmental Officer
<p>3. Where it is necessary to stockpile untreated soil for moderate periods (up to 1 week) the following additional management measures must be followed:</p> <ul style="list-style-type: none"> ■ Stockpiles are to be contained by bunds with stormwater runoff directed to a collection sump. Bunds are to be constructed from low permeability materials that are not ASS or have been fully lime treated. ■ A guard layer of neutralising agent (5 kg/m³) should be spread across the soil surface prior to placement of the stockpile. The rate of neutralising agent applied should be based on 0.3 times the average total potential plus existing acidity for every 1 m height of soil in the stockpile. ■ The surface area of the stockpile is to be minimised by shaping and possibly capping or covering to prevent moisture loss and rainfall entry. ■ Keep the surface of the stockpile moist using a spray of water or neutralising solution with care to avoid over-wetting. 	Environmental Officer

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C6. MANAGEMENT FOR EXCAVATIONS

The following provides a list of management strategies for trenching and excavations.

Management Strategy	Responsibility
<p>1. As a general practice in trenching operations, stockpiles of excavated material should be left exposed for the minimum practical time before being treated and/or replaced beneath the permanent groundwater table before oxidation can occur.</p> <ul style="list-style-type: none"> ■ The Guidelines recommend reburial below the permanent water table within 18 hours (overnight). This can be effectively managed by staging excavation operations into short sections of work that are kept open for limited time periods (i.e. overnight or <18 hours). ■ Any trenches left exposed at the end of shift must have a lime guard layer applied at a nominal rate of 5kg/m² to prevent the oxidation of any pyritic sediment and mitigation of leachate. 	Environmental Officer
<p>2. For minor trenching excavations the following backfilling techniques will be adopted;</p> <ul style="list-style-type: none"> ■ A guard layer applied at a nominal rate of 5kg/m² shall be applied adjacent to and on the up-side gradient of the proposed trench excavation works prior to placement of excavated materials. ■ Excavated materials will be stockpiled for the shortest possible time on the limed area adjacent to the trench. ■ Lime shall be applied to the base of the excavation at a rate of 5 kg/m² prior to backfilling with limed materials. ■ Excavated material shall be limed at the nominated rate during backfilling to achieve mixing. The highest liming rate, as determined by laboratory analysis within location, shall be adopted for backfilling of representative materials for a 50 m length. ■ Excess material that cannot be backfilled into the trench to below ground level shall be transported to the designated bunded stockpile/treatment area for lime treatment. ■ Where practicable, stockpiling and liming should not be conducted in areas directly adjacent to watercourses or drainage channels. 	Environmental Officer
<p>3. Due to the anticipated variable depth of groundwater throughout the site, there is a level of uncertainty in relation to batter slope angles during excavations. This has the potential to increase excavation quantities and the volume of ASS treatment required, while also slowing excavation production rates and extending ASS exposure times. This can be effectively managed by staging excavation operations into short sections of work (in so far</p>	Environmental Officer



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as is reasonable) that are kept open for limited durations.	
4. To counteract the effect of drawdown on the surrounding soil (cone of depression) during excavations, it is recommended that re-watering strategies are implemented (such as recharge) circulating groundwater back behind sheet piles (if required) to negate the possible impacts of lowered groundwater levels and the potential oxidation of surrounding sediments.	Environmental Officer
5. The rate of groundwater seepage is expected to vary depending on the subsurface conditions, prevailing weather conditions, the proximity to local watercourses and tidal phases. Should groundwater inflow be considered too excessive during excavations, alternative construction methodologies will be considered, such as; adopting buoyancy control on the pipe to enable it to be laid in a wet trench or temporary shoring using sheet piling to minimise the extent of groundwater drawdown and limit seepage into the trench. This helps mitigate the possible impacts of lowered groundwater levels and the potential oxidation of surrounding sediments.	Environmental Officer
6. All waters collected from groundwater and surface water inflow into excavations via seepage and runoff must be retained, monitored and appropriately treated to comply with the appropriate discharge criteria (Appendix C) prior to discharge off site or re-use on site.	Environmental Officer
7. Where practicable groundwater levels and water quality within the cone of depression should be monitored during and after dewatering activities (if applicable).	Environmental Officer

C7. INSPECTION AND MONITORING



The results of the following activities are to be recorded.

Activity	Frequency	Responsibility
1. Maintain photographic record of site development works associated with soil movements.	As required	Environmental Officer
2. Maintain records tracking soil movements around the site including diagrams, volumes and soil descriptions for stockpiles in temporary storage areas as well as final placement sites.	As required	Environmental Officer
3. Inspect the condition of stockpile batters, drains, open trenches and structure excavations.	Weekly or following rainfall	Environmental Officer
4. Maintain record of lime dosing and quantities of lime brought onsite.	Per dose	Environmental Officer
5. Undertake testing of surface water and groundwater in accordance with Appendix D Section D4 and D5.	Weekly	Environmental Officer

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C8. PERFORMANCE INDICATORS

Item	Performance Indicator
1. Verification of lime treatment	Verify the effectiveness of lime treatment by undertaking Chromium Reducible Sulphur (CRS) analysis of treated soils at a rate of 1 test per 250 m ³ . The lime-treated material is to have a 'net acidity' of no greater than 10 mole H ⁺ /t, acid neutralising capacity (ANC) of not less than 1.5 times the existing plus potential acidity and a pH after neutralisation (pH _{KCl}) of greater than or equal to 6.5. CRS analysis is to be undertaken by suitability equipped NATA accredited laboratory.
2. Surface water and groundwater	Refer Environmental Measures in Appendix C.
3. Photographic Record	No obvious degeneration of the aesthetic value of the open-space that may be possibly attributed to acid leachate.
4. Non-conformance	All non-conformances are to be reported to the Environmental Officer and rectified as soon as is practical.

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APPENDIX D

WATER QUALITY MANAGEMENT PROCEDURES

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D1. ENVIRONMENTAL VALUES

The protection of surrounding surface water and groundwater.



D2. OBJECTIVES

1. Limit environmental impact on adjacent properties.
2. Control potential sources of contaminated stormwater.
3. Limit the quantity of soil lost during earthworks activities.
4. Manage all discharges of water from the earthworks site.
5. Comply with Environmental Protection (Water) Policy 2009, and local council laws, codes and policies.
6. Use the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 for the protection of environmental values.
7. International Erosion Control Association Australasia, Best Practice Erosion and Sediment Control, Book 1 to 3 (November 2008).

D3. ENVIRONMENTAL CONTROL MEASURES

The following provides a list of the environmental control measures for management of surface water and groundwater at the site.

Environmental Control Measure	Responsibility
1) The velocity of stormwater over the site will be reduced where gradients exist by the installation of retarding structures, such as silt fences.	Environmental Officer
2) Release of water off-site will take place at the approved release points only (Table D1). Water quality monitoring will be undertaken in accordance with D4.	Environmental Officer
3) All surface water run-off and groundwater seepage within excavations is to undergo treatment, if required, for quality correction prior to off-site discharge, or reuse on site.	Environmental Officer
4) [Small amounts of] Hydrated lime will be kept on site at all times for pH adjusting of waters before discharging.	Environmental Officer
5) Surface water not meeting suspended solids discharge performance criteria will be filtered, or flocculated before discharge.	Environmental Officer



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6)	All waters being discharged off site must not cause discoloration of receiving waters.	Environmental Officer
7)	Discharges of water from site must not cause measured levels of water pollutants (other than specified in D5) in the receiving waters to fall outside acceptable ranges specified in the ANZECC 2000 ³ guidelines.	Environmental Officer
8)	Stockpiles when not in use will be watered to minimise dust emissions and not placed on paths, or stormwater drains.	Environmental Officer
9)	Assess baseline receiving water quality (including dissolved Fe and Al) at release point as part of the REMP prior to commencement of soil disturbance activities.	Environmental Officer

Table D1: Contaminant Release Points, Sources and Receiving Environments

Release Points	Coordinates		Contaminant Source and Location	Description of Receiving Environment
	Northing	Easting		
HCN	308390.7	7371840.3	Pipeline trench water, Stormwater from the Mainland Construction Pad	Humpy Creek, The Narrows, Port Curtis
HCS	309262.9	7371269.4	Pipeline trench water, Stormwater from the Mainland Construction Pad	Humpy Creek, The Narrows, Port Curtis
TC	309639.5	7370837.9	Pipeline trench water, Tunnel seepage water, Stormwater from the Mainland Construction Pad, acid sulfate soil leachate from Treatment Pad Area	Targinie Creek, The Narrows, Port Curtis
CI	314168.0	7372302.8	Stormwater from the Port Curtis Construction Site Pad area	The Narrows, Port Curtis

³ Australian and New Zealand Guidelines for Fresh & Marine Water Quality, 2000.



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D4. INSPECTION AND MONITORING

The following inspection and monitoring program will be conducted at the site.

Activity	Frequency	Responsibility
1) Inspect disturbed areas for signs of land erosion or deterioration	<ul style="list-style-type: none"> ■ Daily ■ After each major rainfall event⁴ 	Environmental Officer
2) Inspect stockpiles for sediment loss	<ul style="list-style-type: none"> ■ Daily 	Environmental Officer
3) Inspect location, design and stormwater protection of stockpiles so that sediment is not deposited into the stormwater system	<ul style="list-style-type: none"> ■ Daily ■ After each major rainfall event⁵ 	Environmental Officer
4) Check that all sediment fences and erosion control mechanisms are working during rain periods	<ul style="list-style-type: none"> ■ Daily ■ After each major rainfall event⁵ 	Environmental Officer
5) ASS Treatment Pad Water monitoring (locations to be confirmed i.e. release points, sedimentation pond and treatment tanks)	Minimum monitoring frequency:	Environmental Officer
<ul style="list-style-type: none"> ■ Turbidity (NTU) 	<ul style="list-style-type: none"> ■ Immediately prior to discharge and daily during discharge events 	
<ul style="list-style-type: none"> ■ Total Petroleum Hydrocarbons (visual) e.g. hydrocarbon film, oil, floating scum and litter 	<ul style="list-style-type: none"> ■ Monthly during periods of no release 	
<ul style="list-style-type: none"> ■ pH, Electrical Conductivity, Dissolved Oxygen 		
<ul style="list-style-type: none"> ■ Aluminium and Iron (dissolved) 	<ul style="list-style-type: none"> ■ Periods of no release must be recorded 	
	Minimum monitoring frequency	



⁴ >25mm of a rainfall within a 24 hour period

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<ul style="list-style-type: none"> ■ Petroleum Hydrocarbons C6 – C9 (mg/L) ■ Petroleum Hydrocarbons C10 – C36 (mg/L) ■ Total Petroleum Hydrocarbons (mg/L) ■ Total Suspended Solids <p>All results to be kept in the site office and presented to NRM on request</p>	<ul style="list-style-type: none"> ■ Monthly during periods of no release ■ Immediately prior to discharge and weekly during discharge events ■ Periods of no release must be recorded 	
--	---	--

<p>6) Trench Water monitoring (locations to be confirmed i.e. release points, sedimentation pond and treatment tanks)</p> <ul style="list-style-type: none"> ■ Turbidity (NTU) ■ Total Petroleum Hydrocarbons (visual) e.g. hydrocarbon film, oil, floating scum and litter ■ pH ■ Dissolved Oxygen (mg/L) 	<p>Minimum monitoring frequency:</p> <ul style="list-style-type: none"> ■ Immediately prior to discharge and daily during discharge events ■ Monthly during periods of no release ■ Periods of no release must be recorded 	Environmental Officer
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<ul style="list-style-type: none"> ■ Petroleum Hydrocarbons C6 – C9 (mg/L) ■ Petroleum Hydrocarbons C10 – C36 (mg/L) ■ Total Petroleum Hydrocarbons (mg/L) ■ Total Suspended Solids <p>All results to be kept in the site office and presented to NRM on request</p>	<p>Minimum monitoring frequency</p> <ul style="list-style-type: none"> ■ Monthly during periods of no release ■ Immediately prior to discharge and weekly during discharge events ■ Periods of no release must be recorded 	
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<p>7) During construction groundwater (locations and numbers of monitoring wells yet to be determined) will be tested for:</p> <p>pH, conductivity, Aluminium (dissolved), Iron (dissolved) and Groundwater Level</p> <p>All results to be kept in the site office and presented to NRM on request</p>	<ul style="list-style-type: none"> ■ 6 times over 1 month prior to earthworks (baseline) ■ Weekly during earthworks ■ 4 times over 4 weeks following completion of works 	<p>Environmental Officer</p>
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D5. PERFORMANCE CRITERIA

Item	Performance Indicator	
1. Release Water from ASS Treatment Pad at Contaminant Release Points (refer to Table D1)	pH	Within the range of 6.5–9 pH units
	Dissolved Oxygen	>4.0 mg/L
	Total Suspended Solids (mg/L)	Monitor Only
	Turbidity (NTU)	<60 NTU
	Dissolved Iron*	<0.3 mg/L
	Dissolved Aluminium*	<0.2 mg/L
	Oil, Grease, floating scum, litter	No visible plume or hydrocarbon film
	Total Petroleum Hydrocarbons (mg/L)	<10 mg/L
	Petroleum Hydrocarbons C6-C9 (mg/L)	Monitor Only
Petroleum Hydrocarbons C10-C36 (mg/L)	Monitor Only	



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2. Release Water from Trenching Operations at Contaminant Release Points (refer to Table D1)	pH	Within the range of 6.5–9 pH units
	Dissolved Oxygen	>4.0 mg/L
	Total Suspended Solids (mg/L)	Monitor Only
	Turbidity (NTU)	<60 NTU
	Oil, Grease, floating scum, litter	No visible plume or hydrocarbon film
	Total Petroleum Hydrocarbons (mg/L)	Monitor Only
	Petroleum Hydrocarbons C6-C9 (mg/L)	Monitor Only
	Petroleum Hydrocarbons C10-C36 (mg/L)	Monitor Only
3. Groundwater	pH	Baseline (pH<5.5) - 0.3 pH unit change below the lower baseline range and an upper limit of 8.5. Baseline (pH 5.5 to 8.5)-1 pH unit change below the lower baseline range and an upper limit of 8.8 Baseline (pH >8.5)- 0.3 pH unit change above the upper baseline range and a lower limit of 6.5
	Aluminium (dissolved)	+/- 10% of baseline range
	Iron (dissolved)	+/- 10% of baseline range
4. Surface Water Control System	All control systems are maintained in good working order. Surface water is separated from disturbed and undisturbed areas.	
5. Stockpiles	Location and design of stockpiles meets all control measures. Stormwater protection of stockpiles is maintained, effective and in good working order.	
6. Non conformance	All non-conformances are reported and rectified.	

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D6. CORRECTIVE MEASURES

Item	Corrective Measure
1. Release of contaminants to waters	The release of contaminants to waters from the release points must be monitored at the locations specified in Table 1: Contaminant Release Points, Sources and Receiving Environment (as per the EA) for each quality characteristic and at the frequency specified in D4.
2. Iron and Aluminium	<p>If the concentration of iron and aluminium exceed the trigger values specified in D5 when measured at the monitoring points specified in Table 1: Contaminant Release Points, Sources and Receiving Environment, the following action must be taken;</p> <ul style="list-style-type: none"> a) Where the receiving environment results are the same or higher than the measured concentration of iron and/or aluminium no action is to be taken; or b) Where the measured concentration of iron and/or aluminium exceed the receiving environment results an investigation in accordance with the ANZECC and ARMCANZ 2000 guidelines must be undertaken, with a written report provided to the administering authority within 30 business days of obtaining written confirmation of results, outlining: <ul style="list-style-type: none"> i. details of the investigation carried out; and ii. actions taken to prevent environmental harm.
3. Iron and Aluminium Trigger value exceedances	Where an exceedance of a trigger value for investigation has occurred and is being investigated, in accordance with D6 (2) (b) (ii), no further reporting is required for subsequent trigger events for that quality characteristic.

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APPENDIX E
PHASE 2 - ACID SULFATE SOIL INVESTIGATION REPORT

Appendix B

Pest and Weed Management Plan



GLNG

Gas Transmission Pipeline

Pest and Weed Management Plan

Document Number: 3380-GLNG-3-1.3-0006

PREPARED BY:

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Title	Name	Signature	Date
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APPROVED BY:

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DATE	REV	REASON FOR ISSUE	AUTHOR	CHECKED	APPROVED
04/08/10	1	For Use	AW	BF	NC
23/11/10	2	For Contract Award	AW	BF	NC
02/06/11	3	Re-issued for Use	BH	IB	NC
15/07/11	4	For Agency Review	CC		
29/03/12	5	Revised for SEWPaC Review	AW	BF	NC
16/05/12	6	Revised for SEWPaC Second Review	AW	BF	NC

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- C Example Washdown Register – for Washdown Facilities
- D Weed Management Plans
- E Pest Animal Profiles

1. Introduction

1.1 Purpose

The purpose of this Pest and Weed Management Plan (PWMP) is to detail the requirements for the management of weeds associated with the construction of the GLNG Gas Transmission Pipeline (GTP). The PWMP is applicable to GLNG Operations (the Company) employees, Contractors and all personnel associated with the planning and construction of the pipeline.

1.2 Scope

The scope of this document is to outline the pest and weed management protocols for the various stages of the GLNG GTP and to provide the Contractor with a baseline set of weed data and management strategies to assist the Contractor in developing an acceptable CPWMP.

Pre-construction:

Clearly define the boundaries and procedures throughout the Project Area to ensure all preconstruction activities (surveys, landholder access, site visits, infrastructure upgrades and preparation) to not transfer Class 1 or 2 weeds from areas currently infested to new “clean” areas.

Construction

To provide the physical and procedural parameters and boundaries to the EPC Contractor from which they can develop their project specific ‘Contractors Pest and Weed Management Plan’. Together, these plans will provide the procedures and guidelines on how the spread of weeds throughout the Project Area will be prevented and compliance with this document will be maintained.

Post Construction

To establish the boundaries and procedures for weed management along the Pipeline for all monitoring and maintenance procedures for the Project life.

This document has been prepared in accordance with the EIS and SEIS for the GLNG Project, as well as the Project Environmental Management Plans

1.3 Objectives and Performance Criteria

The objectives and performance criteria for the PWMP (Pest and Weed Management Plan), as detailed in the GLNG Project EIS, are:

Objective

- To prevent the introduction and spread of weed and pest species throughout areas associated with the construction of the GLNG Transmission pipeline

Performance Criteria

- No new weed infestations in the Project Area (pipeline, access tracks and ancillary Project Areas (laydown areas, camps, water points, quarries etc) as a result of construction activities
- No spread of weeds from infested areas to previously weed free areas
- No mature or seeding weeds located within the Project Area during construction

- Right of Way (ROW) restored to a state that minimises the potential for weed colonisation of disturbed areas
- No net increase in the abundance or distribution of pest animal species in the Project Area

1.4 Definitions

Term	Definition
Certified Clean	Washed down vehicle Certified clean by Weed Inspector
Class 1 Declared Plant or Declared Animal	<p>A plant or animal that:</p> <ul style="list-style-type: none"> • Is not commonly present in Queensland and, if introduced, would cause an adverse economic, environmental or social impact • Are subject to eradication from the state <p>Landowners must take reasonable steps to keep land free of Class 1 pests</p> <p>It is a serious offence to introduce, keep or supply a Class 1 pest without a permit issued by the Department of Primary Industries and Fisheries</p>
Class 2 Declared Plant or Declared Animal	<p>A plant or animal that:</p> <ul style="list-style-type: none"> • Is established in Queensland and have, or could have, an adverse economic, environmental or social impact • Requires coordination and are subject to programs led by local government, community or landowners <p>Landowners must take reasonable steps to keep land free of Class 2 pests</p> <p>It is a serious offence to introduce, keep or supply a Class 2 pest without a permit issued by the Department of Primary Industries and Fisheries</p>
Class 3 Declared Plant ¹ or Declared Animal	<p>A plant or animal that:</p> <ul style="list-style-type: none"> • Is established in Queensland and has, or could have, a substantial adverse economic, environmental or social impact <p>Landowners may be required to manage Class 3 weeds in or near environmentally significant areas such as protected areas, important habitats for threatened species or areas of interest only</p>
Declared Pest	A live animal or plant confirmed to be a declared pest under the <i>Land Protection (Pest and Stock Route Management) Act 2002</i>
Infested Area	An area infested with a declared pest. These areas can be defined by local council, the regulatory body or local landholders – depending on the size of the infestation
Inspection	Inspection carried out by a trained Weed Inspector in compliance with the Queensland Government <i>Queensland Checklist for Inspection Procedures</i>

¹ This class has been inserted for information purposes only as weed surveys to date have not included Class 3 plants. However, as noted, Class 3 plants may need to be managed within environmentally significant areas and it is recommended that pre-construction surveys record the locations of such species in such areas.

Term	Definition
Project Area	Includes the pipeline ROW, access tracks and ancillary Project Areas (laydown areas, camps, water points, quarries)
Washdown Log	Log of washdowns completed for a specific vehicle/plant/equipment. The Log is maintained by the vehicle/equipment operator
Washdown	Washdown carried out, using the provisions of the Queensland Government <i>Queensland Checklist for Cleandown Procedures</i> as a Guideline, to remove organic matter and material from vehicles and equipment that may lead to the introduction or spread of weed species
Washdown Register	Washdown Facility specific Register of all washdowns completed at the particular Washdown Facility. The Register is maintained by the Weed Inspector for the particular facility
Weed Inspector	<p>Person who has completed Weed Inspector Training and is trained in the following nationally recognised units:</p> <ul style="list-style-type: none"> • RTD2312A Inspect Machinery of Plant Animal and Soil Material • RTD2313A Clean Machinery of Plant Animal and Soil Material <p>OR</p> <p>Person accepted by the Company as having the appropriate training to undertake the role as outlined in the PWMP e.g. nominated Environmental Officer(s)</p>
Weed Management Zones	The Project Area has been divided into Weed Management Zones to assist with the implementation of this PWMP. Refer to Section 2.2.1

1.5 Abbreviations

ACDC Act	Agricultural Chemicals Distribution Control Act 1966
CICSDA	Callide Infrastructure Corridor State Development Area
CPWMP	Contractor Weed Management Plan
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPC	Engineering, Procurement and Construction
GLNG	Gladstone Liquefied Natural Gas
GRT	Giant Rats Tail Grass
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline
ROW	Right of Way
WMP	Weed Management Plan (this document)

2. Background

2.1 Identification of Key Risks

2.1.1 Weed Survey

Weed surveys of the pipeline route and associated Project Area have been completed. Further weed surveys will be completed by the Contractor to further refine the nature and extent of weeds within the Project Area, such that the information is current at the time construction activities commence.

In addition to consultation with local authorities and landholders, weed surveys undertaken during 2009, 2010 and a field revision in 2011 have identified the following weeds to be of major concern within the Project Area and surrounds:

- *Parthenium hysterophorus* (Parthenium) – Class 2 weed
- *Sporobolus pyramidalis* (Giant rats tail grass) – Class 2 weed
- *Eragrostis curvula* (African love grass) – major concern to landholders

Details of all species identified during the field surveys along with their location are provided as Attachment D.

2.1.2 Pest animal survey

Fauna surveys of the pipeline route and associated Project Area were undertaken between 2008 and 2010 with the following pest animals were recorded:

Canis lupus dingo and *Canis familiaris* (Dingo and wild dog) – Class 2 pest animals
Vulpes vulpes (red fox) – Class 2 pest animal
Sus scrofa (feral pig) – Class 2 pest animal
Felis catus (feral cat) – Class 2 pest animal
Oryctolagus cuniculus (rabbit) – Class 2 pest animal
Rhinella marinus (cane toad) – not a declared pest animal

Note The National Management Group, Australia's key decision-making body on emergency pests, has officially declared that red imported fire ant has been eradicated from the area, following a successful eradication and pest freedom verification program carried out by Biosecurity Queensland. This means that the movement restrictions on high-risk materials can now be lifted. This is a big win for the fire ant eradication program and the Yarwun community. However, fire ants still pose a threat and restrictions remain in place in South East Queensland. Fire ants are easily spread in soil, mulch, plants and landscaping equipment, so movement controls must be adhered to in order to reduce the risk of further spread.

Source http://www.dpi.qld.gov.au/4790_18539.htm

2.1.3 Review of Activities

A review has been undertaken of the pipeline construction activities. Activities considered to pose the highest risk of introducing or spreading weeds and pest animals are listed below and will be subject to specific controls:

- Pre-construction route field studies (eg geotechnical studies, route review with landholders, route inspection with contactors)
- Activities on pipeline route prior to clearing and grading of the ROW
 - Survey Crew

- Fencing Crew
- Clear and grade activities
- First arrival of construction vehicles, equipment and supplies
- Accessing ROW and travelling back to camps
- Movement of vehicles between crews/activities
- Deliveries of materials to the ROW
- Travelling away from Project Area after accessing the ROW

2.2 Overview of Management Strategies

The Company's strategy is controls focused on preventing the introduction and/or spread of weed and pest animal species during the construction of the GLNG GTP. The Company has determined that the controls to prevent the introduction and/or spread of Parthenium and Giant Rats Tail Grass (GRT) will also be effective in controlling the introduction and/or spread of the other weed species.

There are numerous strategies available for weed management however it must be noted that individually, they cannot adequately manage or control the spread of weeds. The effective management of weed will only be attained through the combination of a series of weed management strategies. (i.e. vehicle washdowns will not get every seed off a vehicle). Weed spraying will not kill every plant and there is no chemical that kills seeds effectively. Isolating certain vehicles to certain areas is effective, however this relies on the integrity of project personnel, which is not a factor that this project is going to rely on. In addition, the pest animal species detected in the Project Area are widespread and established across the region, so their management will require an integrated, catchment-scale approach.

2.2.1 Weed Management Zones

It will be the responsibility of the Contractor to determine appropriate weed management zones for the Project Area and manage the zones accordingly. However as a minimum, the information and mapping provided in Attachment D should be used to determine 'clean' and 'dirty' locations and develop appropriate weed management protocols.

2.2.2 Summary of Strategies

The major strategies to be implemented in the PWMP to control the identified risks are:

- a) Ongoing weed surveys and weed spraying
- b) Training of personnel in the requirements of this PWMP
- c) Establishment of weed management zones
- d) **Control vehicle and equipment movements** between zones via a sticker identification system
- e) Establishment of weed washdown facilities staffed by appropriately qualified and experienced Weed Inspectors
- f) Ensuring all vehicles, equipment and supplies brought to the Project Area and departing are **certified clean**
- g) Implementation of inspection and monitoring protocols
- h) Post-construction weed monitoring and control strategy

Note The weed control strategies outlined in this PWMP are based upon weed surveys completed during 2009, 2010 and 2011. Upon completion of any additional surveys, the weed control strategies may be further revised



Pest animals

- Ensure all vehicles, equipment and supplies brought to the Project Area are free of pest animals
- Report all sightings of pest animals and monitor changes in abundance or distribution within the Project Area
- Secure waste organic material (eg food scraps) to deter scavenging by pest animals
- Avoid creating artificial water sources (eg depressions) that provide a source of drinking water to vertebrate pests or breeding habitat to invertebrate pests
- Support a broad scale, integrated pest management approach as identified in regional and state pest management strategies

3. General provisions

3.1 Responsibilities

Company – Implementation of the PWMP up to the point of the issue of the EPC contractor. The Company is also responsible for review and acceptance of the Contractor's CPWMP, monitoring compliance of the Contractor to the requirements of the WMP and CEMP, and management of the EPC contract which contains KPI's associated with implementation of this PWMP.

Contractor – Development and implementation of a Contractor Weed Management Plan (CPWMP) to comply with the PWMP. This will include (but not limited to) completion of pre-construction survey(s) and pre-construction weed control, training of personnel (see below), provision and maintenance of equipment, facilities and associated services and consumables and the monitoring of compliance to the CPWMP².

Supervisors (Contractors and the Company) – establishment of a best practice culture and monitoring, and enforcement of the requirements of this PWMP and the CPWMP. This will include ensuring that all sub-Contractors are aware of the requirements of the CPWMP prior to entering the Project.

Plant / vehicle operators – ensuring plant/equipment is certified as clean prior to arrival to the Project Area, undertaking washdown at required locations, maintaining a Washdown Log and ensuring activities are completed in accordance with WMP and CPWMP.

Weed/Pest inspector – inspection of vehicles, certification to cleanliness, administer weed zone stickers, maintain Washdown Register for the facility and ensure serviceability of washdown equipment on site.

Note The CPWMP will be designed to demonstrate the Contractors systems and procedures by which they will ensure compliance with this document. Where the CPWMP or any other contractual document refers to the PWMP, this will imply compliance with the Company PWMP through the complete implementation of the CPWMP. A breach of the CPWMP will be a breach of the PWMP and will imply a failure to meet a Key Performance Indicator.

3.2 Training

The Company and the Contractor are responsible for ensuring that the following training is completed.

Weed/Pest Inspector(s) – Completed Weed Inspector Training and is trained in the following nationally recognised units.

- RTD2312A Inspect Machinery of Plant Animal and Soil Material
- RTD2313A Clean Machinery of Plant Animal and Soil Material
- Alternate training and/or experience accepted by the Company (refer to Section 1.4)

All personnel – inducted to requirements of the PWMP including:

- Identification of key weed species and pest animal species
- Washdown requirements (on specific vehicles and where to clean)
- Access protocols (between the specified zones)
- Certification process (stickers, Washdown Log, Washdown Register, Weed Inspector)



² Records of all induction and training completed shall be maintained to demonstrate compliance with this PWMP. The CPWMP will be designed to *demonstrate the Contractors systems and procedures by which they will ensure compliance with this document. Where the CPWMP or any other contractual document refers to the PWMP, this will imply compliance with the GLNG PWMP through the complete implementation of the CPWMP. A breach of the CPWMP will be a breach of the PWMP and will imply a failure to meet a Key Performance Indicator.*

4. Company Pre-Construction Weed and Pest Animal Management

This section applies to all activities undertaken by the Company and associated Contractors or consultants prior to award of the EPC contract.

Upon award of the contract and approval of the CPWMP by the Company, all Project personnel shall comply with the requirements of the CPWMP.

4.1 Weed Identification and Control

4.1.1 Requirements

Weed Identification

- Weed surveys of the Project Area (including ROW, access tracks and any known ancillary areas) were undertaken by trained personnel/contractors in June and September of 2009 (dry season) and February and June of 2010 (post wet season). An additional review has been undertaken in April 2011 and the results have been attached in the update plans and material
- Weeds identified were recorded and have been mapped accordingly (refer Attachment D)
- The Company personnel will continue to liaise closely with local Council officers and landholders for existing weed information
- Survey findings will be utilised by Project personnel and Contractors to define the specific weed control measures for construction and the targeted weed control program

Weed Control

- Prior to the appointment of the Contractor, weed control of the Project Area (ROW, camps, storage areas, access) will be undertaken by appropriately qualified and experienced contractors who are appropriately licensed under the *Agricultural Chemicals Distribution Control Act 1966* (ACDC Act)
- Where possible, weed control will be scheduled to occur prior to weed seeding
- Prior to weed spraying, relevant land holders will be consulted
- Significant weed infestation areas will be monitored after treatment and repeat treatment undertaken as required

4.1.2 Performance Indicators

- Weed surveys undertaken during at least one dry and one wet season.
- Weed outbreaks recorded in GIS
- Weed control completed and recorded
- Weed zones established, monitored and marked on project maps (updated as applicable)
- No mature weeds or seeding plants within Project Area

4.2 Pre-Construction Access to Project Area

This section applies to all vehicles accessing the Project Area and travelling off sealed public roads.

4.2.1 Requirements

- Planning for access to the Project Area will include:
 - Identification of existing vehicle washdown facilities and planning work around the location of washdown facilities (refer to Attachment A for a list of public facilities)
- If applicable, fixed washdown facilities and washdown procedures shall comply with:
 - *Queensland Guideline for the Construction of Vehicle and Machinery Washdown facilities* (refer to Section 8)
 - *Queensland Government Checklist for Clean-down* (refer to Section 8)
- When moving between ‘dirty’ and ‘clean’ areas, within the Project Area, vehicles, plant and/or equipment will:
 - Be washed down and certified clean
 - Provide/be issued with a Weed Hygiene Declaration Form
 - All vehicles/equipment/plant shall have a Washdown Log (refer to Attachment B for an example of a washdown log) that must be maintained by the vehicle operator. This includes washdowns that require certification and washdowns completed by the vehicle operator. Washdown Logs are auditable and shall be provided upon request
- Vehicle operators:
 - Shall remain on designated access tracks and avoid driving through weeds as far as possible
 - Must not drive through flowering or seeding plants
- The location of any mature and/or seeding weed species is to be reported to the Company Pipeline Environmental Manager within 24 hrs

4.2.2 Performance Indicators

- Weed locations marked on Project maps
- Washdown Logs implemented and maintained
- Washdown Logs demonstrate washdown occurring to coincide with vehicle/equipment/plant movements
- Washdown facilities are available at all times (mobile/temporary units are available prior to establishment of fixed facilities)
- Weed Inspectors present at active washdowns
- No driving through seeding or flowering weed plants

5. EPC Contractor Pre-Construction Weed and Pest Animal Management

This section applies to all activities undertaken by the EPC Contractor prior to the commencement of construction. The only field activities that may be carried out under this section prior to the establishment of washbays and other weed control infrastructure will be weed surveys, or weed management work and/or work associated with the establishment of fixed weed washdown facilities.

5.1 Project Establishment

5.1.1 Requirements

Development of Construction Weed Management Plan

- CPWMP shall:
 - Be prepared by the Contractor and submitted to the Company for approval prior to any work under the EPC contract commencing
 - Comply with the requirements of this PWMP
 - Establish a system to control the movement of vehicles and equipment between weed management zones (refer to Section 2.2.1)
 - Provide the procedures that detail how compliance will be implemented
 - Establish a system to monitor and report on pest animal abundance and distribution
 - Identify the control measures that will be adopted to manage the impacts of existing pest animals within the Project area

Weed Zones

- Weeds management zones will be developed and implemented by the Contractor
- The construction area will be divided into weed management zones for the purpose of defining and preventing the unrestricted movement of vehicles from 'dirty' to 'clean' zones
- The zones shall be clearly identified both in the CPWMP and on the ground and work programs and flow designed around the zones
- Zones shall be clearly marked on construction drawings and within the field

Establishment of Washdown Facilities

- The location of project specific weed washdown facilities will be determined in consultation with weed management zone maps
- These washdown facilities shall be established to enable the efficient movement of vehicles between the weed zones whilst ensuring material that may facilitate the introduction or spread of weeds is removed. This may include the use of mobile washdown facilities where appropriate
- As a minimum, these washdown facilities shall be installed at the following locations:
 - At each construction camp
 - Boundaries of each weed zone
 - Major access points to the ROW, corresponding with weed zone boundaries
- Additional washdown facilities shall be constructed/resourced as required
- Each active washdown facility that is established for certification of vehicles shall be permanently staffed by an appropriately experienced and qualified Weed Inspector (when works are not occurring in that area there will be no need for an

inspector, however arrangements will be required to be made for an inspector to certify the vehicle if movement through the facility is required)

- Washdown facilities shall:
 - Be sized and equipped to facilitate the quick movement of vehicles and equipment within the Project Area whilst ensuring compliance with the CPWMP or this PWMP
 - *Comply with Queensland Guideline for the Construction of Vehicle and Machinery Washdown facilities* (refer to Section 8)
 - Include equipment to remove material from within the vehicle
- The location of Washdown Facilities shall be recorded in the project GIS, clearly marked on project maps and included in the inspection and monitoring program

Location of Infrastructure and Access routes

- It is recommended that construction camps be established such that crews can work within a defined zone and travel to and from camp without crossing a zone
- The location of construction access routes, delivery areas, stockpiles and laydown areas shall take into consideration the location of these zones and weed management strategies outlined in this PWMP
- Access routes shall be planned to achieve the following:
 - Vehicles operate in such a manner as to limit crossing of weed zone boundaries
 - Vehicles start in clean areas and then move into the dirty areas
 - Vehicles do not drive through or contact any seeding or flowering weeds
 - Vehicles are subject to washdown and certification to move between zones

5.1.2 Performance Indicators

- CPWMP developed and approved by the Company prior to entry to the field (HOLD POINT)
- Weed zones established and marked on project maps
- Project specific weed washdown facilities are immediately established and identified on project maps
- Weed Inspectors are present at designated washdown facilities

5.2 Weed and Pest Animal Identification and Control

5.2.1 Requirements

Weed Identification

- Prior to construction, regular weed surveys of the Project Area (including ROW, access tracks and any known ancillary areas) shall be undertaken
- Weed surveys shall be:
 - Undertaken by trained personnel or Contractors
 - Scheduled for times of high weed growth ie within 2 weeks or as soon as possible after first significant rainfall event and/or after periods of high rainfall
- Weeds identified shall be recorded in project GIS and included in project mapping

Pest animal identification

- Prior to construction, regular pest animal surveys of the Project Area (including ROW, access tracks and any known ancillary areas) shall be undertaken;
- Pest animal surveys shall be: Undertaken by appropriately qualified and experienced personnel or Contractors. Scheduled for both night (spotlight

searches) and day. Undertaken incidentally dependent on environmental conditions (eg pest predator populations may irrupt following periods of high rainfall):

- Incidental sightings of pest animals should be recorded and included in weekly Environmental Reports
- Pest animals identified shall be recorded in project GIS and included in project mapping

Weed Control

- Prior to construction, weed control of the Project Area (ROW, camps, storage areas, access) shall be undertaken by appropriately qualified and experienced Contractors who are appropriately licensed under the ACDC Act
- Weed control shall be scheduled to occur prior to weed seeding
- Prior to any weed spraying, permission shall be obtained from the Company
- Significant weed infestation areas shall be monitored after treatment and repeat treatment undertaken as required

Pest animal control

- If deemed necessary (ie where infestations occur), prior to construction, pest animal control of the Project Area (ROW, camps, storage areas, access) shall be undertaken by appropriately qualified and experienced Contractors who are authorised persons under the *Land Protection (Pest and Stock Route Management) Act 2002*
- Pest animal control shall be humane, strategic, integrated and adopt best practice principles as outlined in the following publications:
 - NSW Department of Primary Industries Humane Pest Animal control: Code of Practice and Standard Operating Procedures and related Model Codes of Practice for the Humane Control of Vertebrate Pests which are available at the following link <http://www.feral.org.au/tag/COP/>
 - The Animal Care and Protection Act 1994 specifically in relation to the appropriate treatment and euthanasia of pest animals. Any euthanasia will be undertaken in accordance with the Australian Code of Practice for the Care of Animals for Scientific Purposes, 7th Edition, 2004
 - Threat Abatement Plans for key species. GLNG will act within the requirements of threat abatement plans. Specifically the plans require a property management plan; in this case the pest and weed management plan will fulfil this requirement. The threat abatement plan requires input to local and regional databases for pest animal distribution. GLNG will collect data on pest species captured and will make this data available for reporting
 - The QLD government pest animal fact sheets
- The approach will be to manage pests encountered within the RoW during trenching activities. The Fauna Handler is to euthanise the animal as per the Fauna Handling Procedure. Where pest numbers are a concern to human safety (e.g. high numbers of feral pigs), a suitably qualified vertebrate pest field officer is to be contacted to implement a mitigation strategy (i.e. culling activities). Prior to any pest animal control, permission shall be obtained from GLNG
- Significant pest animal infestation areas shall be monitored after treatment and repeat treatment undertaken as required

5.2.2 Performance Indicators

- Weed and pest animal surveys monthly or more frequently after rain events
- New weed outbreaks recorded in GIS



- Weed control completed and recorded
- No flowing or seeding weeds within Project Area
- Company approval obtained prior to spraying
- Incidental sightings of pest animals recorded

6. Project Weed Management

6.1 Management of Access to the Project Area

6.1.1 Requirements

The Contactor shall establish a system for the control of vehicles within and between weed management zones and this system shall be documented in the CPWMP submitted to the Company for approval. The minimum requirements are outlined below.

- Prior to entering or leaving the Project Area vehicles, plant and/or equipment shall:
 - Be washed down and certified clean
 - Provide/be issued with a Weed Hygiene Declaration Form
- Additional washdown and certification will be required:
 - When travelling from a 'dirty' weed management zone to a 'clean' weed management zone (refer to Section 2.2.1). Vehicles will require the old sticker to be removed and a new one issued
 - All vehicles shall display the appropriate sticker(s) to define the zone they are approved to access and travel within
 - Different stickers shall represent authorisation for different zones and each sticker shall be numbered
 - Signage shall be installed at key points within the Project Area clearly outlining the Zone and certification requirements for entry and exit
 - Site specific washdown facilities shall be established in accordance with Section 5.1 and operated in accordance with Section 6.3
 - Boundary fence lines shall be marked both on alignment sheets and in the field, and crews shall not transfer anything across these lines unless authorised by the relevant Supervisor
 - No organic material shall be moved between zones
 - No haybales or equivalent materials shall be used on the project

Clear and Grade Crew

- Clear and grade crew will be subject to additional washdown at defined locations along the ROW where the specific weed infestation changes occur (eg Prickly Acacia, Mother of Millions and Rubber Vine)
- This will apply between specified properties within relevant zones
- The location of additional washdown points shall be clearly identified both on alignment sheets and in the field
- Washdowns in this situation shall be recorded by the Environmental Officer or the Weed Inspector in the relevant Washdown Log

6.2 Road Vehicles and Deliveries

The protocols for access to the Project Area outlined in Section 6.1 shall apply to all vehicles, including delivery vehicles, buses etc, even if they are only travelling on sealed public roads. The Contractor may propose an alternate system (must be approved by the Company prior to implementation) that includes the following requirements:

- Vehicles that are limited to travel on public roads must not leave a public road unless it is washed down and certified again prior to re-entering that public road



- Delivery vehicles travelling off sealed public roads must wash down and be certified for all travel from a 'dirty' to a 'clean' zone

6.3 Operation of Washdown Facilities

6.3.1 Requirements

- Site specific weed facilities shall be established in accordance with Section 5.1
- Stickers designating vehicle cleanliness and zone authorisation shall only be administered:
 - By a Weed Inspector
 - Once a vehicle is certified clean
 - For the zone where access is required
- Stickers may only be removed by a Weed Inspector
- Procedures for the washdown and inspection of vehicles shall:
 - Be established and documented in the CPWMP
 - Comply with the *Queensland Government Checklist for Clean-down and Inspections* (refer to Section 8)
- The vehicle/plant/equipment operator shall maintain the Washdown Log for all washdowns completed (refer to Attachment B)
- The Weed Inspector shall maintain a Washdown Register of all washdowns and vehicle/plant/equipment certifications completed at their allocated facility (refer to Attachment C for an example of a washdown register)
- Stickers shall be numbered and the corresponding number recorded on the Washdown Logs and Washdown Registers
- Upon departure from the Project Area, all stickers shall be removed by a Weed Inspector

Both a washdown log and washdown register are shown in Attachments B and C respectively. The washdown log is for the vehicles and is carried around in each piece of machinery. Signoff will be by the person operating the machinery. The washdown register is for the washdown bays themselves and will have signoff by a certified inspector.

6.3.2 Performance Indicators

- Washdown Registers and Washdown Logs consistent and correspond to vehicle movements
- Vehicles displaying correct stickers
- Weed Inspectors present and certifying to appropriate standard at active washdowns
- Washdown facilities are maintained and fully operable
- No mature weeds in flower or seed throughout the ROW and Ancillary works areas

6.4 Inspection and Monitoring

The Contractor shall establish an Inspection and Monitoring Program defining the scope, the interval and responsibility. The program shall be documented within the CPWMP.

As a minimum, the inspection and monitoring program shall include:

- Random checks on cleanliness of vehicles/plant/equipment and completion of Washdown Logs



- Daily inspection of vehicles within each zone to ensure correct stickers are displayed
- Weekly inspection/monitoring of Project Area for evidence of weeds
- Spraying of weed infestations by licensed Contractors (as approved by the Company)
- Random inspection of Washdown Logs and facility Washdown Registers – for consistency and correspond to vehicle movements
- Inspection of facility Washdown Registers and random cross checking of Washdown Registers versus Vehicle Washdown Logs

Corrective Action

- Equipment/vehicles failing inspections will be subject to be rewashed prior to certification
- Weed spraying of weed outbreaks
- Incident report or non-conformance report raised for non-compliances identified
- Contractor will assume responsibility for future management of weeds in an area of non-compliance
- Repeated non-compliance will result in stop-work, recertification of equipment and retraining of individuals

6.5 Records to be Maintained

The Contractor shall document within the CPWMP, the records that will be maintained to demonstrate compliance with this PWMP. This shall include the title, responsible person and the storage location for that record. As a minimum, this shall include:

- Washdown Logs for vehicles/plant/equipment
- Washdown Registers for facilities
- Records of Inspections completed as outlined in Section 6.4
- Induction and Training Records
- Incident Reports
- Non-compliance reports
- Audit Reports
- Evidence of weed surveys and monitoring activities
- Records of weed control activities

7. Project Pest Management

7.1 Prevent establishment of pest animals

7.1.1 Requirements

Pest animals known to occur in the Project Area are listed in section 2.1.2. Any new pest animals detected are to be reported immediately to Company and recorded in the Project GIS.

7.1.2 Performance indicators

- Pest animals are not proliferated in the Project Area

7.2 Management of existing pest animals

7.2.1 Monitoring

Spotlight and diurnal surveys

The Contractor will establish a regular monitoring program of nocturnal (spotlight) and diurnal ground pest animal surveys. These surveys shall:

- Occur at least every two months
- Be either on foot or by slow moving vehicle
- Be representative of all regions of Project Area (ROW, camps, storage areas, access)
- Be undertaken by appropriately qualified and experienced personnel
- Follow accepted survey methodology for transect surveys of ground-dwelling vertebrate fauna (see for example, EPA (1999) and Eyre et.al (1997))
- Be recorded in the Project GIS

Incidental and opportunistic sightings

All staff shall report all sightings of the pest animal species listed in section 2.1.2 to the Environmental Manager (see Attachment E to aid identification), which will be included in weekly environmental reporting and recorded in the Project GIS. 'Sightings' include:

- Seeing the actual animal
- Tracks and scats
- Indicative habitat disturbance (eg digging/uprooting by pigs)
- Evidence of habitat use (eg Den sites of foxes, rabbit burrows)

Indirect evidence of incidental pest animal sightings should be confirmed by appropriately qualified and experienced personnel wherever possible.

Regular monitoring will be used to estimate relative abundance and distribution of pest animals, and identify areas that may require control measures.

7.2.2 Performance indicators

- Regular transect surveys are undertaken and reported in the Project GIS
- Incidental sightings are reported and recorded in the Project GIS and weekly environmental reports. Relative abundance and distribution of pest species is closely monitored to detect increases and/or areas requiring control measures

7.3 Pest animal control

7.3.1 Legislative definitions and requirements

The pest animals listed in section 2.1.2. are declared as class 2 pests under schedule 2 of the *Land Protection (Pest and Stock Route Management) Regulation 2003*, with the exception of the cane toad (*Bufo marinus*) which is not a declared pest. Class 2 pests are defined under section 38 of the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act), as:

“Established in the State and (is) causing, or has the potential to cause, an adverse economic, environmental or social impact in the State”.

Under section 77 of the LP Act, landowners must take reasonable steps to keep their land free of Class 2 pests.

Under The *Pest Management Act 2001*, any pest control or fumigation activity must be carried out by an appropriately qualified and licensed technician.

Section 42 of the *Animal Care and Protection Act 2001* instructs that any act to control a pest animal must be done in a way that causes the animal as little pain as is reasonable. The Australian Government Department of Sustainability, Environment, Water, Population and Communities provide model codes of practice for the humane control of each of the class 2 pests listed in section 2.1.2., which may be accessed at the following links:

<http://www.environment.gov.au/biodiversity/invasive/publications/humane-control.html>

This Department has also published threat abatement plans for rabbits, feral cats and foxes, available here:

<http://www.environment.gov.au/biodiversity/threatened/tap-approved.html>

and has drafted a threat abatement plan for cane toads, which may be accessed here:

<http://www.environment.gov.au/biodiversity/threatened/tap-drafts.html>

The Queensland Government Department of Employment, Economic Development and Innovation publish operational guidelines for the management of each of the class 2 pests listed in section 2.1.2., which may be accessed here:

http://www.dpi.qld.gov.au/4790_8422.htm

This list of legislative requirements is not exhaustive, and there are many other pieces of State and Commonwealth legislation that may influence pest animal management in Queensland.

Pests and Weeds will be managed throughout the life of the project (including both operational and decommissioning phases) in accordance with the legislative requirements and guidelines listed above.

7.3.2 Pest management planning framework

A range of pest management planning instruments exist at the National, State, Regional and Local Government level. Those that relate to pest animal management in the Project Area are listed in Table 1.

Table 1 Pest Management Planning Framework

National	State	Regional	Local Government
Australian Pest Animal Strategy 2007	Qld Pest Animal Strategy 2002-2006	Capricorn Pest Management Group Regional Pest Management Strategy 2004-2009	Calliope Shire Council Pest Management Plan 2005-2008*
Threat Abatement Plan for Competition and Land Degradation by Rabbits 2008	Wild Dog Management Strategy 2010-2015 (Consultation Draft)		Gladstone City Council Pest Management Plan 2005-2008
Threat Abatement Plan for Predation by European Red Fox 2008	Feral Pig Management Strategy 2004		Bananna Shire Council Pest Management Plan 2005-2009
Threat Abatement Plan for Predation by European Feral Cats	Rabbit Management Strategy 2001-2006		
	Pest Management Plan Areas Managed by Qld Parks and Wildlife Service July 2003-2008		

*Calliope Shire Council and Gladstone City Council amalgamated in 2008 to form Gladstone Regional Council

This PWMP is consistent with the principles of the relevant planning instruments outlined above. The contractor will ensure that the CPWMP is also aligned with these principles.

7.3.3 Active control of pest animals

Effective control of pest animals may include any or a combination of the following methods:

- Killing/removal (eg trapping, baiting)
- Exclusion (eg fencing)
- Habitat manipulation (eg rabbit warren ripping)

Control of the pest animal species listed in Section 2.1.2 will occur according to the legislative instruments in Section 7.3.1 and the planning documents in Section 7.3.2. Permission must be sought from The Company before undertaking any of the control methods in this section.

Killing/removal

Only to be undertaken by authorised personnel as prescribed by the relevant Acts (see section 7.3.1) where outbreaks are known to have occurred and control is mandatory under the legislation listed in section 7.3.1.

Exclusion

All areas that contain organic waste material (e.g. food scraps) will be fenced or otherwise adequately secured to prevent scavenging by pest animals.



All areas of significant water ponding that are created during the course of construction will be enclosed by temporary fencing to prevent access by pest animals.

Habitat manipulation

Wherever practicable, and subject to the approval of the Company and compliance with all relevant legislation, any rabbit warrens or fox dens that are encountered will be destroyed.

7.3.4 Performance Indicators

All relevant legislation is complied with :

- CPWMP is consistent with Commonwealth, state, regional and local pest management planning instruments
- Pest animal control methods adhere to recommended guidelines and best practice principles according to the documents in Section 7.3.1
- Pest animal outbreaks are contained and managed effectively and in a timely manner
- All pest animal control actions are recorded in the Project GIS and reporting tools
- The distribution and abundance of pest animals in the Project Area does not increase



8. Post Construction

8.1 Monitoring and Control Program

Pests and Weeds will be managed as required throughout the life of the project, including during operational and decommissioning phases of the pipeline.

Monitoring will determine the success of management measures or requirements for further actions. Any pest or weed species identified during site inspections and audits will be recorded, and appropriate management measures will be employed in response to the presence of these species.

A Weed Monitoring and Control Program (to be included as part of the CPWMP) will be developed and implemented and will include (but not limited to):

- The rate of monitoring and control post completion will be as follows:
 - Post rain event – once a month for three months
 - Otherwise, once every two months
 - In response to landholder or operator request
- Weed monitoring and control activities shall include all Project Areas (eg tracks, ROW, camps, laydown and storage areas)
- Weed control shall be undertaken by appropriately qualified and experienced Contractors who are appropriately licensed under the ACDC Act

Weed monitoring and subsequent weed control will continue under the control of the Contractor for 2 years after completion of pipeline construction. During pipeline operation and decommissioning this responsibility will be handed to the Pipeline Operator.



Reference Material

Queensland Checklist for Clean Down Procedures

http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Cleanup-Procedures.pdf

Queensland Checklist for Inspection Procedures

http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Inspection-Procedures.pdf

Queensland Guideline for the Construction of Vehicle and Machinery Washdown facilities

http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Washdown-Fac-Guidelines.pdf

Weed Hygiene Declaration Form

http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Weed-Hygiene-Declaration.pdf

2009 Pipeline Weed Survey

GLNG Pipeline FEED – Weed Survey Report August 2009, prepared by GHD.,
GLNG DOC No. 3380-GHD-3-3.3-0323.

2010 Weed Survey Report June 2010

GLNG Pipeline FEED – Weed Survey Report June 2010, prepared by GHD.DOC
No. 21386-D-RP-012 REV A.

Coordinator-General's Evaluation Report for an EIS May 2010 – Appendix 3 Gas
Transmission Pipeline – Part 4 Schedule E – Pest and Weed Management
Conditions (E37) a, b and c

DSEWPC – EPBC Approval No2008/4096, Conditions (3) f and g.



Attachments

Attachment A Existing Washdown Facilities

Taken from

http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/4790_8243_ENA_HTML.htm

<p>Baralaba Landmark: near showground and old saleyards Address: Rannes Road Contact: Banana Shire Council Telephone: (07) 4992 9512 Maximum vehicle size: machinery Height limit: no Hose detail: high pressure; high volume hose Cost: \$2 for 15 minutes Surface: concrete slab with tilt Hours: n/a</p>	<p>Biloela Landmark: adjacent to water treatment plant Address: Quarry Road Contact: Gordon Twiner, Banana Shire Council Telephone: 0427 148783 Maximum vehicle size: road train Height limit: no Hose detail: high pressure; high volume hose Cost: \$2 for 15 minutes Surface: concrete slab with tilt Hours: n/a</p>
<p>Bingegang Landmark: near substation and pump station Address: Mackenzie River Capella Road Maximum vehicle size: semitrailer Height limit: no Hose detail: high pressure hose Cost: free Surface: concrete slab Hours: 24 hours</p>	<p>Calliope Landmark: Country Club turnoff Address: Stowe Road Contact: Gladstone Regional Council Telephone: (07) 4975 8100 Maximum vehicle size: semitrailer Height limit: no Hose detail: high volume hose Cost: tokens (\$2 for 15 minutes) available from Choice Service Station: Calliope Cross Roads CQP service station Gladstone Regional Council Surface: concrete slab/bitumen</p>
<p>Injune Landmark: saleyards Address: Roma Road, Injune Contact: Steve Murray, Roma Regional Council Telephone: (07) 4622 1144 Mobile: 0428 261290 Maximum vehicle size: body truck and car (side-by-side); road trains or headers Height limit: no Hose detail: high pressure water; high pressure air and Town pressure Cost: 50 cents per minute Surface: cement slab with ramp Hours: 7 am - 5 pm with key access operational 24 hours</p>	<p>Gladstone Landmark: Gladstone Superwash Address: 154 Goondoon Street Telephone: (07) 4972 9202 Maximum vehicle size: cars and 4WDs Height limit: n/a Hose detail: high pressure spray Cost: \$1 for 2 minutes Surface: n/a Hours: n/a</p>



<p>Moura Landmark: west of town near water treatment plant Address: Dawson Highway Contact: Gordon Twiner, Banana Shire Council Telephone: 0427 148783 Maximum vehicle size: road train (also has a facility for smaller vehicles) Height limit: no Hose detail: high pressure; high volume hose Cost: \$2 for 15 minutes Surface: concrete slab with tilt Hours: n/a</p>	<p>Rolleston Landmark: near sports ground; cattle dip and old saleyards Address: One Mile Road Contact: Central Highlands Regional Council Telephone: (07) 4984 1166 Maximum vehicle size: semitrailer with prime mover Height limit: no Hose detail: high pressure low volume hose 20 L per minute Cost: \$2 per 30 minutes Surface: 23 m concrete slab Hours: 24 hours</p>
--	---



Attachment B – Example Washdown Log for Vehicles/Plant/Equipment

Vehicle / Plant and Rego/ID Number : _____

Date	Driver	Washdown Location	Sticker Number Added	Sticker Number Removed	Authorised Signature
			eg Zone 2 #234	eg Zone 1 #123	



Attachment C – Example Washdown Register

Washdown Facility Name : _____


	Vehicle/Plant	Rego/ID No	Sticker number Added	Sticker number Removed	Authorised officer's Name and Signature



Attachment D – Weed Management Plans

Attachment E – Pest Animal Profiles

Declared Species

<p>Species Name: <i>Canis lupus / Canis familiaris (Dingo / Wild dog)</i></p> <p>Status: Class 2 pest (LP Act)</p> <p>Description: The dominant coat colours are red, ginger and sandy-yellow, although they can also be pure white, black and tan or solid black. Dingoes have a more heavily boned skull and larger teeth (especially the canine) than domestic dogs of similar size. They are naturally lean with large ears pricked, a white tip on the tail and white socks (DPIF 2007a). Adults can reach up to 60cm in height, with females weighing approximately 12kg and males 15kg (DPIF 2007a) Wild dogs refers collectively to dingoes, hybrid dingoes and domestic dogs that have escaped or been deliberately released</p> <p>Distribution: Although thought to have arrived between 3,500-4000 years ago, it is not part of the ancestral fauna of Australia (DPIF 2007a)</p>	<p>Source: (EPA 2007a)</p> 
<p>Dingoes/wild dogs are present in all parts of Queensland however the distribution of the wild dog in relation to purebred dingoes varies</p> <p>Impact: Dingoes/wild dogs can carry diseases such as distemper and parvovirus. Their majority of their diet consists of native species such as kangaroos, wallabies, rabbits and possums (DPIF 2007a). However, wild dogs can kill, harass or maim livestock and other native fauna</p> <p>Management Requirements: The operational objectives for the management of wild dogs include reducing their numbers throughout the Project Area</p> <p>Monitoring Process: Report any dingo/wild dog sightings in the weekly Environmental Report</p> <p>Control Actions: Fauna exclusion fencing to be utilised where necessary. If required, recommended active control methods include baiting, trapping and ground shooting</p>	

Species Name: *Felis catus* (Feral cat)

Status: Class 2 pest (LP Act)

Description: A feral cat is one that is not fed and kept by someone. The word 'kept' specifically means that is cat is housed in a domestic situation

The feral cat differs little in appearance from its domestic counterpart, however when in good condition is displays overall muscle development, particularly noticeable around the head, neck and shoulders (DPIF 2007d)

Feral cats are predominantly short-haired with coat colour range including ginger, tabby, tortoiseshell, grey and black. Males weigh between 3-6 kg and females 2-4 kg depending on condition. Feral cats are most active at night, with peak hunting activity occurring soon after sunset and in the early hours before sunrise (DPIF 2007d). During the day it will rest in any number of den sites including hollow logs, dense clumps of grass, piles of debris, rabbit burrows and hollow limbs of standing trees (DPIF 2007d)

Source: (DPIF 2008b, Invasive Animals CRC 2007b)



Distribution: The feral cat is now present Australia-wide in a variety of habitats

Impact: Feral cats are opportunistic predators of small mammals, birds, reptiles, amphibians, insects and fish (DPIF 2007d). They can be particularly harmful in island situations and have caused the extinction of a number of species. Feral cats also compete for prey with native predatory species such as quolls, eagles, hawks and reptiles

Feral cats may contain a parasite (toxoplasmosis) that can be particularly harmful to marsupials, causing blindness, respiratory disorders, paralysis and loss of offspring (DPIF 2007d)

Management Requirements: The operational objective for the management of feral cats is to reduce their numbers throughout the Project Area.

Monitoring: Reporting all cat sightings in the weekly Environmental Report

Control Actions: Fauna exclusion fencing to be utilised where necessary. If required, recommended active control methods include trapping and ground shooting

Species Name: *Vulpes vulpes* (European red fox)

Status: Class 2 pest (LP Act)

Description: Foxes have pointed muzzles, a flattened and slender skull, large ears and long bushy tails (DPIF 2007c). Adult males weigh approximately 6kg and females approximately 5 kg
 Foxes are usually active at night and rest during the day in an earth den, thicket, hollow log or stick-rake pile. However, in winter when less food is available, foxes may hunt and scavenge during the day
 Distribution: The most common and widespread of the world's fox species, the European red fox has adapted to a variety of habitats ranging from deserts to urban environments. However, they are not found in tropical areas of Australia (DPIF 2007c). Competition with dingoes, climatic preferences and food supply are thought to determine their distribution (DPIF 2007c)

Impact: Foxes are considered to be the greatest threat to the long-term survival of many small mammal species in Australia and play a major role in the decline of ground-nesting birds, critical weight mammals and reptiles such as the green turtle (DPIF 2007c). The European red fox is also thought to have caused a severe reduction in populations of many other threatened species throughout Australia

Source: (EPA 2008 and Invasive Animals CRC 2007a)



Management Requirements: The operational objective for the management of European foxes is to reduce their numbers throughout the Project Area

Monitoring: Report all fox sightings in the weekly Environmental Report

Control Actions: Fauna exclusion fencing to be utilised where necessary. If required, recommended active control methods include baiting, trapping, ground shooting and den fumigation

Species Name: *Sus scrofa* (Feral pig)

Status: Class 2 pest (LP Act)

Description: Feral pigs are predominantly black, buff-coloured or spotted black and white, while juveniles can be striped. Mature boars have a large head and shoulders and a raised and prominent back bone which slopes steeply down to small hams and short hind legs (DPIF 2007e)

Feral pigs are smaller, leaner and more muscular than domestic pigs, with well-developed shoulders and neck and smaller, shorter hindquarters (2007e). Feral pigs have sparser, longer and coarser hair than domestic pigs and have longer, larger snouts and tusks, straight tails, smaller mostly pricked ears and narrower backs (DPIF 2007e)

Feral pigs are generally nocturnal, spending daylight hours sheltered in dense cover. They are shy animals and will avoid human contact

Distribution: Feral pigs inhabit approximately 40% of Australia and are found in all habitat types in Queensland (DPIF 2007e).

Estimations of numbers range up to 24 million with the greatest concentrations of feral pigs found in the larger drainage basins and swamp areas of the coast and inland (DPIF 2007e)

Impact: Feral pigs impact the environment through predation on native animal species, consumption of native flora and damage to watercourses and wetlands. They can also carry many infectious diseases and internal and external parasites. Many of these diseases can spread to humans and livestock (DPIF 2007e)

Source: (DPIF 2008c, EPA 2006, IACRC 2007)



Management Requirements: The operational objective for the management of feral pigs is to reduce their numbers throughout the Project Area

Monitoring: Report all pig sightings in the weekly Environmental Report

Control Actions: Fauna exclusion fencing to be utilised where necessary. If required, recommended active control methods include trapping, baiting and ground shooting

Species Name: *Bufo marinus* (Cane toad)

Status: The cane toad is not a declared pest in Queensland and such there is no legal requirement to control them

Description: In comparison with the native frog and toad species, adult cane toads have a distinctive head and face and are large, heavily built creatures (DPIF 2007f). A high angular bony ridge extends from the eyes to the nose (DPIF 2007f). Adult cane toads have large glands that carry toxin on the shoulder behind the tympanum (ear opening) (DPIF 2007f). The hands and feet are relatively small and lack webbing between the fingers but is present between the toes (DPIF 2007f). In comparison to native frogs, cane toads assume an upright, rigid posture

Colouring of cane toads on the upper surface may be brown, olive-brown or reddish-brown with the underneath surface varying from white to yellow with mottled brown (DPIF 2007f). The surface of the skin is warty (DPIF 2007f)

Distribution: Cane toads currently inhabit at least four of the mainland Australian states including Queensland and generally occur wherever there is water (DPIF 2007f)

Source: (DPIF 2008d)



Impact: Cane toads produce highly toxic venom from glands in its skin that can cause death if ingested by domestic and most native animals. The Cane toad consumes a wide variety of insects, frogs, small reptiles, mammals and birds. They also compete with native frogs for breeding habitat (DPIF 2007f)

Management Requirements: It is recommended that Cane toads be managed in order to reduce their abundance across the Project Area, particularly where water and native frogs are found

Control Actions: Fencing is recommended to keep toads out of ponds intended for native fish and frogs, with a height of 50 cm being sufficient (DPIF 2007f). Freezing is considered a humane form of disposal, as a reaction to the cold causes the animal to initiate dormancy and dies while senseless (DPIF 2007f)

Monitoring Process: Report all sightings and relative abundance in the weekly Environmental Report

Species Name: *Oryctolagus cuniculus* (European rabbit)

Status: Class 2 pest (LP Act)

Description: They are usually grey-brown with a pale belly, black or ginger can also be common, with long hind legs, short front legs, long ears and large eyes (DPIF 2007b). Rabbits usually weigh between 1.3-2.3 kg

Distribution: Rabbits occur across Australia and have spread throughout Queensland with the largest populations found in the granite belt, south-western Darling Downs, Maranoa, southern Warrego and the far south-west (DPIF 2007b). Moderate populations are located in the north-western Darling Downs and North Burnett and low populations in the remainder of the state (DPIF 2007b)

Impact: Rabbits compete with native wildlife for food and shelter and increase the exposure of native wildlife to the dangers of predators such as cats and foxes (DPIF 2007b). Rabbits are implicated in the local extinction of some native species, as well as many native species, such as the Bilby (now threatened)

Source: (DPIF 2008a)



Management Requirements: The operational objectives for the management of rabbits include reducing their numbers throughout the Project Area

Monitoring: Report all rabbit sightings in the weekly Environmental Report

Control Actions: Fauna exclusion fencing to be utilised where necessary. If required, recommended active control methods include baiting, trapping, ground shooting, warren destruction and/or fumigation and biological control

Appendix C
Stormwater Management and Erosion and
Sediment Control Plan (SMESCP)

CONCEPT STORMWATER MANAGEMENT &
EROSION AND SEDIMENT CONTROL PLAN
Marine Crossing – Gas Transmission Pipeline



CLIENT:
GLNG Operations P/L

STATUS:
FINAL

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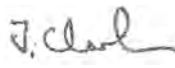
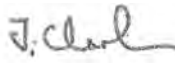
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-	Draft	Steve Dudgeon (CPESC # 4398 & CPSS # 1879) and Steven Chamberlain (CPESC # 6599)	Terry Clark (CPESC # 6089)			9/05/2012
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1. Introduction

O2 was commissioned by Downes Group on behalf of GLNG Operations P/L (herein the Client) to prepare a Storm Water Management Plan (SWMP) and concept Erosion and Sediment Control Plan (ESCP) for the proposed works associated with the Gas Transmission Pipeline Marine Crossing construction.

The area of interest is located approximately 16km north of Gladstone. The location is commonly called the 'Marine Crossing section'.

This plan was developed generally in accordance with the *International Erosion Control Association, Best Practice Erosion and Sediment Control Guideline* (IECA, 2008). The ESCP describes physical controls and processes, that if applied are expected to result in general compliance with the objectives and targets nominated in **Section 1.2**. Should the controls indicated in this document not achieve the identified performance criteria for any reason, it is the responsibility of the earthworks contractor to notify the ESC specialist so that a revision of the ESCP can be undertaken.

Some limitations to strict compliance with IECA (2008) occurred due to limited timeframes and data including;

- Limited soil sampling

1.1. Environmental Approvals and Legislative Requirements

This SWMP and ESCP is provided to meet the Department of Environment and Resource Management (DERM) Request for Further Information (PPL167/PEN103428811 Sections 5.2, 8.2 and 8.4, dated 1st December 2011) and EPBC Approval (2008/4096 Condition 37 (c, d and e)) for Mainland GTP (Excluding Narrows), dated 22nd October 2010.

1.2. Purpose of Plan

GLNG have indicated that this Concept Stormwater and Erosion and Sediment Control Plan been produced as site specific, but still a general scheme arrangement for the purpose of obtaining approvals (e.g. the Environmental Authority and the EPBC). This plan is not approved for construction.

Prior to the commencement of works, a subsequent version of the Stormwater and Erosion and Sediment Control Plan will be produced for construction by the contractor, Saipem.

An Operational Works application for Tidal Works will detail ESC at the tidal creek crossings.



1.3. Objectives and Targets

This Erosion and Sediment Control plan has been developed in accordance with the following guidelines:

- Best Practice Erosion and Sediment Control (IECA, 2008)
- State Planning Policy for Healthy Waters (DERM, 2010)
- Queensland Water Quality Guidelines (DERM, 2009)

The objective of this ESCP is to minimise erosion and sediment discharge and impacts on the environmental values of receiving waters during the construction period.

The following targets, if achieved are expected to achieve the abovementioned objective.

Coarse Sediment (>0.02mm)	Retain all coarse sediment on site
Fine sediment (<0.02mm)	Drain all disturbed areas on the site to sediment basins. Size and operate sediment basins so that all water from the site is captured and treated to achieve 50mg/L (estimated by 75NTU) in rainfall events up to the design event (80%ile, 5 day event). In storms greater than the design event take all other reasonable and practicable measures to minimise erosion and sediment discharge.
pH	Size and operate sediment basins so that all water from the site is captured and treated to achieve a pH in the range of 6.5 – 8.5.

1.4. Proposed works

The summary of relevant works below is based on information provided by GLNG Operations Pty Ltd in a File Note titled 'Preliminary Narrows Crossing Information for Environmental Studies (Ref: 3301-GLNG-3-4-3.3-0004).

The GLNG GTP will transport CSG year-round from the existing and future fields in the Roma, Fairview and Arcadia Valley areas. The pipeline system is comprised of a 42-inch (1.07 m) GTP and associated infrastructure and a telecommunications FOC which will be buried and covered by at least 750 mm of soil.

The eastern end of the GLNG pipeline crosses from the mainland to Curtis Island across a channel of tidal sea water. The section of pipe that crosses the channel is referred to as the "Marine Crossing". The marine crossing is divided into three sections, the two so called "open cut" sections on either side and the tunnel section between them. The mainland open cut section is approximately 2.7 km long, the tunnel crossing approximately 4.5 km long and the open cut section on Curtis Island approximately 1 km long.

The areas included in this ESCP:

- Access track - The travelled width of the access track on a straight will be 7 m (3.5 m per lane). The travelled width of the access track on a curve will be increased from 7 m to account for overhang of vehicles at the corner. The total length will be 1.85 km long and width of the track ROW is 25 m. Total area of disturbance is 4.6 ha.
- Site pads – 7.5 ha (launch pad) and 2.25 ha (receptor pad)
- ROW for pipeline on the mainland – The pipeline will be buried and covered by at least 750 mm of soil, along the specified open cut trenched sections of the pipeline the area of disturbance is 8.1 ha (30m wide x 2.7km)
- ROW for pipeline on the Island – The area of disturbance on the Island is 3 ha (30m wide x 1km).

The approximate combined area of disturbance is **25.5** ha.

The construction program timeline is provided below in **Figure 1**. The site layout plan provided by client is shown below in **Figure 2**, with layout details of the launch and receptor pads provided in **Figure 3** and **Figure 4** respectively.

This report provides ESC planning, design and implementation guidance relevant to construction activities associated with the site. At the time of finalising the ESCP cut and fill plans had not been provided therefore the plan currently only represents clear and grub stage and further plans may need to be provided for subsequent stages.

1.4.1. Open-cut trenched section construction methodology summary

Construction works for the open-cut trench sections will be carried out as an extension of Mainland / Curtis Island GTP Right of Way and will be carried out in accordance with the requirements of AS 2885 Pipelines – Gas and Liquid Petroleum, the Australian Pipeline Industry Association Code of the Environmental Practice (2009) and GLNG Project Specifications.

Works will progress applying the conventional pipeline construction phases working in sequence. The following are the main pipeline construction phases:

- a. Site Survey
- b. Clearing
- c. Grading and Right of Way (RoW) preparation
- d. Stringing Pipe
- e. Pipe Bending

- f. Welding
- g. NDT (non-destructive testing)
- h. Field Joint Coating
- i. Trenching
- j. Lowering
- k. Tie-ins
- l. Padding/Backfilling
- m. Cable installation
- n. Cathodic Protection
- o. Clean-up and Reinstatement
- p. Hydrotest & Precommissioning

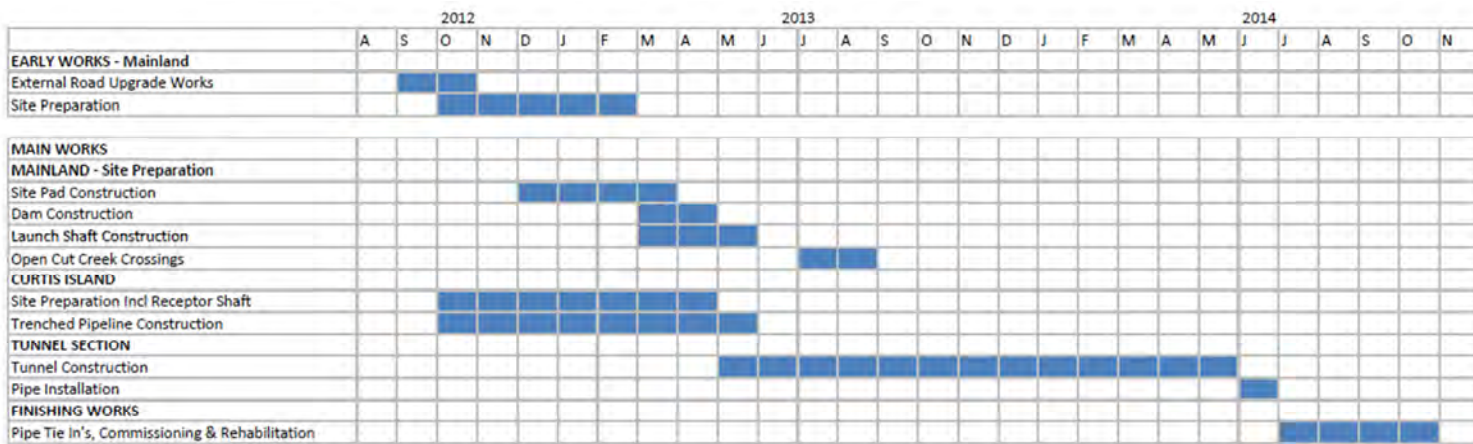


Figure 1: GLNG GTP Marine Crossing Construction Program

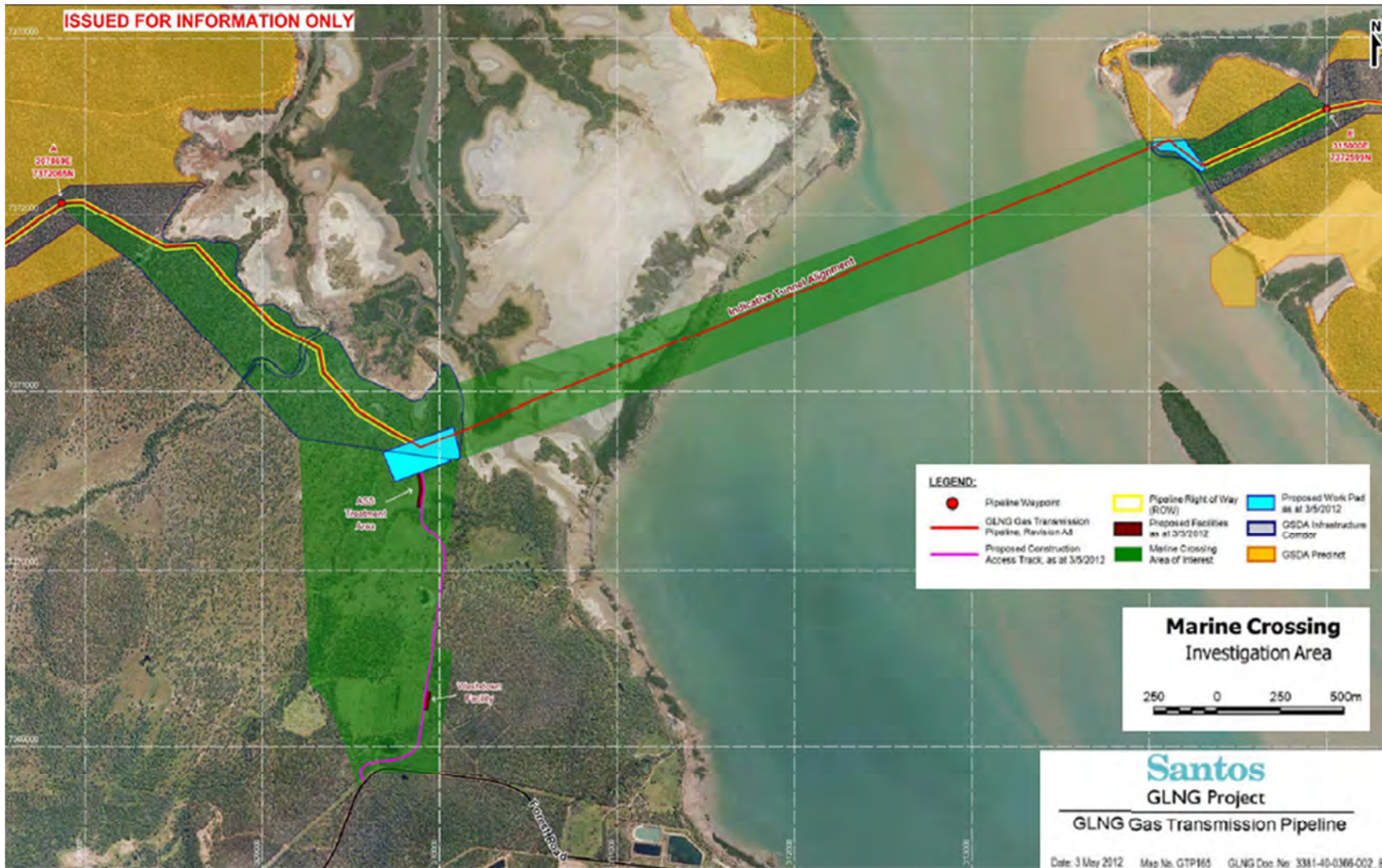


Figure 2: Site Layout Plan (3 May 2012)

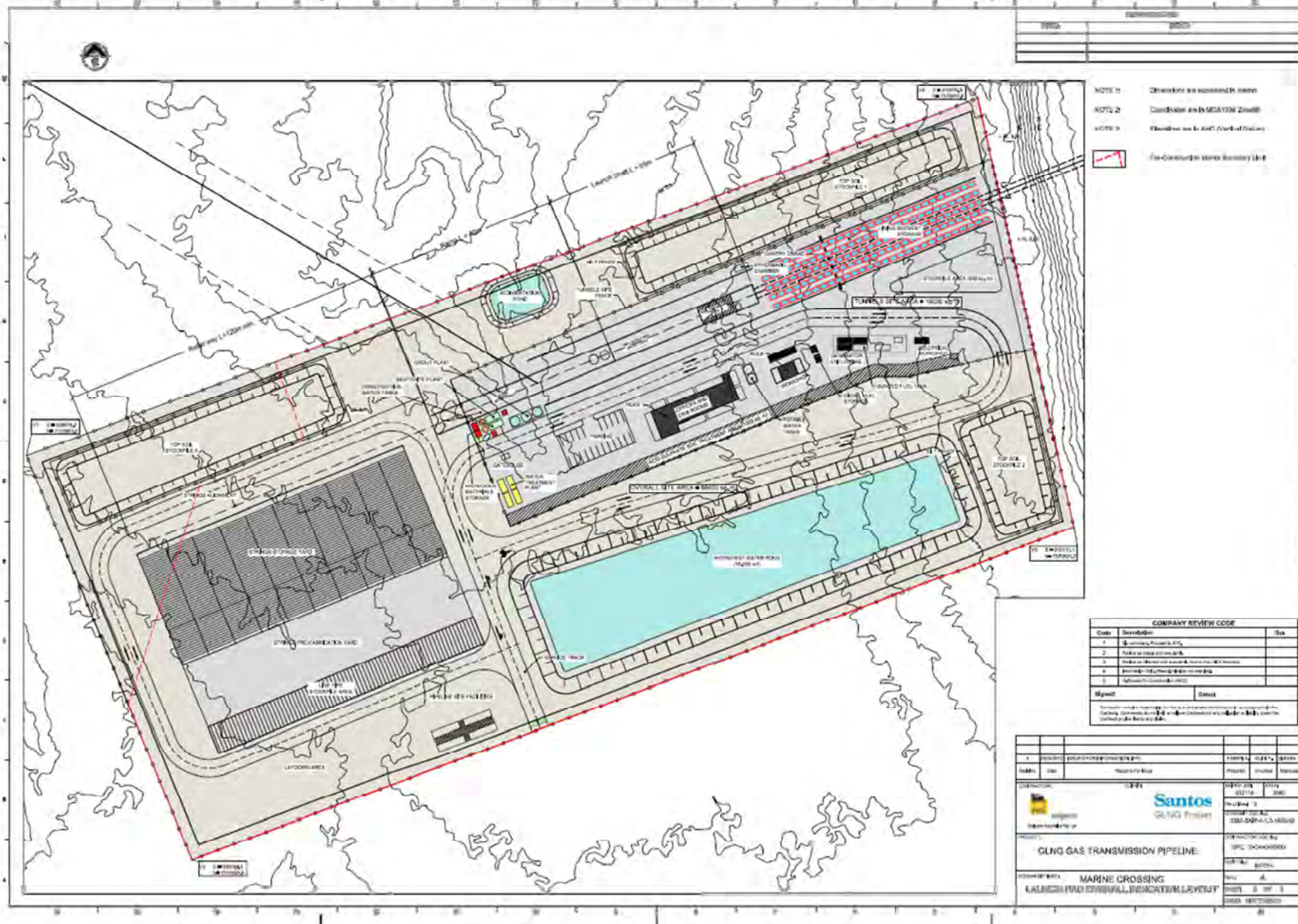


Figure 3: Launch pad infrastructure drawing

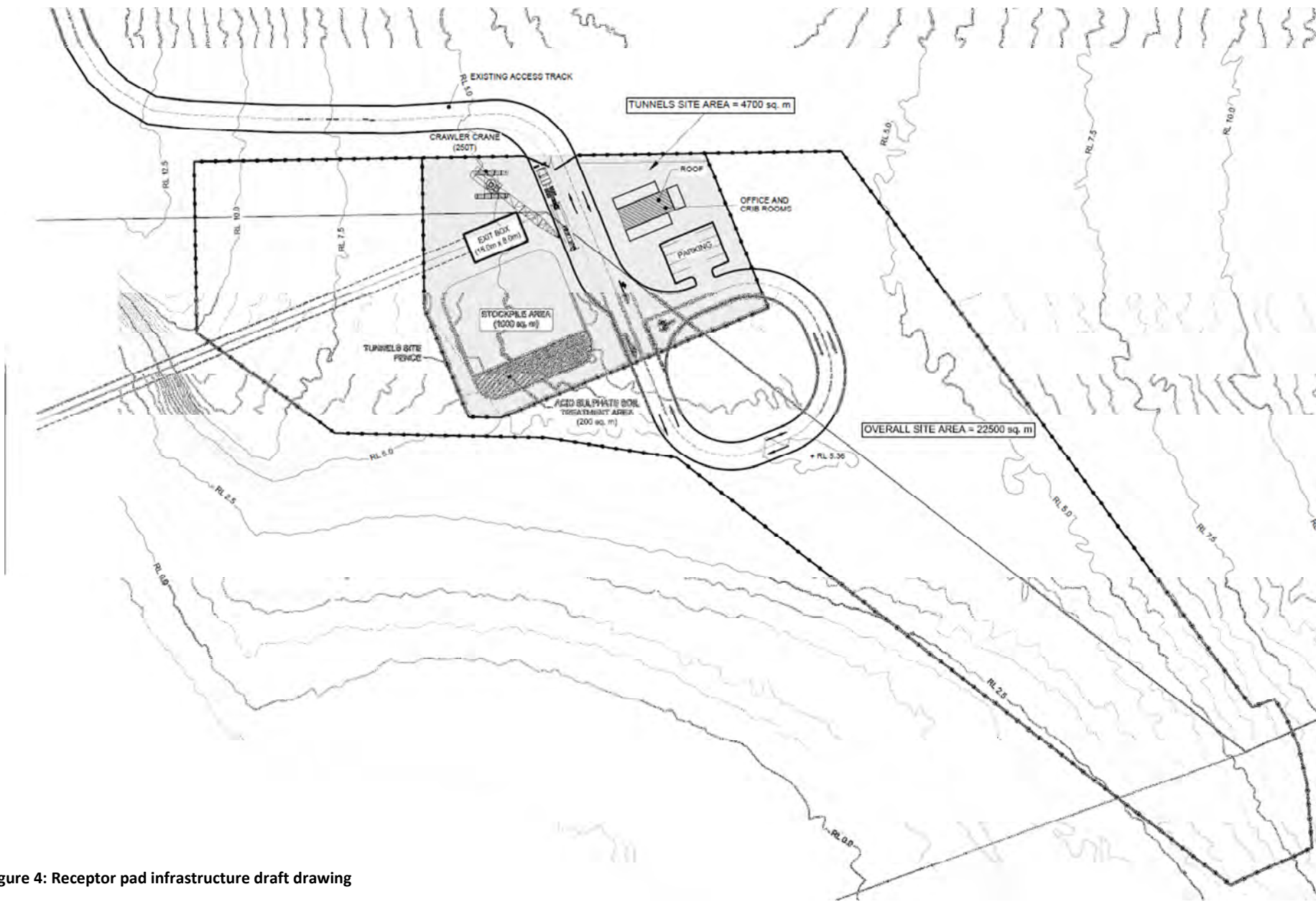


Figure 4: Receptor pad infrastructure draft drawing

2. Existing Site Description

2.1. Inspection

The site was inspected by 2 Certified Professionals in Erosion and Sediment Control (CPESC) from O2 Environmental + Engineering on the 4th and 13th of April 2012. Most areas were able to be accessed with the exception of the pipeline and associated ROW from the launch pad to Humpy Creek (marked in yellow dotted line). **Figure 5** displays all photo points and sites inspected (red dots).

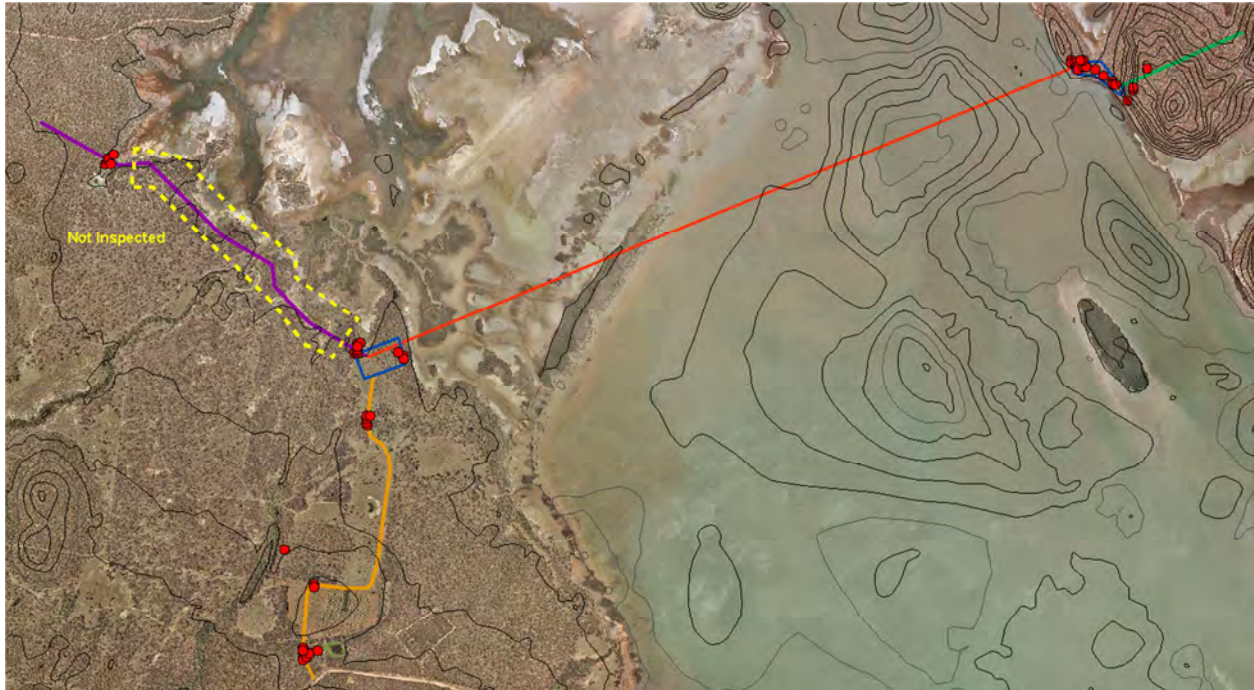


Figure 5: Photo and inspection points

2.2. Environmental aquatic values

2.2.1. Site Drainage

Downes Group provided a report 'Site Value Assessment and Water Mouse Habitat Assessment Report (2012)'. The following information is an extract from their findings in regard to aquatic values.

The site has four constructed waterholes / dams which are all very stable and mostly well vegetated with a range of macrophytes and aquatic plants (native and exotic).

Areas from the access gate and southern parts of the "orchard" appear to drain towards a drainage line (shown on track log as point WC1). This drainage line was flowing at the time of inspection following significant rainfall in the week prior to the site visit. This drainage line flows into the southern dam.

The second dam will be bypassed (in fairly close proximity) by the proposed access track with no impacts anticipated. This area is open and relatively flat with good opportunities to manage surface erosion and stormwater impacts.

The third larger central dam capture runoff from areas from within and to the south of the proposed pad and is a large and well established landscape feature. Drainage patterns for the pad area appear to flow mostly from the east either north to the small *Baumea articulata* and *Eleocharis* packed waterhole, or south to the large third central dam. Areas draining to the southern dam are presently wet on the site with numerous sedges and wetland plants interspersed with grazing grasses.

Water birds and ducks were observed in all dams and an active and inquisitive population of Double Barred Finches (*Taeniopygia bichenovi*) observed in the northern *Baumea* dam. The northern dam is unique in that it remains freshwater despite the estuarine influence observable in lower lying areas around the landscape feature to the east and north.

2.2.2. Launch Pad

The existing proposed location of the pad is well positioned avoiding both drainage features (dams) to the north and south, and positioned such that the seaward edge of the clearing is perched on the top of the existing natural ridgeline. Due to the topography and possibly soil type there is minimal intertidal zone with the open forest dropping immediately into tidal mudflats. A mangrove community is located approximately 50m from the edge of the mudflats

2.3. Topography

The inflow pipeline generally runs north west to south east over low undulating land, perpendicular to the catchments alignment and crosses Humpy and Targinie Creek tributaries and minor gullies. Site levels vary from approximately RL 9m AHD to the north to RL 2m AHD to the south.

The launch pad drains inland North West to a dam from elevation 8m AHD to 4 m AHD with an average slope of 1.54%.

The access track generally slopes north to the launch pad from approximately 18m AHD to 6m AHD. Slopes are generally low and vary from approx. <1% over the initial 450m of the track, to 2% over a small hill and the majority of the site over low lying land with a slope of 0.2%. The track crosses 2 minor gullies.

Curtis Island receptor pad generally drains to the low point in the centre of the site from 12m AHD to 3m AHD. The site is steepest to the south east and north west with slopes of approximately 9% and 6% respectively.

The pipeline exits the site pad at an elevation of 7m AHD and climbs steeply eastward to the upper slope of the north side of the hill at an elevation of 4.8m AHD then traverses steeply down the northern other side of the hill to a valley floor of elevation 8m AHD. The ROW will drain north for most of the length. Average slopes are approximately 12% on the western side of the hill and up to 25% on the eastern side.

2.4. Hydrology and Hydrologic Modeling

The XP-SWMM runoff-routing model been has used to estimate design flow rates within the site. The model represents the sub-catchments as a network of nodes linked to a 1D open channel drainage network. Each node is defined by its pervious (undeveloped) and impervious (developed), fraction impervious and average catchment slope. The net rainfall is routed through the network after appropriate losses (initial and continuing) and roughness factors are applied, resulting in a surface runoff hydrograph for each sub-catchment. The XP-SWMM model was used to estimate the 1, 2, 5, 20, and 100 year ARI discharges.

2.4.1. Hydrologic Routing

Hydrologic modelling has been undertaken using the Laurenson Runoff Routing Method. The Laurenson method requires the catchment to be divided into a pervious and an impervious portion. A fraction impervious of 0% has been applied to the pervious portion and 100% to the impervious portion.

2.4.2. Catchment Delineation and Fraction Impervious

The catchments contributing runoff into the pipeline corridor have been divided into 8 catchments to represent the portions of the study area that flow to each proposed culvert crossing. As a conservative approach, a fraction impervious of 5% has been assumed for each catchment to account for any existing roadways and compacted areas. A copy of the catchment plan is included as **Figure 6**.

2.4.3. Manning's Roughness

Manning's n values have been applied to represent the pervious and impervious portions of the catchment. The following values have been applied:

- Pervious portion n = 0.035; and
- Impervious portion n = 0.014.

2.4.4. Rainfall Losses

Initial Loss (IL) and Continuing Losses (CL) have been applied to the modelling, and again these values have been varied for the impervious (developed) and pervious (undeveloped) portions of the catchment. The following loss rates have been applied:

- Impervious catchment IL = 1mm CL = 0mm/hr;
- Pervious catchment IL = 10mm CL = 2mm/hr

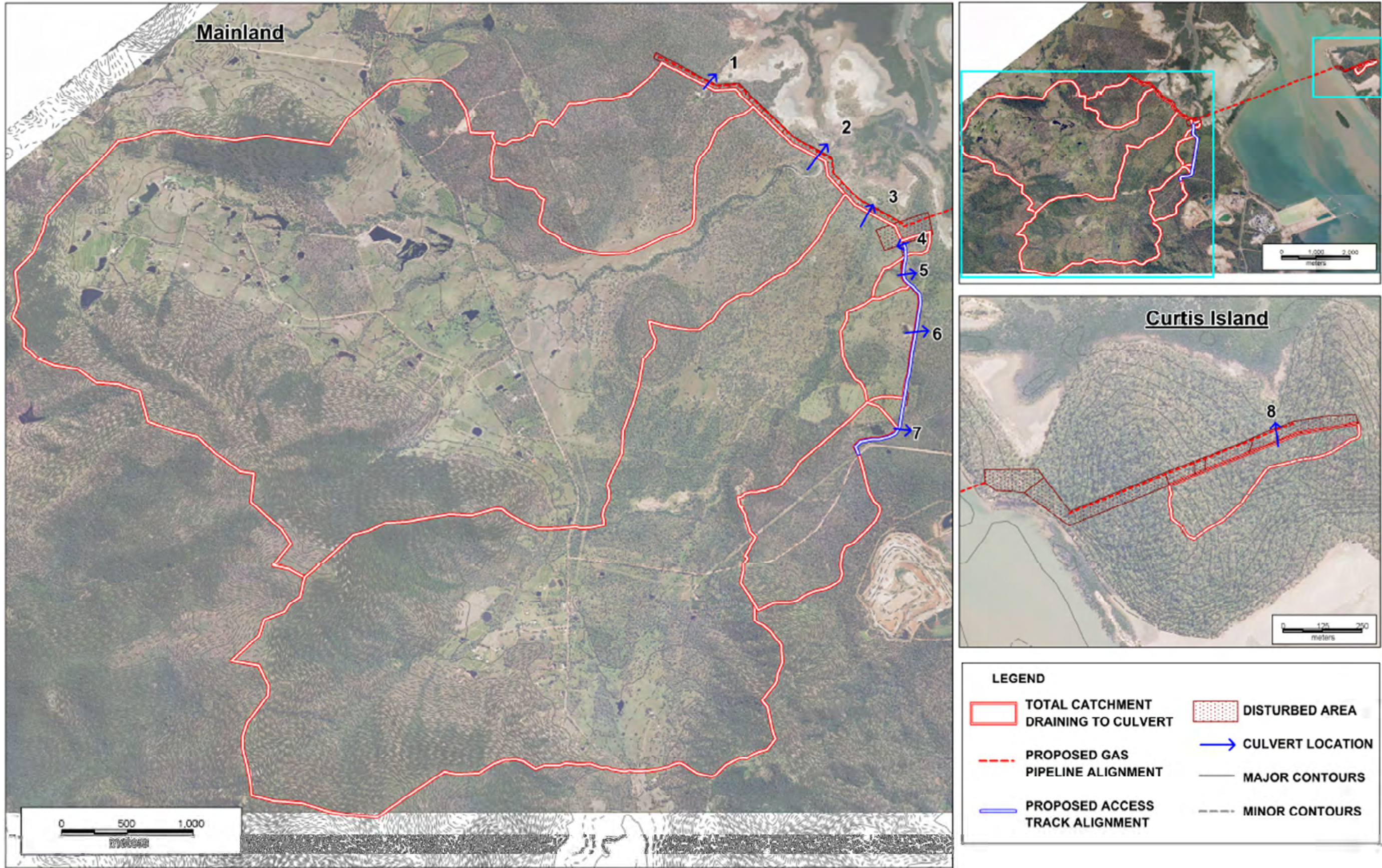


Figure 6: Site catchments

2.4.5. Peak Flow Rate

The hydrologic model has been simulated for a range of storm durations ranging from 15 minutes to 720 minutes. Results of the assessment indicate the 60 minute storm is the critical storm duration for the catchment and produces the peak flow rates for the areas under consideration. A summary of the peak flow rate for the areas of interest are contained in **Table 1**.

Table 1: Peak Flow Rate for Pipeline and Access Track Crossings

Location	Total Catchment Area (ha)	Peak Flow Rate (m ³ /s)				
		1 year ARI	2 year ARI	5 year ARI	20 year ARI	100 year ARI
1	173.9	4.88	6.89	9.62	15.37	20.97
2	1,415	29.36	41.25	57.10	90.50	123.44
3	1,109	35.68	50.41	69.39	112.41	150.11
4	2.25	0.10	0.27	0.38	0.55	0.84
5	5.0	0.29	0.44	0.65	1.11	1.44
6	25.7	1.68	2.36	3.90	6.67	9.21
7	104.7	4.23	6.48	9.07	13.11	19.93
8	7.6	0.46	0.74	1.51	2.25	3.22

2.4.6. Soils

The most detailed soil map available for the study area is that of Isbell and Hubble (1964) which was compiled on field sheets at 1:250,000 scale and published at 1:1,000,000 scale as a contribution to an Australia-wide soil mapping program undertaken by CSIRO Division of Soils. The information was incorporated into part of Sheet 4, which was one of the ten sheets comprising the 'Atlas of Australian Soils' (Northcote et al. 1960–68) and published at 1:2,000,000 scale (20 km to 1 cm). This is the only soil map that provides consistent information about the soils of the whole of Australia.

A digital version of the maps of the 'Atlas of Australian Soils' was created by the Bureau of Rural Science from scanned tracings of the published hardcopies (<http://www.asris.csiro.au/themes/Atlas.html>).

Soil sampling was limited to general reconnaissance and shallow holes dug with a hand trowel.

Three soils samples of ESC suites were taken within the major soil mapping units and representing the dominant land units (**Figure 7**).

Figure 7 shows the soil mapping units for the area of investigation and soil sample sites. The soil mapping displays two (2) soil units' Tb97 and J5.

No geotechnical results or reports were available for the relevant area of interest.

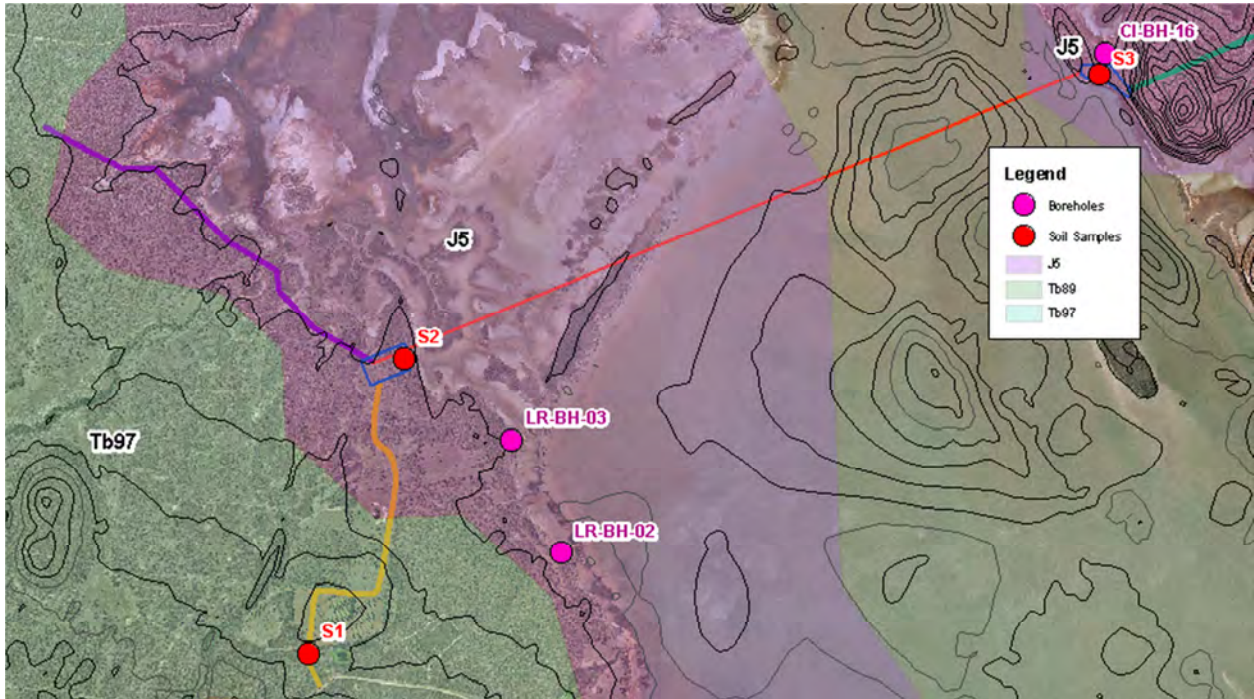


Figure 7: Soil units, soil sample sites and local boreholes

2.4.7. Soil mapping unit Tb97

Found on low rounded hills on metasediments and granites with slopes of not more than 6 degrees. Chief soils are hard acidic yellow mottled soils (Dy3.41) on the slopes with shallow (Um6.43) soils on some crests. Associated are (Dy2.21), (Dy2.11), and (Dy2.41) soils on granitic slopes with (Uc1.21 and Uc1.22) soils on sandy accumulations in some lower slope positions. Small areas of (Gn3.13) and (Uf6.31) soils are found on basic rocks.

The Dy refers to Duplex yellow-grey Clayey Subsoils. The soil type have surface textures ranging from sandy to clay loam, overlying yellow-grey coloured subsoils of significantly higher clay content, commonly light to heavy.

The 3.41 number indicate that:

- (3) A horizon is hard setting and the B horizon is mottled and soil is hard setting
- (.4) A2 horizon is present and conspicuously bleached
- (.41) Acid Soil Reaction Trend.

Figure 8 from soil sample site 1 shows the conspicuously bleached A2 horizon.

Some areas of potential Um6.43 within the vicinity of the hill and access track were likely to be present based on the red colour of the exposed soil (Figure 9). These soils are loamy or clay loam throughout.

One shallow hole to 300mm was dug on the launch pad site. The soil is potentially a Uniform Course (Uc) soil. These soils are sandy throughout having textures of sand, loamy sand, clayey sand and fine sandy loam.



Figure 8: Sample site 1 displaying a potential Dy3.41 soil type



Figure 9: Potential Um6.43 soil type

2.4.8. Soil mapping unit J5

Found in tidal mangrove mud flats and salt pans flanking tidal inlets and local creeks. Chief soils are shallow saline clays (Uf) over strongly gleyed (Um2.23) soils. Associated are (Gn1.83), and (Dd1.13) and similar (D) soils in marginal areas.

2.4.9. Lab results and amelioration recommendations

Lab results are summarized in **Table 2** below. Samples were not taken of subsoils on the launch pad or receptor pad due to limited soil sampling equipment and no cut and fill plans being available to provide guidance to sample location and depth. Detailed lab results are provided in **Appendix D**.

Table 2: Lab recommendations

Sample	Recommendations
S1 – Subsoil	<p>This soil sample was analysed for properties related to healthy plant growth. It was found to be slightly acidic, not saline and not sodic. The cation balance is highly magnesian. The effective cation exchange capacity (eCEC) is low, indicating poor nutrient retention and holding capacity.</p> <p>This sample is a light clay with low permeability. Combined with the magnicity, it may be prone to dispersion. Magnesium is elevated and may lead to an induced potassium deficiency. To buffer against deficiencies, incorporate potassium chloride at 20 g/sqm and gypsum at 200 g/sqm. The gypsum will help to raise the low calcium levels. These additions will further help to improve permeability and negate any tendency to disperse.</p> <p>The soils had an Emerson Aggregate Test result of 3.2.</p>
S2 Topsoil	<p>This soil sample was analysed for properties related to healthy plant growth. It was found to be moderately acidic, not saline and not sodic. The cation balance is dominated by hydrogen, leading to the strong acidity. The effective cation exchange capacity (eCEC) is very low, indicating poor nutrient retention and holding capacity (as expected of sandy soils).</p> <p>This sample is a highly permeable loamy sand. Of the plant available nutrients analysed, all were deficient. N in particular will prove limiting at these low levels. Split applications of urea at 20 g/m² (i.e. 2 x 20 g/sqm applications) will improve the nitrate levels.</p> <p>To improve levels of other nutrients, apply a multipurpose low P NPK fertiliser such as “native plant food”. This product should be applied at 15 - 25 g/sqm. Current phosphate levels will not be harmful to P-sensitive plantings. Incorporating lime at 200 g/sqm will help to raise the pH and increase nutrient availability. Incorporating composted organic matter at 20% by volume will assist in improving the water holding capacity and CEC of the soil.</p>
S2 Subsoil	<p>This soil sample was analysed for properties related to healthy plant growth. It was found to be strongly acidic, not saline and not sodic. The cation balance is dominated by hydrogen, leading to the strong acidity. The high acidity has increased the availability of aluminium, which is at levels likely to result in plant toxicities. The effective cation exchange capacity (eCEC) is very low, indicating poor nutrient retention and holding capacity. This is normal for sandy soils. This sample is a highly permeable loamy sand. Calcium and magnesium are both deficient, and can be improved through additions of</p>

Sample	Recommendations
	<p>lime at 150 g/sqm. This will help to raise the pH and increase the availability of many nutrients. Raising the pH will reduce the risk of aluminium toxicity.</p> <p>The soils had a Emerson Aggregate Test result of 3.2</p>
S3 Topsoil	<p>This soil sample was analysed for properties related to healthy plant growth. It was found to be moderately acidic, not saline and not sodic. The cation balance is highly magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity.</p> <p>This sample is a highly permeable loamy sand. Of the plant available nutrients analysed, all except magnesium were deficient. N in particular will prove limiting at these low levels. Use split applications of urea at 20 g/m² (i.e. 2 x 20 g/sqm applications) to improve the nitrate levels.</p> <p>Magnesium is elevated and may lead to an induced potassium deficiency. Incorporate composted organic matter at 20% by volume and gypsum at 200 g/sqm to raise the low calcium levels and improve the water holding capacity of the soil. These additions will further help to improve permeability and negate any tendency to disperse.</p> <p>To improve nutrient levels, apply a multipurpose low P NPK fertiliser such as “native plant food”. This product should be applied at 15 - 25 g/sqm. Current phosphate levels will not be harmful to P-sensitive plantings. Incorporating lime at 200 g/sqm will help to raise the pH and increase nutrient availability.</p>

3. Erosion Risk Assessment

Erosion risk assessment provides an indicator tool to determine the sediment control and erosion control standards that should be applied to a project.

3.1. Methodology

A quantitative erosion risk assessment for the site has been conducted using the Revised Universal Soil Loss Equation (RUSLE) **Equation 1**. RUSLE aims to predict the potential long term average soil loss rate from a given site based on the following parameters.

$$A = K \times R \times LS \times P \times C$$

Equation 1 (IECA 2008)

Where:

- A is the predicted soil loss per hectare per year
- K is the soil erodibility factor (0.058 – Refer to Section 3.1.1)
- R is the rainfall erosivity factor (4421 – Refer to Section 3.1.3)
- LS is the slope length/gradient factor (varies)
- P is the erosion control practice factor (1.3)
- C is the ground cover and management factor (1)

Application of the RUSLE is based on site and soil characteristics determined by others.

3.1.1. Soil Erodibility

The soil erodibility factor (K factor) is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. Soil texture is the principle component affecting the K factor, but soil structure, organic matter and profile permeability also contribute.

Due to limited soil sampling a conservative K factor was estimated by using the default value in Table E5 of IECA (2008) and increasing by 20% to allow for potential dispersiveness. The K factor estimated was to be **0.058**.

3.1.2. Steepness

Slope length and slope gradient have substantial effects of soil erosion by water. The two effects are represented by the slope length factor (L) and the slope steepness factor (S). In application of RUSLE the two are evaluated together as a numerical representation of the length-slope combination (LS factor).

3.1.3. Rainfall Erosivity

The rainfall erosivity factor (R factor), is a measure of the ability of rainfall to cause erosion. It is the product of two components (1) total energy and (2) intensity for each rainfall event. R factors are published for some locations throughout Queensland, however interpolation of published results is considered inappropriate for the subject area, given the geographical differences between the closest published locations (i.e. Rockhampton and Bundaberg). As a result a localised R factor was determined. This value is constant over the length of the alignment, unlike the K and LS factors which are variable.

An annual erosivity factor was calculated using the following equation (Rosewell & Turner, 1992):

$$R = 164.74 (1.1177)^S S^{0.6444}$$

Where, S is the 2-year ARI, 6-hour ARI rainfall event (mm)

Design rainfall events for the project area have been produced from the BOM Rainfall IFD system (<http://www.bom.gov.au/hydro/has/cdirswebx/cdirswebx.shtml>) with results presented below in **Figure 10**.

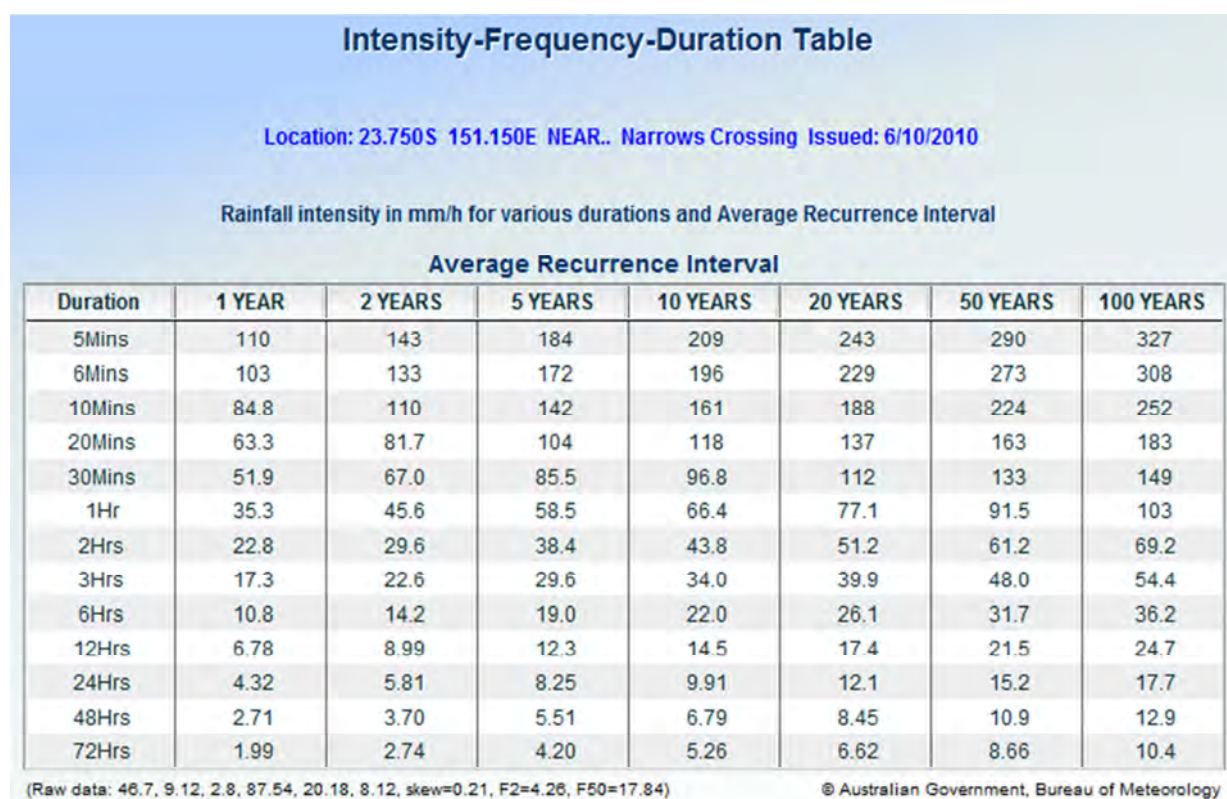


Figure 10: Design Rainfall Events for the Marine Crossing Section Pipeline Alignment

Based on the above 2 year ARI, 6 hour rainfall event an R factor of **4421** has been adopted

3.1.4. Site Management

Within RUSLE, the C and P factors are used to describe management of the site with respect to reducing soil loss. The C factor measures the combined effect of all the interrelated cover and management variables adopted over the site. It also represents non-structural methods for controlling erosion (i.e. covering exposed areas with various matting products; use of chemical stabilisers or by-products to bind soil particles or provide a barrier from raindrop impact; or stabilisation by temporary or permanent vegetation).

The P factor measures the combined effect of all support practices and management variables. P factor is reduced by practices that reduce both the velocity of runoff and the tendency of runoff to flow directly downhill. It also represents structural methods for controlling erosion.

Industry accepted default values of 1 and 1.3 have been adopted as C and P factors respectively in soil loss estimations.

3.2. Results

Estimated soil loss rates (tonnes/ha/year) have been calculated using RUSLE for each catchment across the site. The output of the erosion risk assessment is presented below in **Table 4** and mapped in **Appendix A**.

Each catchment erosion risk is categorised and coloured to allow overview as per **Table 3** (adopted from IECA 2008).

Table 3: Erosion Risk Category

Soil Loss (t/ha/yr)	Erosion Risk Category
0 to 150	Very Low
150 to 225	Low
225 to 500	Moderate
500 to 1500	High
> 1500	Extreme

Table 4: Calculated Erosion Risk

Construction Area	Exposed Area (ha)	R	K	Equal Area Slope (%)	LS	P	C	A (t/ha/yr)	Soil Loss (t/yr)
Catchments – West of the Marine Crossing Section									
D01	1.38	4421	0.058	1.89	0.38	1.3	1	126	174
D02	0.53	4421	0.058	1.15	0.23	1.3	1	77	40
D03	0.60	4421	0.058	1.09	0.22	1.3	1	73	43
D04	0.42	4421	0.058	1.50	0.30	1.3	1	100	42
D05	0.28	4421	0.058	1.69	0.34	1.3	1	113	32
D06	0.39	4421	0.058	1.85	0.37	1.3	1	123	48
D07	1.03	4421	0.058	1.54	0.31	1.3	1	103	106
D08	0.95	4421	0.058	0.92	0.18	1.3	1	61	58
D09	0.95	4421	0.058	0.98	0.20	1.3	1	65	62
D10	0.67	4421	0.058	1.01	0.20	1.3	1	67	45

Construction Area	Exposed Area (ha)	R	K	Equal Area Slope (%)	LS	P	C	A (t/ha/yr)	Soil Loss (t/yr)
D11	7.46	4421	0.058	1.42	0.28	1.3	1	95	707
D12	0.60	4421	0.058	0.76	0.15	1.3	1	51	31
D13	0.36	4421	0.058	1.71	0.29	1.3	1	97	35
D14	0.62	4421	0.058	0.50	0.10	1.3	1	33	21
D15	0.96	4421	0.058	1.55	0.31	1.3	1	103	99
D16	0.52	4421	0.058	1.96	0.39	1.3	1	131	68
D17	0.73	4421	0.058	1.24	0.25	1.3	1	83	60
Catchment – Curtis Island									
D18	0.77	4421	0.058	11.07	3.54	1.3	1	1,181	905
D19	0.24	4421	0.058	5.56	1.36	1.3	1	453	108
D20	0.51	4421	0.058	12.26	4.41	1.3	1	1,471	747
D21	0.11	4421	0.058	21.28	4.68	1.3	1	1,561	174
D22	0.28	4421	0.058	19.94	8.37	1.3	1	2,792	785
D23	0.96	4421	0.058	12.87	4.63	1.3	1	1,544	1,483
D24	1.04	4421	0.058	6.27	1.54	1.3	1	512	534
D25	1.19	4421	0.058	5.05	1.36	1.3	1	455	541

3.3. Application

A summary of best practice erosion management techniques for various erosion risk ratings is presented in **Table 5**. The minimum sediment control standard based on erosion risk rating and corresponding soil loss rate is shown in **Table 6**. The pipeline west of the Marine Crossing is mainly very low erosion risk. The receptor pad is assessed as very low to moderate erosion risk and a conservative approach should be applied with the application of moderate management approach. The pipeline on Curtis Island is assessed as high to extreme erosion risk.

Table 5: Erosion Risk Rating Based on Soil Loss and Required Management (adapted from Table 4.4.7 of IECA 2008)

Erosion Risk Rating	Soil Loss Rate (t/ha/year)	Advance Land Clearing Allowed (wks work)	Max days to Stabilisation	Staged Construction and Stabilisation of Earth Batters >6H:1V	Stockpiles stabilised
Very Low	0 to 150	8	30 (60%)		
Low	150 to 225	8	30 (70%)		
Moderate	225 to 500	6	20 (70%)	✓	
High	500 to 1500	4	10 (75%)	✓	✓
Extreme	> 1500	2	10 (80%)	✓	✓

Table 6: Minimum Sediment Control Standards Based on Soil Loss

Soil Loss Rate (t/ha/year)	Sediment Control Technique	Default Sediment Control Treatment Measure
0 to 75	Type 3	Sediment fence, sediment trap
75 to 150	Type 2	Filter tube dam, rock filter dam, sediment trench, sediment weir, compost/mulch berm
> 150	Type 1	Sediment basin (sized in accordance with design standard)

Note: Based on Tables 4.5.1 and 4.5.3 of IECA (2008)

4. Design Standards and Assumptions

4.1. Introduction

A Conceptual Erosion and Sediment Control Plan (ESCP) has been developed for the sites and presented in **Appendix B**.

Design calculations and sizing for the sediment basin, emergency spillway and temporary clean and dirty water drains is provided in **Appendix C**.

The operation of the sediment basin is to be in accordance with the Sediment Basin Operating Procedure within **Appendix E**. This document provides guidance to site personnel on the management, operation, monitoring, treatment, discharge and maintenance of sediment basins located onsite.

Technical notes regarding the implementation of erosion and sediment control measures on site are provided in **Appendix F**.

Construction of temporary watercourse crossings should be undertaken as per guidelines within **Appendix G**.

Standard design drawings and factsheets for nominated erosion and drainage controls can be sourced from **www.austieca.com.au**.

The application of best practice erosion and sediment control is based upon the appropriate integration of three groups of control measures:

- Drainage control measures;
- Erosion control measures (including revegetation measures); and
- Sediment control measures.

Discussion is provided below with regard to each group of control measures to be applied onsite. Wherever reasonable and practical, control measures from all three groups must be integrated in a total treatment system.

4.2. Drainage

Drainage standards adopted are shown below in **Table 7** below. Standards were adopted as per Table 4.3.1 of IECA (2008).

Temporary drain alignment is to be incorporated into the final drainage design layout as much as possible. Details of temporary drainage design are provided in **Appendix C**.

Table 7: Design Standards Drainage

Structure	Conveyance/stability	Notes
Temporary Drainage Structures	2 year ARI + 150mm freeboard	Assumes <12 month design life
Emergency Spillway Basin	20 year ARI + 300mm freeboard	Assumes <12 month design life
Diversion of clean water around the site	2 year ARI + 150mm freeboard	Assumes <12 month design life
C ₁₀	0.70	Low soil permeability assumed, ¹ I ₁₀ = 66.4 mm/hr

4.2.1. Flow Diversion

Where possible, provision for the diversion of up-slope stormwater runoff for catchments above exposed areas, including temporary stockpile locations, stringing yards, access roads and compounds shall be made.

4.2.2. Spacing of Lateral Drains Long Continuous Slopes

Long unstable slopes must be divided into manageable drainage areas to prevent the formation of rill erosion. Catch drains or flow diversion banks should be placed at regular intervals down the slope to collect and divert surface runoff to properly designed drains bounding the disturbance area. Contour bunds should be constructed to the spacing's shown below in **Table 8**.

Table 8: Recommended "Maximum" Drain or Bench Spacing on Non-Vegetated Slopes

Percentage	Batter Slope		Horizontal Spacing (m)	Vertical Spacing (m)
	(Degrees)	(H):(V)		
1%	0.57	100:1	90	0.9
2%	1.15	50:1	60	1.2
4%	2.29	25:1	40	1.6
6%	3.43	16.7:1	32	1.9
8%	4.57	12.5:1	28	2.2
10%	5.71	10:1	25	2.5
12%	6.84	8.33:1	22	2.6
15%	8.53	6.67:1	19	2.9
20%	11.3	5:1	16	3.2
25%	14.0	4:1	14	3.5
30%	16.7	3.33:1	12	3.5
35%	19.3	2.86:1	10	3.5
40%	21.8	2.5:1	9	3.5
50%	26.6	2:1	6	3.0

4.3. Erosion Control

Various applicable stabilisation measures are presented in **Table 9**. Such measures should be considered if the proposed permanent revegetation and stabilisation measures in **Section 4.5** are delayed beyond 30 days.

Table 9: Application of Erosion Control Measures to Soil Slopes (reproduced from Table 4.4.13 of IECA 2008)

Flat Land (<1 in 10)	Mild Slopes (1 in 10 – 1 in 4)	Steep Slopes (steeper than 1 in 4)
Erosion Control Blankets	Bonded Fibre matrix	Bonded Fibre Matrix
Gravelling	Compost Blankets	Cellular Confinement Systems
Mulching	Erosion Control Blankets, Mats and Mesh	Compost Blankets
Revegetation	Mulching well anchored	Erosion Control Blankets, Mats and Mesh
Rock Mulching	Revegetation	Revegetation
Soil Binder	Rock Mulching	Rock Armouring
Turfing	Turfing	Turfing

It is understood that when earthworks are complete, the launch and receptor pads are to have gravel placed along trafficked areas including between the pipe storage lines, in parking and equipment laydown areas, and around the washdown area.

4.4. Sediment Control

The need for sediment basins was triggered due to the need to protect the terminal receiving environment from suspended solids in most rainfall events, and the requirement of:

- *State Planning Policy for Healthy Waters* (DERM, 2010) to direct all water to a sediment basin if total estimate soil loss is greater than 150t/yr (total) from the site.
- *Queensland Water Quality Guidelines* (DERM, 2009) during the construction phase for disturbances greater than 1 hectare, it is a requirement to take all reasonable and practicable measures to collect all runoff from disturbed areas and drain to a sediment basin.

A sediment basin was not triggered for the mainland proportion of the site under IECA (2008) due to the fact that the aerial soil loss from the site is estimated to be less than 150t/ha/yr.

Table 10: Design Standard Sediment Control

Element	Conveyance/stability	Notes
Basin Type	F/D-type basin	Fine/dispersive soils
Basin Batter slopes	3 (h) : 1(V)	
Sediment Storage Volume	Calculated Using RUSLE	Considers 2 month clean out frequency
Cv	0.56	Group D (low permeability soils, 32.8mm design rainfall depth)
80%ile 5 day rainfall (Adopted for basins with design life greater than 6 months, Table B4 of IECA, 2008)	32.8mm	Published rainfall intensity for Gladstone (Table B5 of IECA, 2008)
Design size for all other treatment devices	3mnth ARI (0.5 x Q1)	IECA 2008

Calculations undertaken to determine the sediment basin size are attached in **Appendix C**. The Sediment Basin Construction and Operation Procedure is attached in **Appendix E**.

4.4.1. Sediment Control Standard

As detailed within **Section 3.3**, the IECA (2008) provides a risk based standard for selection of sediment control techniques (see **Table 6** of **Section 3.3**). The type of control is determined depending on soil loss rate and area of disturbance. Estimates of soil loss due to erosion from each sub-catchment along the Marine Crossing pipeline alignment have been calculated to determine the minimum sediment control standard to be applied. The results of soil loss estimations are presented in below in **Table 11**.

Based on the estimated soil loss calculations and the need to protect receiving environment, 11 of 25 catchments trigger the need for Type 1 sediment control measures, namely a Type D/F sediment basin.

Table 11: Catchment Areas, Soil Loss and Treatment Types

Construction Area	Exposed Area (ha)	A (t/ha/yr)	Soil Loss (t/yr)	Minimum Control Standard	Comment
Catchments – West of the Marine Crossing					
D01	1.38	126	174	Type 1	Type 1 nominated due to proximity to waterway
D02	0.53	77	40	Type 3	Type 1 nominated due to proximity to waterway
D03	0.60	73	43	Type 3	Type 2 nominated due to proximity to water
D04	0.42	100	42	Type 3	
D05	0.28	113	32	Type 3	
D06	0.39	123	48	Type 3	
D07	1.03	103	106	Type 2	
D08	0.95	61	58	Type 3	
D09	0.95	65	62	Type 3	
D10	0.67	67	45	Type 3	
D11	7.46	95	707	Type 1	Type 1 nominated due size of disturbed catchment
D12	0.60	51	31	Type 3	
D13	0.36	97	35	Type 3	
D14	0.62	33	21	Type 3	
D15	0.96	103	99	Type 2	
D16	0.52	131	68	Type 3	
D17	0.73	83	60	Type 3	
Catchment – Curtis Island					
D18	0.77	1,181	905	Type 1	
D19	0.24	453	108	Type 2	Type 1 nominated due to high erosion risk

Construction Area	Exposed Area (ha)	A (t/ha/yr)	Soil Loss (t/yr)	Minimum Control Standard	Comment
D20	0.51	1,471	747	Type 1	
D21	0.11	1,561	174	Type 2	Type 1 nominated due to extreme erosion risk
D22	0.28	2,792	785	Type 1	
D23	0.96	1,544	1,483	Type 1	
D24	1.04	512	534	Type 1	
D25	1.19	455	541	Type 1	

4.4.2. Sediment Control Measures in Areas of Sheet Flow

Table 12 outlines the typical use of various sheet flow sediment control techniques.

Table 12: Sheet Flow Sediment Control Techniques

Technique	Typical Use
Buffer Zones	<ul style="list-style-type: none"> Type 3 sediment trap. Most suited to sandy soils. Can provide some degree of turbidity control while the <i>Buffer Zone</i> remains unsaturated.
Filter Sock	<ul style="list-style-type: none"> Type 2 sediment trap. Suitable for all soil types.
Filter Fence	<ul style="list-style-type: none"> Type 3 sediment trap. Very small catchment areas (e.g. stockpiles). Better capture of the finer (sand/silt) sediments compared to woven <i>Sediment Fence</i>.
Mulch Berm	<ul style="list-style-type: none"> Type 2 sediment trap. Suitable for all soil types.
Sediment Fence (woven fabric)	<ul style="list-style-type: none"> Type 3 sediment trap. Suitable for all soil types. Long duration construction sites likely to experience several storm events.
Sediment Fence (non-woven composite fabric)	<ul style="list-style-type: none"> Type 3 sediment trap. Suitable for all soil types. Preferred type of <i>Sediment Fence</i> when placed adjacent critical habitats such as waterways. Short duration construction sites or sites likely to experience only

Technique	Typical Use
	a few storm events.

It should be noted that the use of existing grasses to ‘filter’ sediment runoff are not effective enough to be classified as Type 3 systems. Grass filter strips are defined as supplementary sediment control techniques (ie below the minimum Type 3 control and as such cannot be relied solely on without preceding controls).

4.4.3. Sediment Control Structures in Areas of Minor Concentrated Flow

Table 13 outlines the typical use of sediment control techniques for minor concentrated flows, such as roadside drains.

Table 13: Minor Concentrated Flow Sediment Control Techniques

Technique	Typical use
Check Dam Sediment Trap	<ul style="list-style-type: none"> • Supplementary sediment trap. • Trapping sediment in table drains and other minor drainage lines. • Check dams may be constructed from rock, sand bags, or compost filled socks. • Compost-filled socks can adsorb some dissolved and fine particulate matter.
Coarse Sediment Trap	<ul style="list-style-type: none"> • Type 3 sediment trap. • Best used on sandy soils. • Commonly used as sediment trap at the low point of a Sediment Fence. • Used as an alternative to a spill through weir on a Sediment Fence.
Filter Tube Dam	<ul style="list-style-type: none"> • Type 2 sediment trap. • Trapping sediment in minor drainage lines. • Generally provides greater treatment of low flows than a U-shaped Sediment Trap. • Filter Tubes can be integrated into a variety of Type 2 and 3 sediment traps (such as rock check dam, U-shaped sediment trap, rock filter dam and sediment weir) to improve efficiency during minor flows.
Modular Sediment Trap	<ul style="list-style-type: none"> • Type 3 sediment trap. • Modern replacement for straw bale barriers. • Capability of accepting concentrated flows depends on construction technique.
U-Shaped Sediment Trap	<ul style="list-style-type: none"> • Type 3 sediment trap. • Minor concentrated flows such as table drains. • The sediment fence must be constructed in a U-shape with an appropriate spill through weir. • Filter tubes can be integrated into a U-shaped sediment trap to increase the effective hydraulic capacity and to improve the

Technique	Typical use
	treatment of low flows.

4.4.4. Sediment Control Structures in Areas of Concentrated Flow

Table 14 outlines the attributes of relevant sediment control techniques used in concentrated flow, such as roadside drains.

Table 14: Concentrated Flow Sediment Control Techniques

Technique	Typical use
Rock Filter Dam: Filter cloth used as the primary filter medium.	<ul style="list-style-type: none"> • Type 2 sediment trap. • Locations where there is sufficient room to construct a relatively large rock embankment. • The incorporation of filter cloth is the preferred construction technique if the removal of fine-grained sediment is critical. De-silting and replacement of the fabric can be difficult.
Sediment Trench	<ul style="list-style-type: none"> • Type 2 or 3 sediment trap. • Used in long, narrow spaces. • At the base of fill batters where there is limited space between the toe of the batter and the property boundary.

4.5. Revegetation and Stabilisation

Revegetation or temporary stabilisation should be completed within the timeframes nominated in **Table 5** depending on erosion risk. If works are likely to be suspended for an extended period, stabilisation of exposed areas will also be required within the specified timeframes.

In accordance with IECA (2008) options for temporary stabilisation are presented in **Table 9**.

Wherever practicable dispersive soils should be treated and/or completely buried under a layer of non-dispersive soil before placing any erosion control measures, including vegetation. Gypsum application should be applied at a rate of 10kg/cubic meter.

4.6. Instream Works

It is understood that the appointed Contractor (Saipem) has prepared a Watercourse Crossing Procedure (Construction Method Statement B6) to detail the proposed construction methodology, sequencing and duration of works within waterways and controls to be employed to manage risks posed by any such works. Said document has not been reviewed as part of preparing this SWMP and ESCP.

There are four areas identified as “Special Management Areas”. In total there are four tidal creeks and three non-tidal creeks. The tidal creeks will be subject to a subsequent application for Operational Works for Tidal Works which will detail ESC for those crossings. The non-tidal creeks will be detailed in the subsequent Saipem ESC Plan.

Creek crossings methodology will to be generally as per Saipem’s Construction Method Statement B6 in subsequent Saipem ESC Plan.

Instream construction activities and the removal of existing watercourse crossings have the potential to generate sediment plumes within the work area (i.e. waterways). Sediment released from a work site into a waterway or water body can cause an increase in both turbidity and bed load sediment.

During works within waterways two sources of water flow will need to be managed. Firstly, stream flows passing through the work area, and secondly lateral flows consisting of local stormwater runoff flowing towards the channel. Practical measures need to be employed to convey the lateral inflow of stormwater runoff around or through the work area in a non-erosive manner. This inflow of ‘clean’ water should not mix with any ‘dirty’ water generated within the work area.

The diversion of lateral inflow will be required in the following cases:

- When rainfall is expected or likely;
- Lateral inflows are likely to flow over exposed soil or cause bank erosion within the work area; and
- Material stockpiles on the side of the waterway which may wash into the system.

The primary objectives when trenching through water crossings include:

- Timing of works to coincide with periods of no/low flow and a low probability of significant rainfall;
- Staging of works to divert creek flows around work area;
- Stockpiles should be positioned above flood levels with appropriate sediment control measures installed; and

- Rapid rehabilitation and stabilisation of waterway bed and banks.

Once the method of construction, sequencing and timing of works is known for all activities occurring in and in close proximity to waterways a review of the risks posed will need to be conducted prior to commencing any works.

5. Waterway Crossing Hydraulic Assessment

5.1. Culvert Design

Based on the results of the hydrologic assessment undertaken (detailed in **Section 2.4**), hydraulic modeling has been undertaken to assess the necessary drainage infrastructure required as part of the pipeline corridor and access tracks to ensure the movement of machinery and vehicles can continue through periods of rainfall.

For temporary works (i.e. during construction), the appropriate ARI rainfall event needs to be nominated as the design rainfall event, in accordance with IECA (2008) and associated Catchment to Creek Pty Ltd fact sheet titled 'Temporary Watercourse Crossings: Culverts (2010)'. The design standard of the culverts will be dependent on the in-bank hydraulic capacity of the watercourse and the timing of works (i.e. dry or wet season).

However, for permanent drainage structures, the 20 year ARI rainfall event has been nominated as the design rainfall event and the velocity-depth product specified by QUDM applied as the limiting factor for any permanent waterway crossing.

Application of these design criteria has enabled culvert infrastructure to be sized for Locations 1 to 8 (previously illustrated in **Figure 6**) for a range of design standards. The results of this preliminary assessment are summarised in **Table 15**.

Table 15: Culver Configuration for Waterway Crossings

Location	Crossing Design - 1 year ARI	Crossing Design - 2 year ARI	Crossing Design - 5 year ARI	Crossing Design - 20 year ARI
1 ⁽¹⁾	3 x 1200mm RCP	3 x 1200mm RCP	3 x 1200mm RCP	3 x 1200mm RCP
2	3x1500mm RCP	7x1500mm RCP	11 x 1500mm RCP	11 x 1800 x 1500 RCBC
3	4x1500mm RCP	9x1500mm RCP	13 x 1500mm RCP	24 x 1800 x 1500 RCBC
4	1 x 275mm RCP	1 x 275mm RCP	1 x 300mm RCP	1 x 450mm RCP
5	1x450mm RCP	1x600mm RCP	2 x 600mm RCP	3 x 600mm RCP
6	1x600mm RCP	1 x 900mm RCP	2 x 900mm RCP	3 x 900mm RCP
7	2x900mm RCP	4x900mm RCP	6 x 900mm RCP	8 x 900mm RCP
8	1x450mm RCP	2x450mm RCP	4 x 450mm RCP	3 x 600mm RCP

NOTE: (1) The culverts at Location 1 have already been constructed as part of the works undertaken by QGC. Three culverts were observed during the site inspection but it remains unclear as to what size these units were.

5.1.1. Minor Culvert Design

Three additional waterway crossings will be required. The size of the contributing catchments at these locations is considerably less than those previously assessed and the necessary drainage infrastructure much less. Again, the appropriate ARI rainfall event needs to be nominated as the design rainfall event, in accordance with IECA (2008) and associated Catchment to Creek Pty Ltd fact sheet titled 'Temporary Watercourse Crossings: Culverts (2010)'. The design standard of the culverts will be dependent on the in-bank hydraulic capacity of the watercourse and the timing of works (i.e. dry or wet season). Based on the hydrologic and hydraulic modeling undertaken at these locations, the following culverts will be required:

- 5 year ARI event 1050mm RCP,
- 2 year ARI event 900mm RCP, or
- 1 year ARI event 750mm RCP

The results of the modelling indicate the critical storm duration can be conveyed by these culverts without flows passing over the ROW.

6. Roles and Responsibilities

Table 16 outlines the responsibilities of parties with respect to ESC.

Table 16: Roles and Responsibilities

Role	Responsibility
Project Superintendent	<ul style="list-style-type: none"> • Overall responsibility of ESC implementation; • Notify the Environmental Manager immediately of any non-compliance with ESCP; • Ensure the prompt implementation of measures to mitigate erosion and sediment generation;
Project Engineer	<ul style="list-style-type: none"> • Provide design information as required; • Inspect ESC installation and maintenance; • Inspect offsite impacts and management;
Site Supervisor/Foremen	<ul style="list-style-type: none"> • Monitor daily rainfall; • Notify Environmental Advisor/Consultant when runoff generating rainfall occurs in the previous 24 hours; • Treat, test and dispose of captured runoff as per operating procedures; • Maintain current records of rainfall, storage volumes, water quality, treatment practices, discharge volumes;
Environmental Advisor/Consultant	<ul style="list-style-type: none"> • Conduct in-situ monitoring; • Collect and submit samples to laboratory; • Collate results and prepare reports as required; • Sample basin water quality and authorise discharge; • Conduct site inspections and audits as required;
Erosion and Sediment Control Auditor / Advisor (CPESC)	<ul style="list-style-type: none"> • Conduct site inspections and audits as required; • Prepare audit reports; • Provide advice regarding ESC site improvement;
All Personnel	<ul style="list-style-type: none"> • Report any damage to ESC devices and any potential or actual environmental harm in line with Duty to Notify under the requirements of the Environmental Protection Act 1994;

7. Corrective and Preventative Action

An environmental incident with respect to the ESCP is defined as any occurrence where sediment is released from the site, whether controlled or uncontrolled, or where stormwater is released (controlled) from site which does not meet the water quality requirements.

All incidents and non-conformances are to be reported and investigated and corrected in accordance with the ESCP to ensure effective soil and water quality management practices at all times.

Best practice site management requires all ESC measures to be inspected by the Contractors nominated representative at least daily when rain is occurring, within 24 hours prior to expected rainfall, and within 18 hours of a rainfall event of sufficient intensity and duration to cause onsite runoff (IECA, 2008). Such inspections must check:

- **Daily site inspections** (during periods of runoff producing rainfall)
 - All drainage, erosion and sediment control measures
 - Occurrences of excessive sediment deposition (whether on-site or off-site)
 - All site discharge points

- **Weekly site inspections** (even if work is not occurring on-site)
 - All drainage, erosion and sediment control measures
 - Occurrences of excessive sediment deposition (whether on-site or off-site)
 - Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements
 - Litter and waste receptors
 - Oil, fuel and chemical storage facilities

- **Prior to anticipated runoff producing rainfall**
 - All drainage, erosion and sediment control measures
 - All temporary flow diversion and drainage works

- **Following runoff producing rainfall**
 - Treatment and de-watering requirements of sediment basins
 - Sediment deposition within sediment basins and the need for its removal
 - All drainage, erosion and sediment control measures
 - Occurrences of excessive sediment deposition (whether on-site or off-site)
 - Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements
 - Occurrences of excessive erosion, sedimentation, or mud generation around the site office, car park and/or material storage areas.

8. Surface Water Monitoring Program

The requirements of the surface water quality monitoring program are subject to an Environmental Management Plan as stipulated within the various project Conditions of Approval. At a preliminary level **Table 17** outlines possible requirements for surface water monitoring with respect to ESC. The operation and monitoring of sediment basins is to be conducted in accordance with the sediment basin operating procedure contained within **Appendix E**.

Table 17: Preliminary Surface Water Monitoring Program (excluding Sediment Basins)

Responsibility	Contractor to carry out sampling.
Analytes	As per EMP. At a minimum: <ul style="list-style-type: none"> • pH • Turbidity • Dissolved Oxygen (DO) • Electrical Conductivity (EC) • Temperature (°C)
Monitoring Locations	As per EMP. At a minimum: <ul style="list-style-type: none"> • Upstream and downstream of works; • Drainage discharge points; and • Sediment basin discharge points
Timing	As per EMP. At a minimum, on any day when stormwater run-off discharges from the site, or immediately after a rainfall event of nominated intensity and duration.
Methodology	Samples are to be collected by a suitably qualified party and submitted to NATA accredited laboratory for analysis. Samples to be collected in accordance with Qld EPAs “Water Quality Sampling Manual” December 1999 (or later version).

9. Auditing, Corrective and Preventative Action

9.1. Inspection Requirements

Best practice site management requires all ESC measures to be inspected by the Site Manager, responsible ESC officer or contractors nominated representative at least daily when rain is occurring, weekly, within 24 hours prior to expected rainfall, and within 18 hours of a rainfall event of sufficient intensity and duration to cause onsite runoff (IECA, 2008). Such inspections must check:

- **Daily site inspections** (during periods of runoff producing rainfall)
 - All drainage, erosion and sediment control measures
 - Occurrences of excessive sediment deposition (whether on-site or off-site)
 - All site discharge points

- **Weekly site inspections** (even if work is not occurring on-site)
 - All drainage, erosion and sediment control measures
 - Occurrences of excessive sediment deposition (whether on-site or off-site)
 - Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements
 - Litter and waste receptors
 - Oil, fuel and chemical storage facilities

- **Prior to anticipated runoff producing rainfall**
 - All drainage, erosion and sediment control measures
 - All temporary flow diversion and drainage works

- **Following runoff producing rainfall**
 - Treatment and de-watering requirements of sediment basins
 - Sediment deposition within sediment basins and the need for its removal
 - All drainage, erosion and sediment control measures
 - Occurrences of excessive sediment deposition (whether on-site or off-site)
 - Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements
 - Occurrences of excessive erosion, sedimentation, or mud generation around the site office, car park and/or material storage areas.

9.2. Audits

Site inspections are to be undertaken in accordance with the Site Inspection Checklist provided on page 7.19 – 7.31 of the IECA, *Best Practice Erosion and Sediment Control Guidelines* (2008) by the Contractors nominated representative. The Contractor must ensure that appropriate procedures and personnel are engaged to plan and conduct site inspections and water quality monitoring throughout the construction and maintenance phase.

In accordance with the IECA, *Best Practice Erosion and Sediment Control Guidelines* (2008), audits are to be conducted at intervals of not more than one (1) calendar month commencing from the day of site

disturbance until all disturbed areas have been adequately stabilised against erosion to the acceptance of the relevant regulatory authority. Such audits must be:

- Undertaken by a person suitably qualified and experienced in erosion and sediment control (ie. CPESC) that can be verified by an independent third party (this person must not be an employee or agent of the principal contractor); and
- Conducted on the next business day following a rainfall event in which greater than 10mm of rainfall has been recorded by the Bureau of Meteorology rain gauge nearest to the site.

Due to the remoteness of the site, it is recommended that site audits are only undertaken on a monthly basis by a suitably qualified independent third party (ie. CPESC). It is recommended that site inspections following a 10mm rainfall event (as specified by IECA (2008)) are undertaken by the Contractors nominated representative.

It is recommended audits include:

- Copies of all original completed ESC site audit checklists, non-conformance and corrective action reports;
- Rainfall records, sediment basin flocculation, site discharge water quality monitoring results and assessment of performance of ESCP Objectives and Targets;
- A current ESC Plan showing those areas of site stabilization and the percentage completion of all soil stabilization/erosion control works;
- Identified Corrective Actions from the site inspection and update on status of previous corrective actions (over and above internal corrective action process);
- Representative date-stamped color photographs, clearly identifying and locating each primary ESC device on the site and showing its condition and use including, as a minimum:
 - Sediment basin embankments, basin water levels, inflow points, depth marker and emergency spillway outlets
 - Sediment fencing
 - Each catch drain and diversion channel
 - Stormwater inlet and outlet protection
 - Stabilized site entry/exit point/s
 - All ESC related corrective action requests
 - Ground stabilization areas and the stabilization media used, such as sheet mulching, hydromulching etc.

The audit must include:

- Copies of all original completed ESC site audit checklists, non-conformance and corrective action reports;
- Rainfall records, sediment basin flocculation and water quality results, site discharge water quality monitoring results and interpretation of results against the Site Water Quality Objectives;
- A current ESC Plan showing those areas of site stabilization and the percentage completion of all soil stabilization/erosion control works;
- A table showing the completion of all actions (or percentage thereof) required by the compliance program;

- Representative date-stamped color photographs, clearly identifying and locating each primary ESC device on the site and showing its condition and use including, as a minimum:
 - Sediment basin embankments, basin water levels, inflow points, depth marker and emergency spillway outlets
 - Sediment fencing
 - Each catch drain and diversion channel
 - Stormwater inlet and outlet protection
 - Stabilized site entry/exit point/s
 - All ESC related corrective action requests
 - Ground stabilization areas and the stabilization media used, such as sheet mulching, hydromulching, concrete etc.

9.3. Audit Reporting

Audit reports are to be compiled within 5 business days of completion of the site inspection, and submitted to the Project Engineer.

10. Reference List

BOM. (2010). Rainfall IFD Data System. Retrieved 11 29, 2010, from Bureau of Meteorology: <http://www.bom.gov.au/hydro/has/cdirswebx/cdirswebx.shtml>

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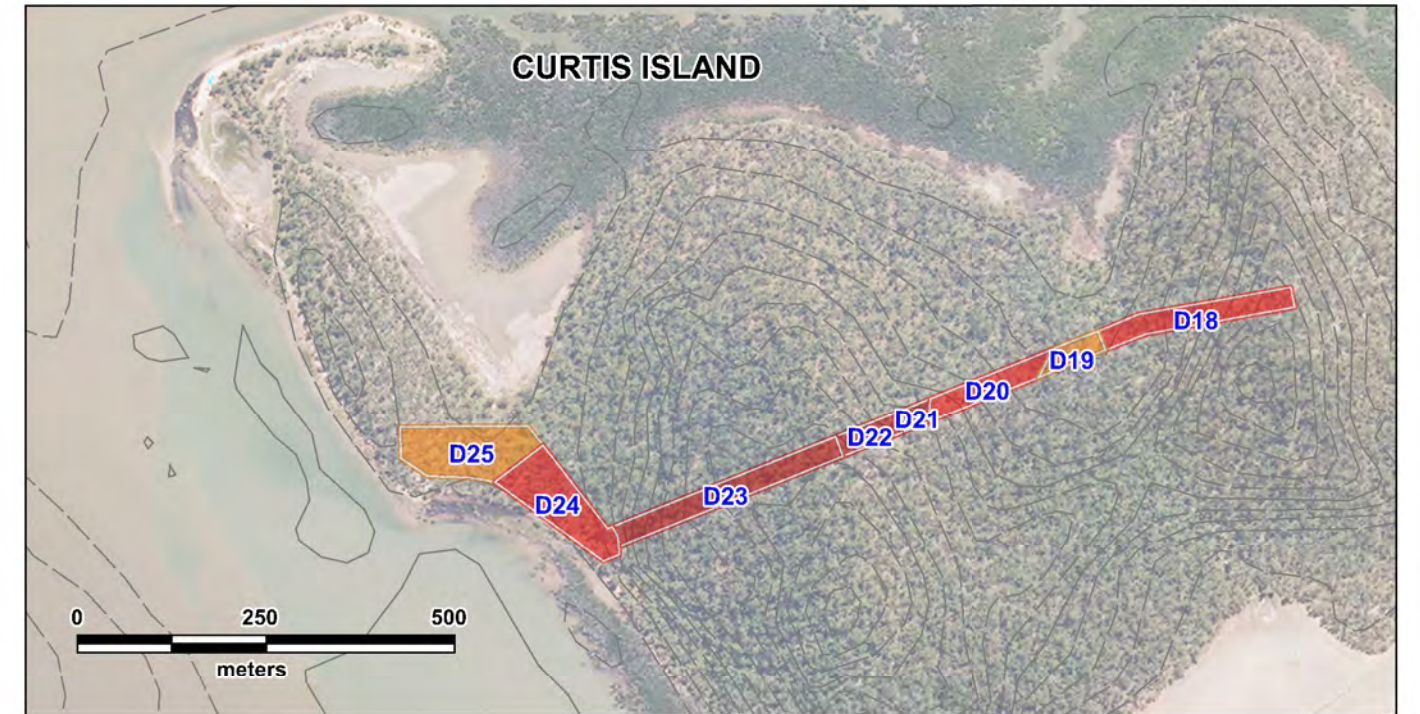
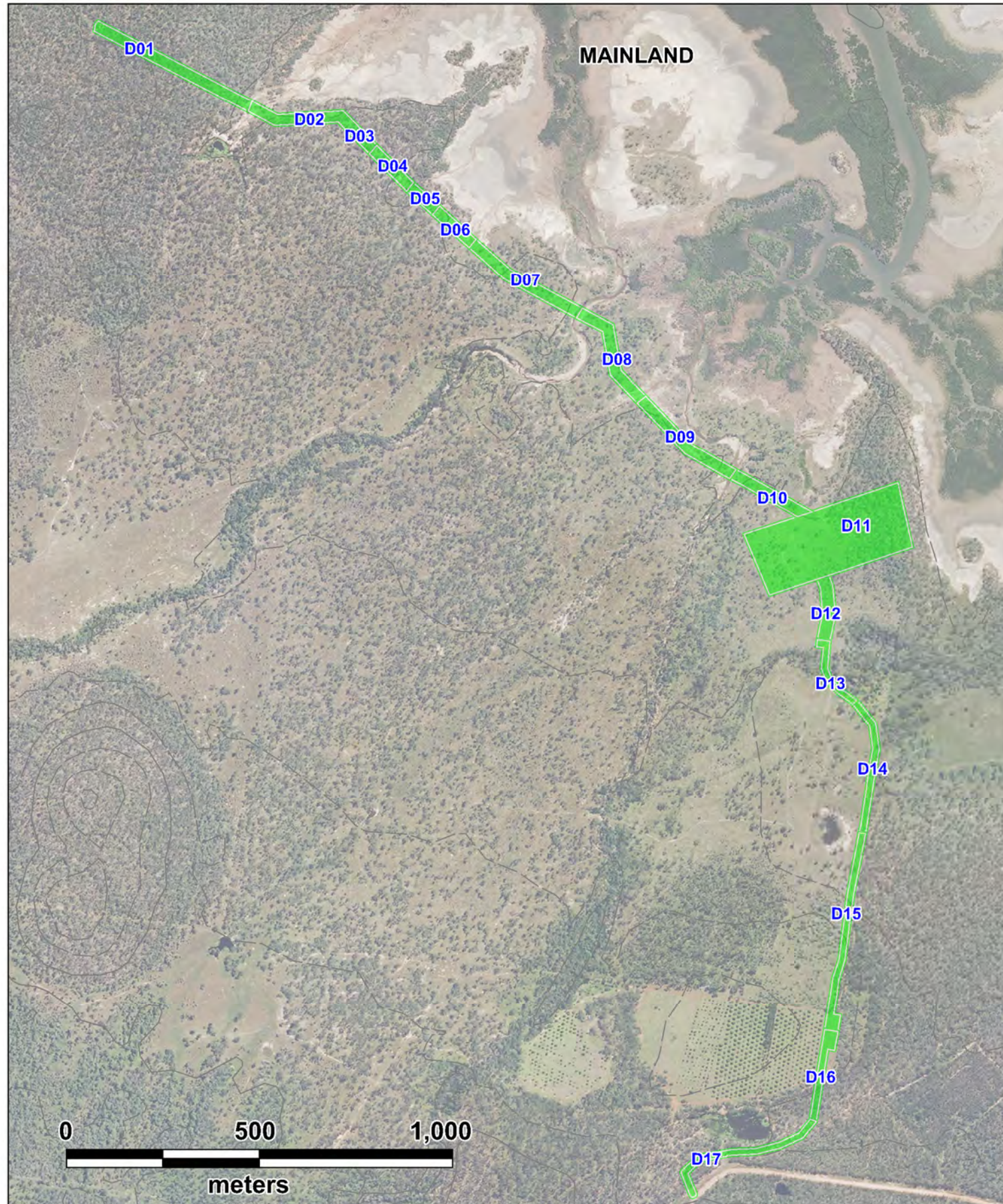
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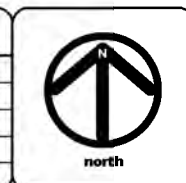
Appendix A Erosion Risk Mapping



EROSION RISK ASSESSMENT

Catchment ID	Risk Rating	Catchment ID	Risk Rating
D01	Very Low	D14	Very Low
D02	Very Low	D15	Very Low
D03	Very Low	D16	Very Low
D04	Very Low	D17	Very Low
D05	Very Low	D18	High
D06	Very Low	D19	Moderate
D07	Very Low	D20	Extreme
D08	Very Low	D21	Extreme
D09	Very Low	D22	Extreme
D10	Very Low	D23	Extreme
D11	Very Low	D24	High
D12	Very Low	D25	Moderate
D13	Very Low		

rev.	amendments	date



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design: MN&LD
 drawn: MN
 date: 20-04-12
 checked: ST
 datum: mAHD
 rl: 56

GLNG Operations Gas Transmission Pipeline Marine Crossing

GLNG

EROSION RISK ASSESSMENT PLAN

date APRIL 2012
 job # SC12-0029
 drawing 018



Appendix B ESC Drawings



LEGEND

- Proposed Gas Pipeline Alignment
- Disturbed Area

O2 ENVIRONMENT+ ENGINEERING
 ACN: 136 340 924 ABN: 79 136 340 924
 BRISBANE
 490 Boundary Street
 Spring Hill, QLD, 4000
 t (07) 3339 7900
 www.o-2.com.au

rev.	amendments	date



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drawn:	MN
date:	20-04-12
checked:	ST
datum:	mAHD
rl:	56

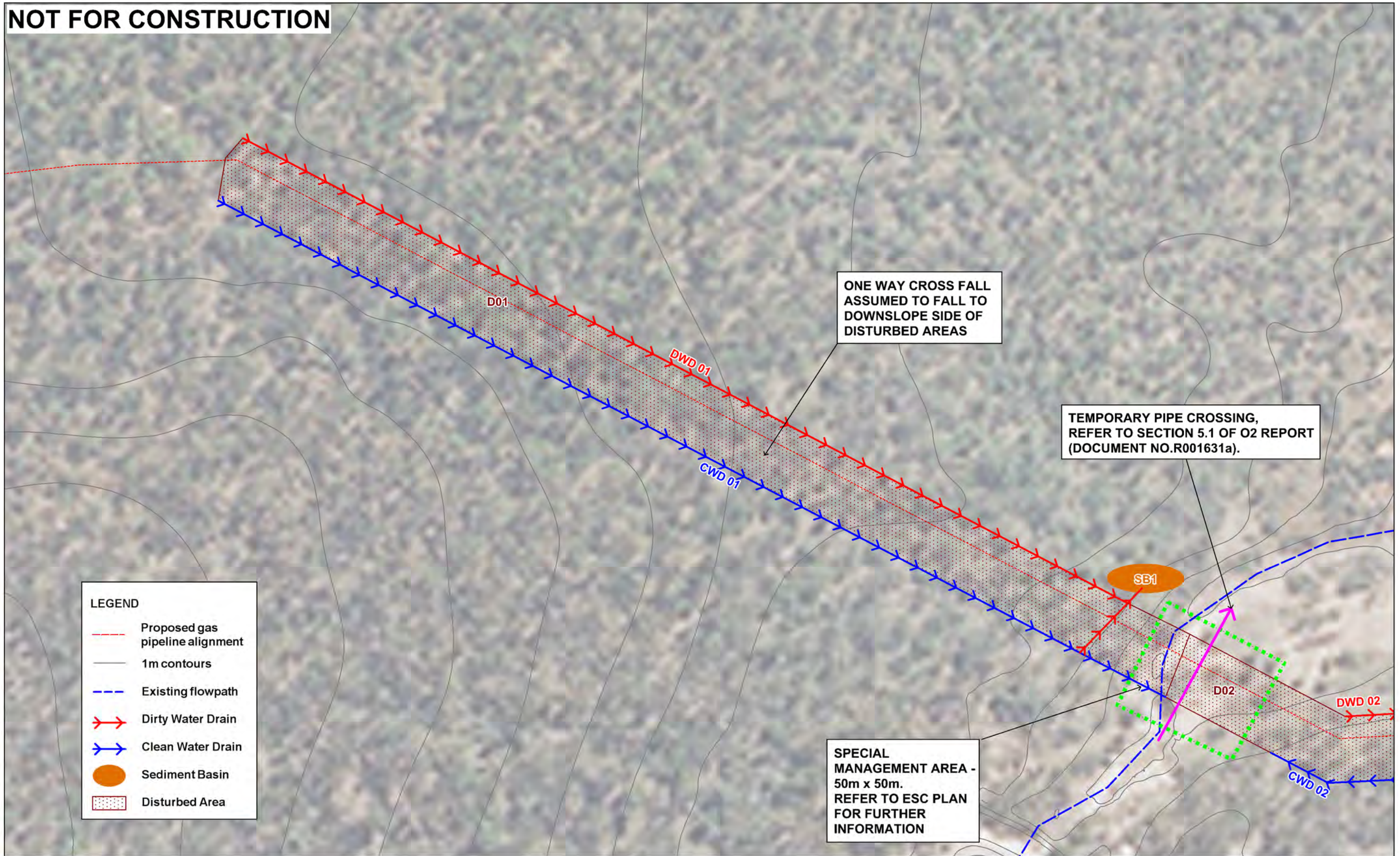
GLNG Operations Gas Transmission Pipeline Marine Crossing

GLNG

Sheet location

date	MAY 2012
job #	SC12-0029
drawing	002

NOT FOR CONSTRUCTION



LEGEND

- Proposed gas pipeline alignment
- 1m contours
- Existing flowpath
- Dirty Water Drain
- Clean Water Drain
- Sediment Basin
- Disturbed Area

ONE WAY CROSS FALL ASSUMED TO FALL TO DOWNSLOPE SIDE OF DISTURBED AREAS

TEMPORARY PIPE CROSSING, REFER TO SECTION 5.1 OF O2 REPORT (DOCUMENT NO.R001631a).

SPECIAL MANAGEMENT AREA - 50m x 50m. REFER TO ESC PLAN FOR FURTHER INFORMATION

ACN: 136 340 924 ABN: 79 136 340 924
 BRISBANE
 490 Boundary Street
 Spring Hill, QLD, 4000
 t (07) 3339 7900
 www.o-2.com.au

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meters

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date:	20-04-12
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rl:	56

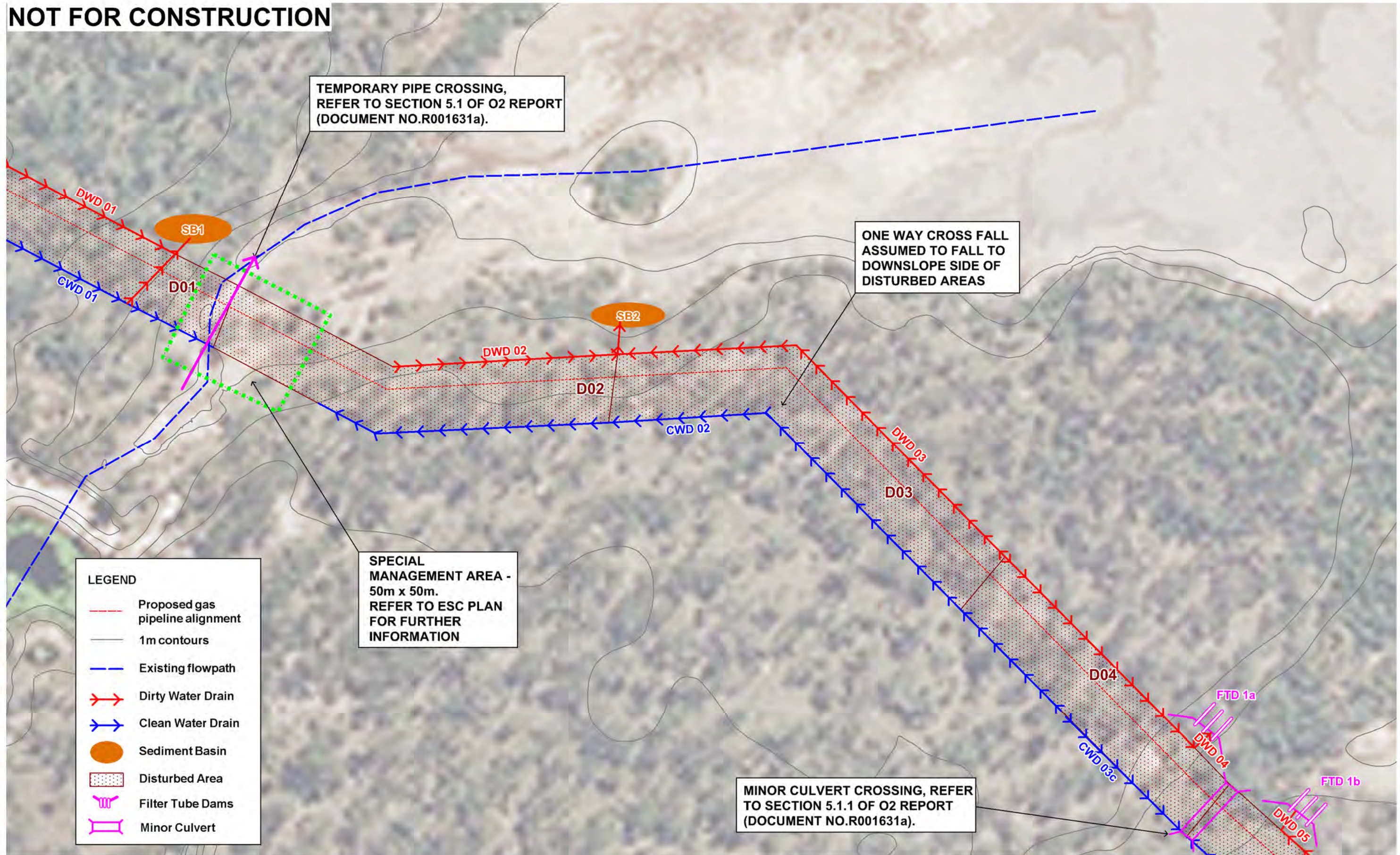
GLNG Operations Gas Transmission Pipeline Marine Crossing

GLNG

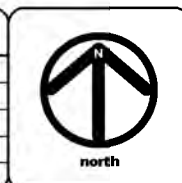
CLEAR & GRUB ESC PLAN - SHEET 1

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job #	SC12-0029
drawing	003

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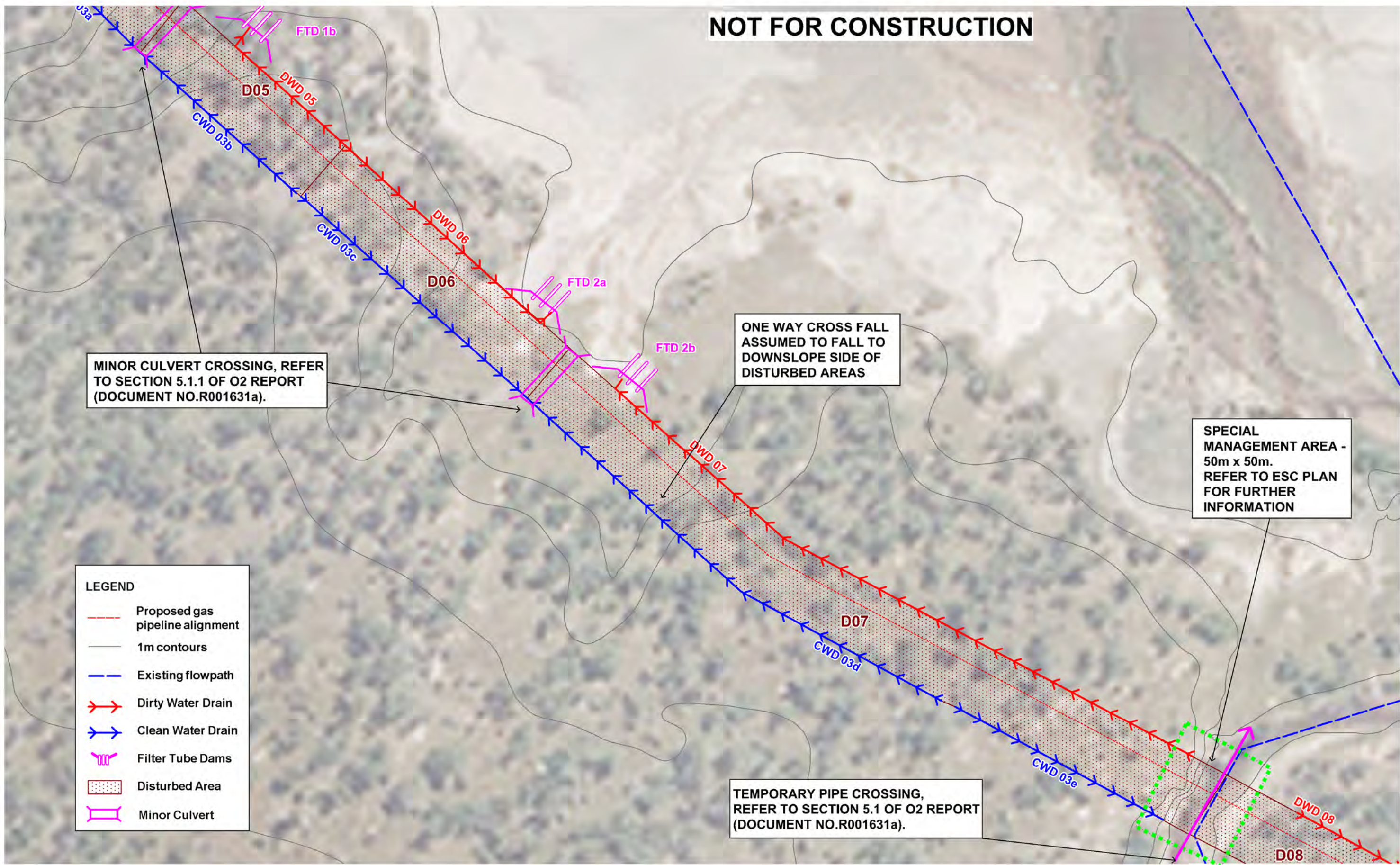
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CLEAR & GRUB ESC PLAN - SHEET 2

date	MAY 2012
job #	SC12-0029
drawing	004

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MINOR CULVERT CROSSING, REFER TO SECTION 5.1.1 OF O2 REPORT (DOCUMENT NO.R001631a).

ONE WAY CROSS FALL ASSUMED TO FALL TO DOWNSLOPE SIDE OF DISTURBED AREAS

SPECIAL MANAGEMENT AREA - 50m x 50m. REFER TO ESC PLAN FOR FURTHER INFORMATION

TEMPORARY PIPE CROSSING, REFER TO SECTION 5.1 OF O2 REPORT (DOCUMENT NO.R001631a).

- LEGEND**
- Proposed gas pipeline alignment
 - 1m contours
 - Existing flowpath
 - Dirty Water Drain
 - Clean Water Drain
 - ▤ Filter Tube Dams
 - Disturbed Area
 - ▭ Minor Culvert

ACN: 136 340 924 ABN: 79 136 340 924
 BRISBANE
 490 Boundary Street
 Spring Hill, QLD, 4000
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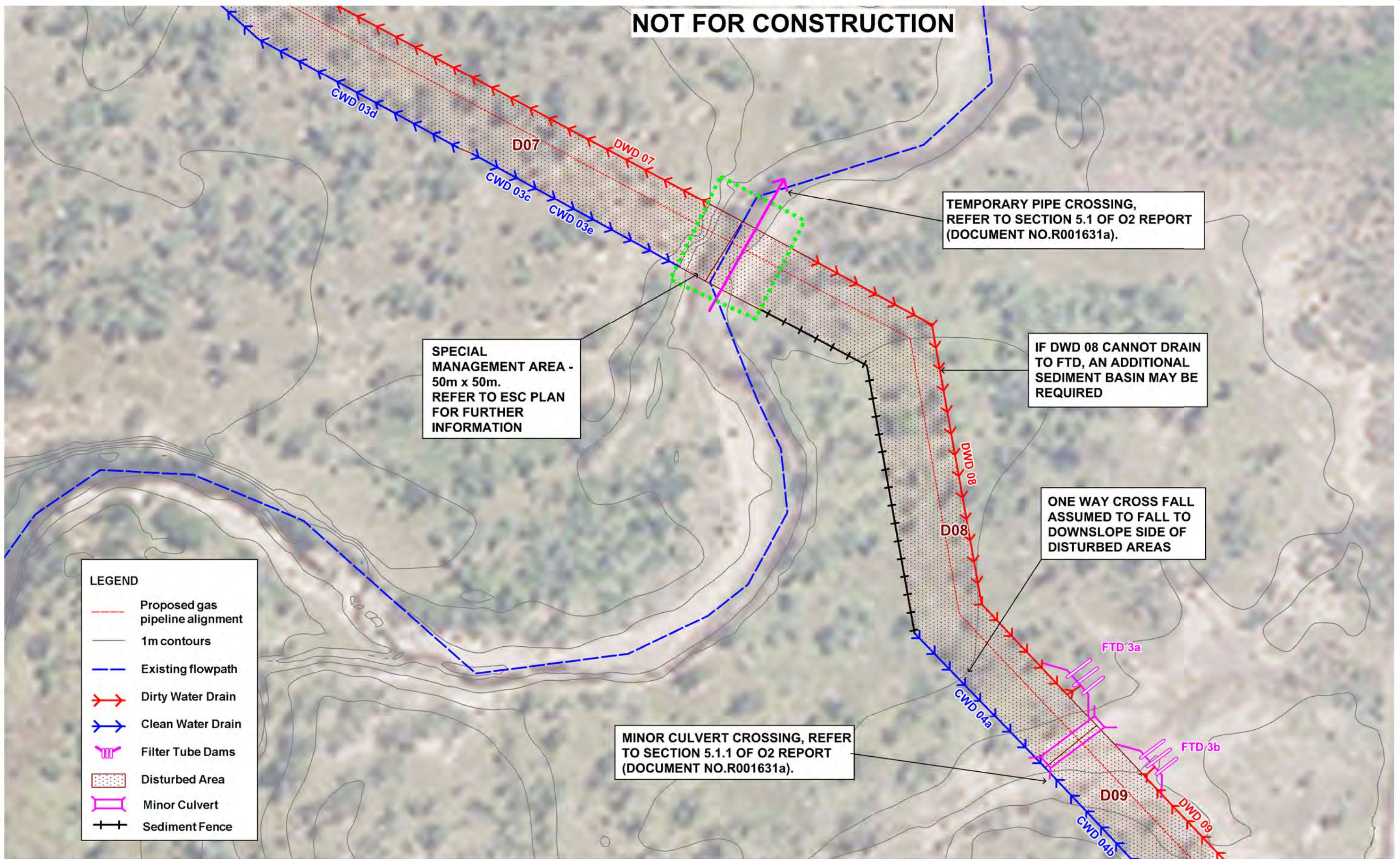
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CLEAR & GRUB ESC PLAN - SHEET 3

date	MAY 2012
job #	SC12-0029
drawing	005

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TEMPORARY PIPE CROSSING, REFER TO SECTION 5.1 OF O2 REPORT (DOCUMENT NO.R001631a).

SPECIAL MANAGEMENT AREA - 50m x 50m. REFER TO ESC PLAN FOR FURTHER INFORMATION

IF DWD 08 CANNOT DRAIN TO FTD, AN ADDITIONAL SEDIMENT BASIN MAY BE REQUIRED

ONE WAY CROSS FALL ASSUMED TO FALL TO DOWNSLOPE SIDE OF DISTURBED AREAS

MINOR CULVERT CROSSING, REFER TO SECTION 5.1.1 OF O2 REPORT (DOCUMENT NO.R001631a).

LEGEND

- Proposed gas pipeline alignment
- 1m contours
- Existing flowpath
- Dirty Water Drain
- Clean Water Drain
- ⌌ Filter Tube Dams
- Disturbed Area
- ⌌ Minor Culvert
- + + Sediment Fence

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metres

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CLEAR & GRUB ESC PLAN - SHEET 4

date	MAY 2012
job #	SC12-0029
drawing	006

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ONE WAY CROSS FALL ASSUMED TO FALL TO DOWNSLOPE SIDE OF DISTURBED AREAS

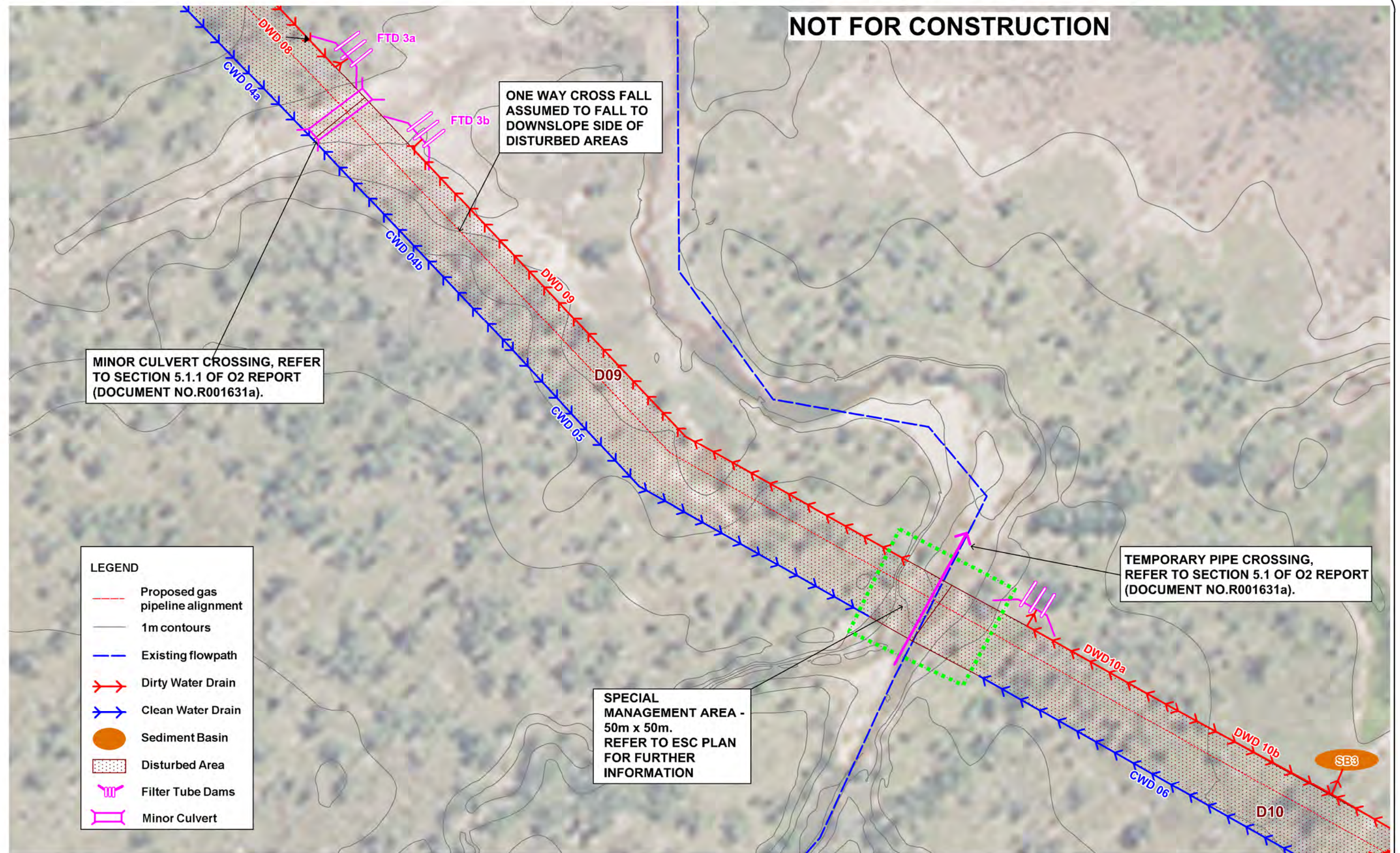
MINOR CULVERT CROSSING, REFER TO SECTION 5.1.1 OF O2 REPORT (DOCUMENT NO.R001631a).

TEMPORARY PIPE CROSSING, REFER TO SECTION 5.1 OF O2 REPORT (DOCUMENT NO.R001631a).

SPECIAL MANAGEMENT AREA - 50m x 50m. REFER TO ESC PLAN FOR FURTHER INFORMATION

LEGEND

- Proposed gas pipeline alignment
- 1m contours
- Existing flowpath
- ↔ Dirty Water Drain
- ↔ Clean Water Drain
- Sediment Basin
- Disturbed Area
- ⌵ Filter Tube Dams
- ⌵ Minor Culvert



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0 25 50
meters

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CLEAR & GRUB ESC PLAN - SHEET 5

date	MAY 2012
job #	SC12-0029
drawing	007

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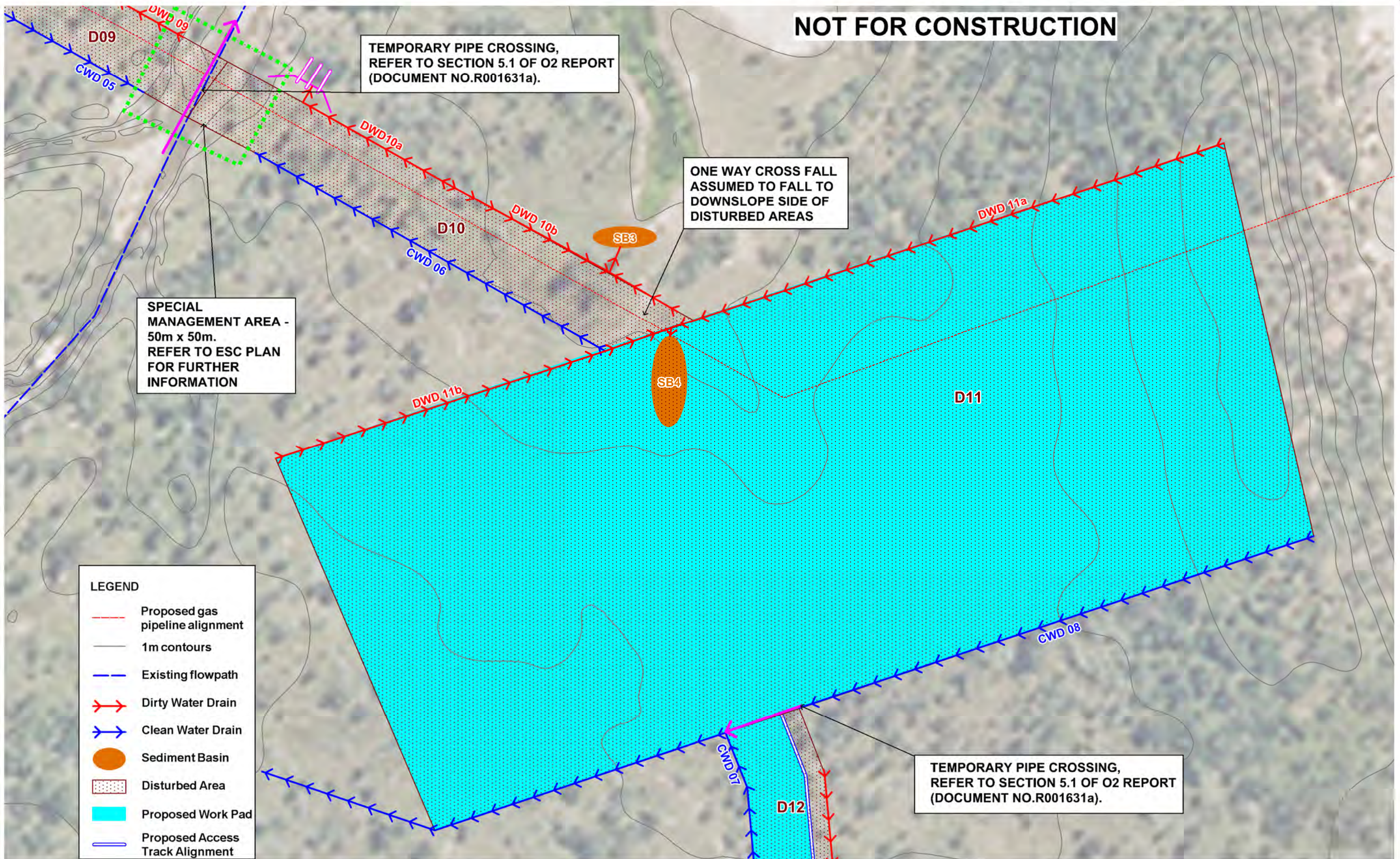
TEMPORARY PIPE CROSSING,
REFER TO SECTION 5.1 OF O2 REPORT
(DOCUMENT NO.R001631a).

ONE WAY CROSS FALL
ASSUMED TO FALL TO
DOWNSLOPE SIDE OF
DISTURBED AREAS

SPECIAL
MANAGEMENT AREA -
50m x 50m.
REFER TO ESC PLAN
FOR FURTHER
INFORMATION

LEGEND

- Proposed gas pipeline alignment
- 1m contours
- Existing flowpath
- ↗ Dirty Water Drain
- ↘ Clean Water Drain
- Sediment Basin
- Disturbed Area
- Proposed Work Pad
- Proposed Access Track Alignment



TEMPORARY PIPE CROSSING,
REFER TO SECTION 5.1 OF O2 REPORT
(DOCUMENT NO.R001631a).

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meters

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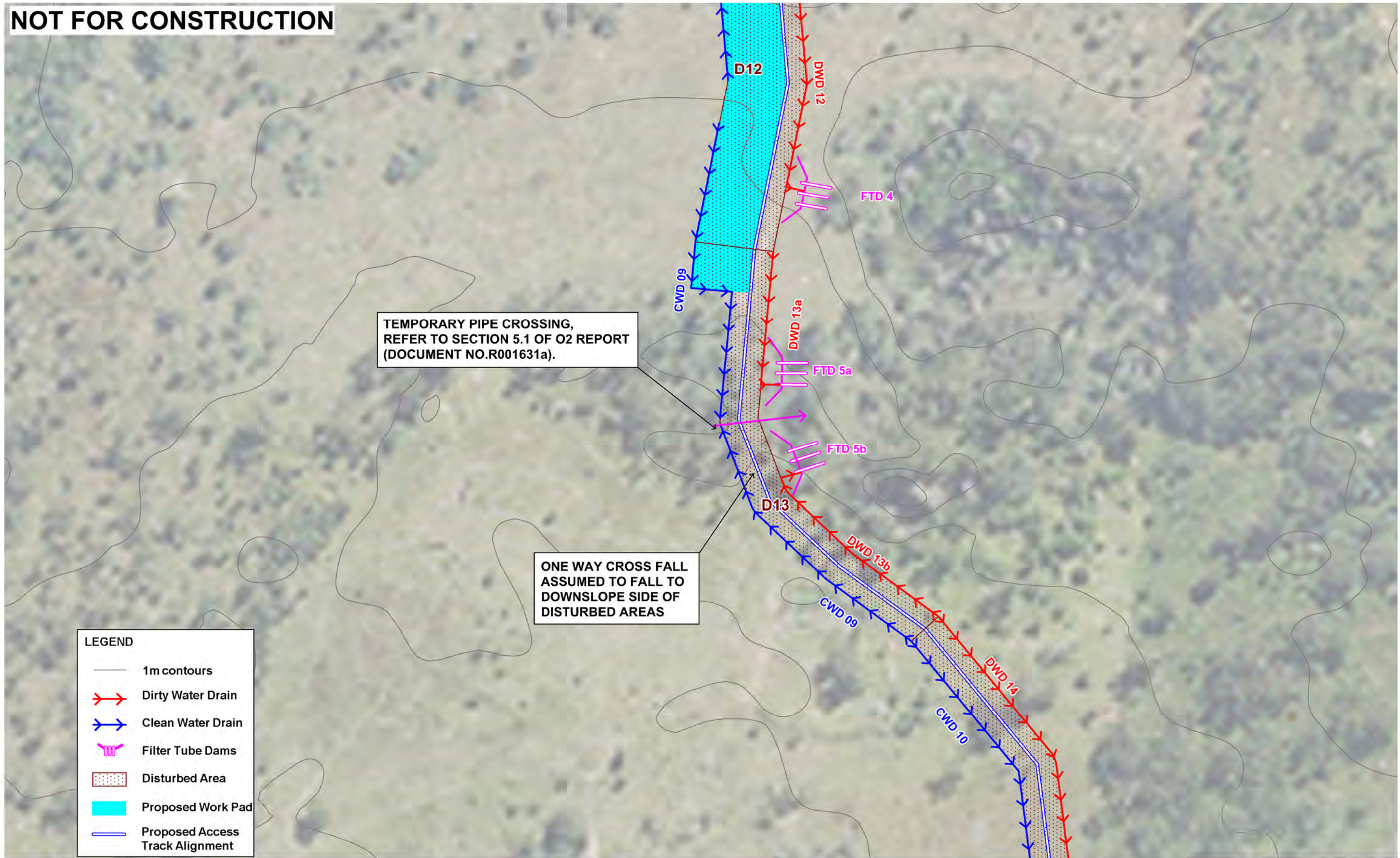
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CLEAR & GRUB ESC PLAN - SHEET 6

date	MAY 2012
job #	SC12-0029
drawing	008

NOT FOR CONSTRUCTION



TEMPORARY PIPE CROSSING,
REFER TO SECTION 5.1 OF O2 REPORT
(DOCUMENT NO.R001631a).

ONE WAY CROSS FALL
ASSUMED TO FALL TO
DOWNSLOPE SIDE OF
DISTURBED AREAS

LEGEND

- 1m contours
- Dirty Water Drain
- Clean Water Drain
- Filter Tube Dams
- Disturbed Area
- Proposed Work Pad
- Proposed Access Track Alignment

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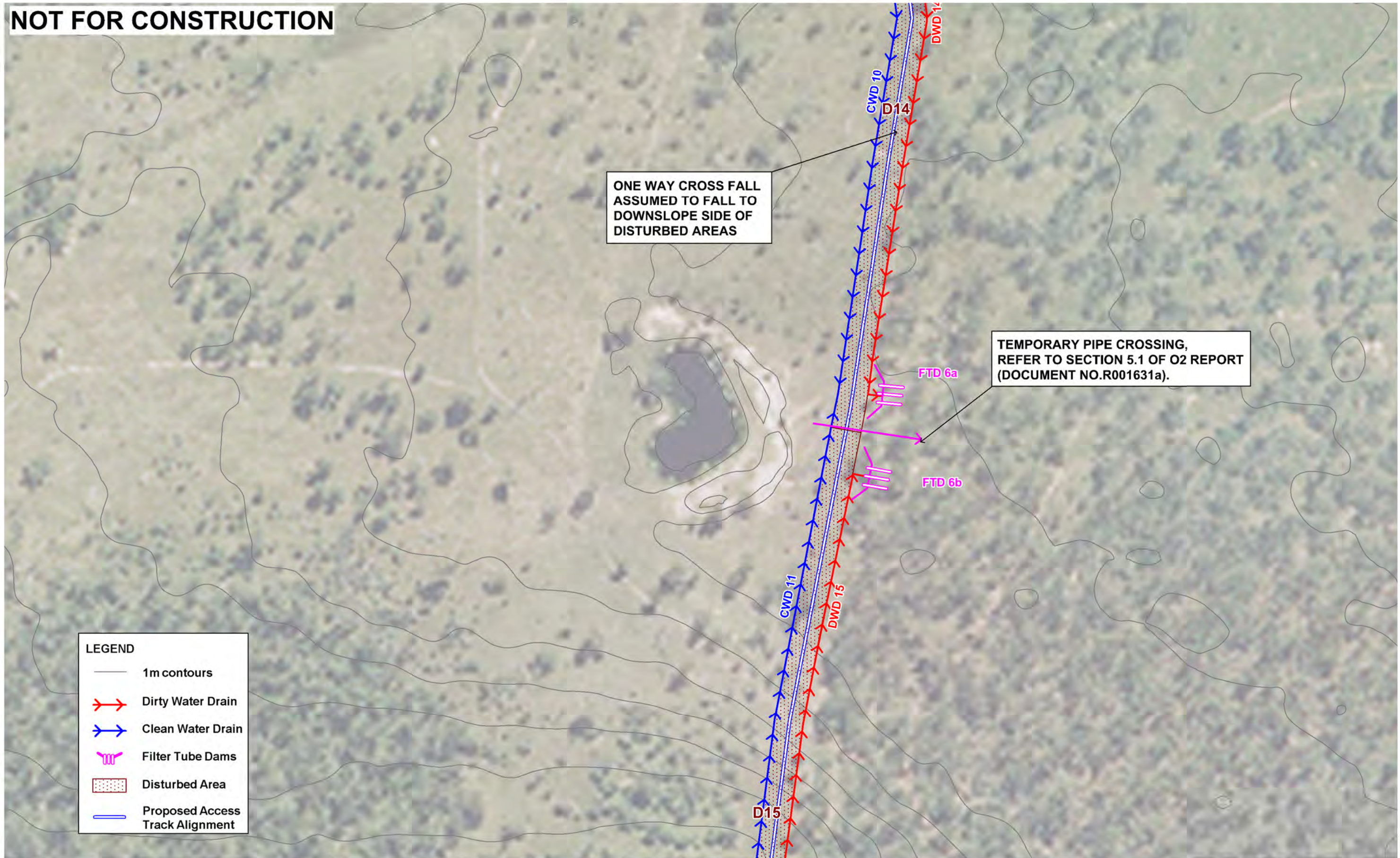
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CLEAR & GRUB ESC PLAN - SHEET 7

date	MAY 2012
job #	SC12-0029
drawing	009

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LEGEND

- 1m contours
- Dirty Water Drain
- Clean Water Drain
- Filter Tube Dams
- Disturbed Area
- Proposed Access Track Alignment

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metres

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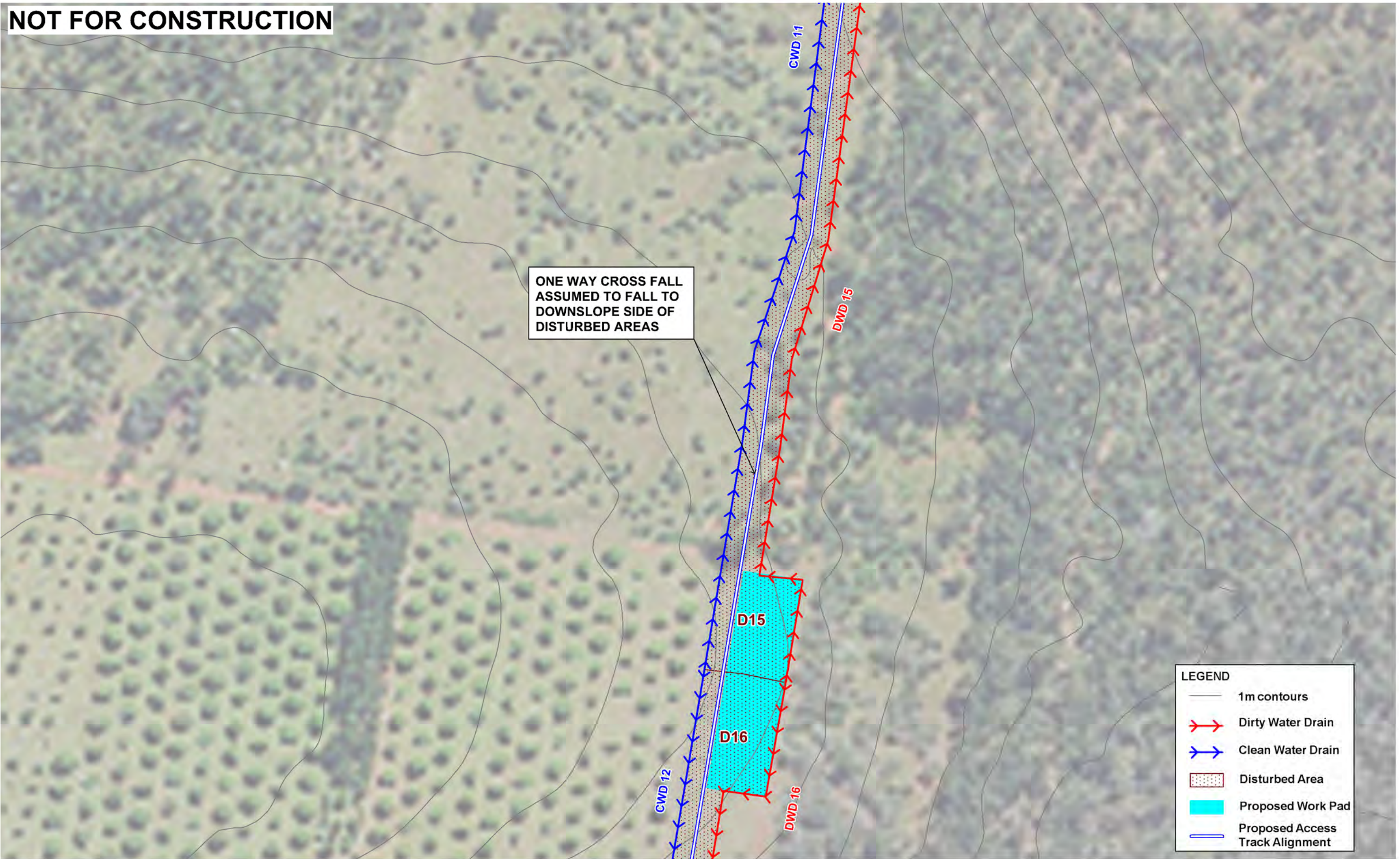
GLNG Operations Gas Transmission Pipeline Marine Crossing

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CLEAR & GRUB ESC PLAN - SHEET 8

date	MAY 2012
job #	SC12-0029
drawing	010

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LEGEND	
	1m contours
	Dirty Water Drain
	Clean Water Drain
	Disturbed Area
	Proposed Work Pad
	Proposed Access Track Alignment

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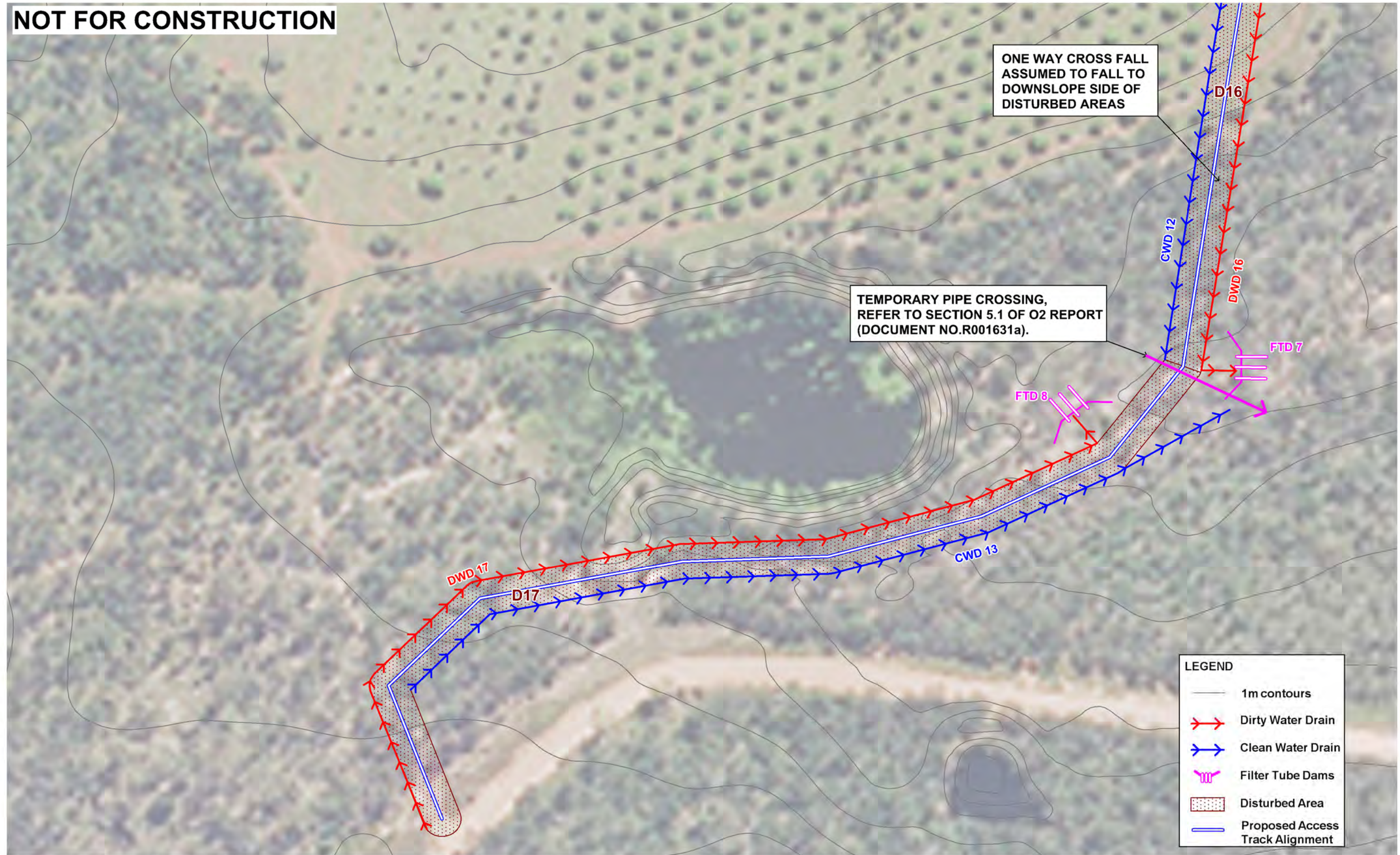
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 CLEAR & GRUB ESC PLAN - SHEET 9

date	MAY 2012
job #	SC12-0029
drawing	011

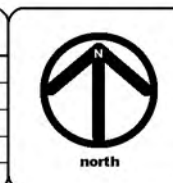
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LEGEND	
	1m contours
	Dirty Water Drain
	Clean Water Drain
	Filter Tube Dams
	Disturbed Area
	Proposed Access Track Alignment

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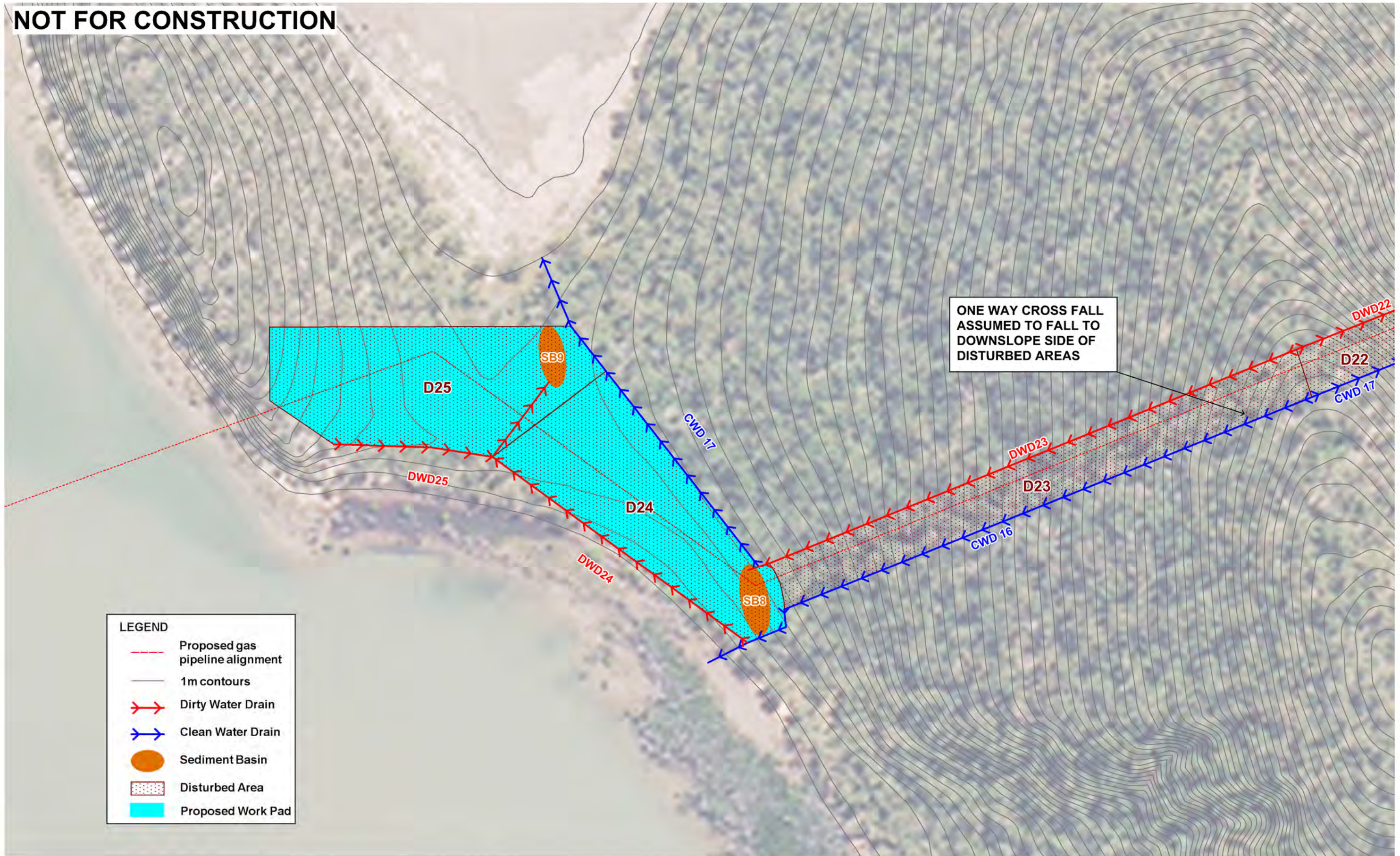
GLNG Operations Gas Transmission Pipeline Marine Crossing

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CLEAR & GRUB ESC PLAN - SHEET 10

date	MAY 2012
job #	SC12-0029
drawing	012

NOT FOR CONSTRUCTION



LEGEND	
	Proposed gas pipeline alignment
	1m contours
	Dirty Water Drain
	Clean Water Drain
	Sediment Basin
	Disturbed Area
	Proposed Work Pad

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rev.	amendments	date



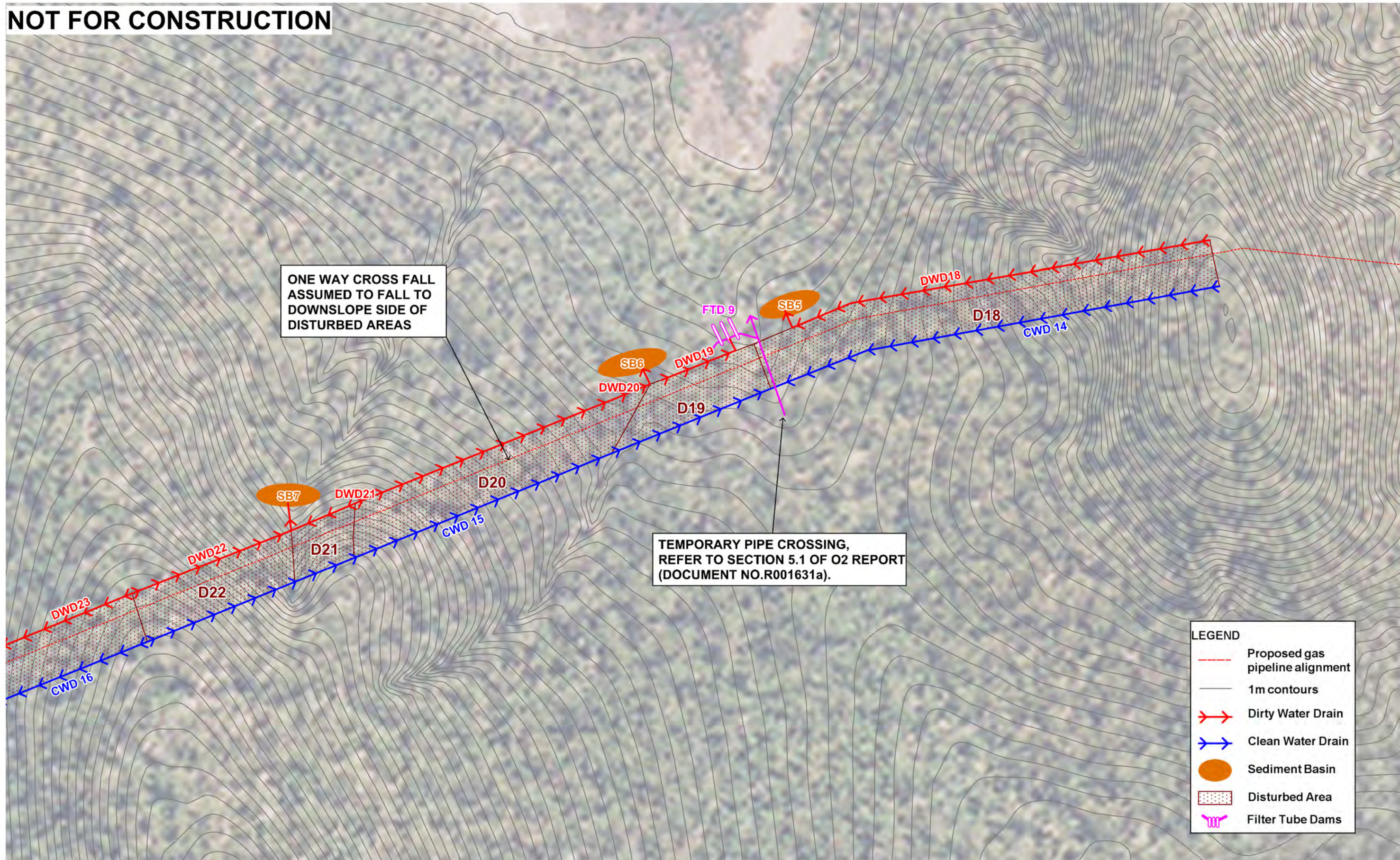
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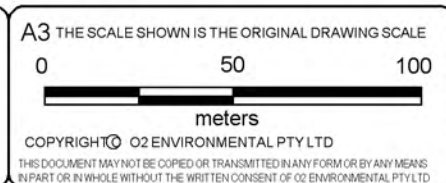
GLNG Operations Gas Transmission Pipeline Marine Crossing
GLNG
CLEAR & GRUB ESC PLAN - SHEET 11

date	MAY 2012
job #	SC12-0029
drawing	013

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rev.	amendments	date



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checked:	ST
datum:	mAHd
rl:	56

GLNG Operations Gas Transmission Pipeline Marine Crossing
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CLEAR & GRUB ESC PLAN - SHEET 12

date	MAY 2012
job #	SC12-0029
drawing	014



Appendix C Design Specification and Calculations

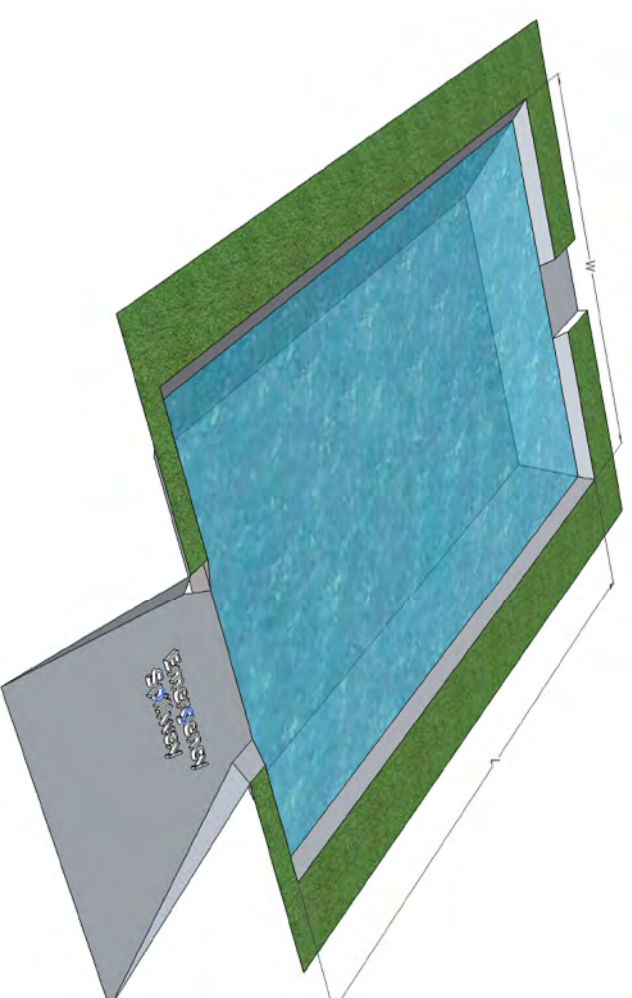
GLNG GAS TRANSMISSION ESCP

SEDIMENT BASIN DETAILS

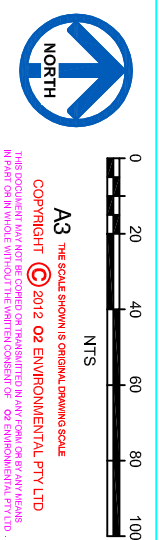
Sediment Basin Label	Volumetric Runoff Coefficient	Catchment Area (ha)	Design Rainfall Event	Setting Zone Volume (m ³)	Sediment Storage Volume (m ³)	Total Volume at Spillway	Depth (incl. freeboard) (m)	Pond length width ratio (L/W)	Batter Slope	Freeboard (m)	Length (incl. freeboard) (m)	Width (incl. freeboard) (m)
SB1	0.56	1.38	32.8	253.5	23.3	276.8	1.5	3.0	3.0	0.3	35.3	13.0
SB2	0.56	1.13	32.8	207.6	11.6	219.1	1.5	3.0	3.0	0.3	32.4	12.0
SB3	0.56	0.67	32.8	123.1	6.0	129.0	1.5	3.0	3.0	0.3	27.0	10.2
SB4	0.56	7.46	32.8	1370.3	92.8	1463.1	1.5	3.0	3.0	0.3	69.5	24.4
SB5	0.56	1.01	32.8	185.5	158.9	344.4	1.5	3.0	3.0	0.3	38.4	14.0
SB6	0.56	0.51	32.8	93.7	100.0	193.6	1.5	3.0	3.0	0.3	31.0	11.5
SB7	0.56	0.39	32.8	71.6	145.1	216.7	1.5	3.0	3.0	0.3	32.3	12.0
SB8	0.56	0.96	32.8	176.3	197.6	373.9	1.5	3.0	3.0	0.3	39.6	14.4
SB9	0.56	2.23	32.8	409.6	154.6	564.2	1.5	3.0	3.0	0.3	46.6	16.7

SPILLWAY DETAILS

Sediment Basin Label	Peak Flow Entering Basin, Q (m ³ /s)	Weir			Chute				Energy Dissipator						
		Base Width, b (m)	Horizontal Slope of Weir, m	Upstream Water Level, Relative to Weir, H (m)	Min. Height with 0.30m Freeboard (m)	Base Width (m)	Side Slope	Chute Slope (m/m)	Lining	Flow Depth (m)	Required Chute Depth with 0.30m Freeboard (m)	Mean Rock Size, d ₅₀ (mm)	Width 1 (m)	Width 2 (m)	Length (m)
SB1	0.35	3.00	2	0.16	0.46	3.0	2	0.25	Concrete	0.04	0.34	100	3.7	4.0	2.1
SB2	0.38	3.00	2	0.16	0.46	3.0	2	0.25	Concrete	0.04	0.34	100	3.8	4.0	2.1
SB3	0.21	3.00	2	0.11	0.41	3.0	2	0.25	Concrete	0.03	0.33	100	3.7	3.7	1.5
SB4	2.19	9.00	2	0.26	0.56	9.0	2	0.25	Concrete	0.06	0.36	200	9.8	10.6	3.4
SB5	0.43	3.00	2	0.18	0.48	3.0	2	0.25	Concrete	0.04	0.34	100	3.8	4.0	2.1
SB6	0.23	3.00	2	0.12	0.42	3.0	2	0.25	Concrete	0.03	0.33	100	3.7	3.7	1.5
SB7	0.19	3.00	2	0.10	0.40	3.0	2	0.25	Concrete	0.03	0.33	100	3.7	0.0	0.0
SB8	0.39	3.00	2	0.16	0.46	3.0	2	0.25	Concrete	0.04	0.34	100	3.8	0.0	0.0
SB9	0.96	3.00	2	0.29	0.59	3.0	2	0.25	Concrete	0.07	0.37	200	3.9	0.0	0.0



REV	DATE	REVISION DETAILS	APPROVED



DRAWN	MN&LD	CLIENT	TITLE
DESIGNED	MN	GLNG	ESCP
APPROVED	ST	PROJECT	SEDIMENT BASIN DETAILS
DATE	04/04/12	GLNG Operation Gas Transmission	DRAWING NO. 017
RPEO NO.	N/A	Pipeline Marine Crossing	REV.
GRID REF.	N/A		



Appendix D Lab Results



Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Tel: 02 9980 6554
Fax: 02 9484 2427

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Em: info@sesl.com.au
Web: www.sesl.com.au



Batch N°: 22163	Sample N°: 1	Date Received: 19/4/12	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
------------------------	---------------------	-------------------------------	--

Client Name: O2 Environment & Engineering	Project Name: Soil Sample Received 19/4/12
Client Contact: Steven Chamberlain	Location:
Client Job N°:	SESL Quote N°:
Client Order N°:	Sample Name: Site 1 Subsoil
Address: Unit 7a, 8 Grebe St Peregian Beach QLD 4573	Description: Soil
	Test Type: SSCP, EAT

RECOMMENDATIONS

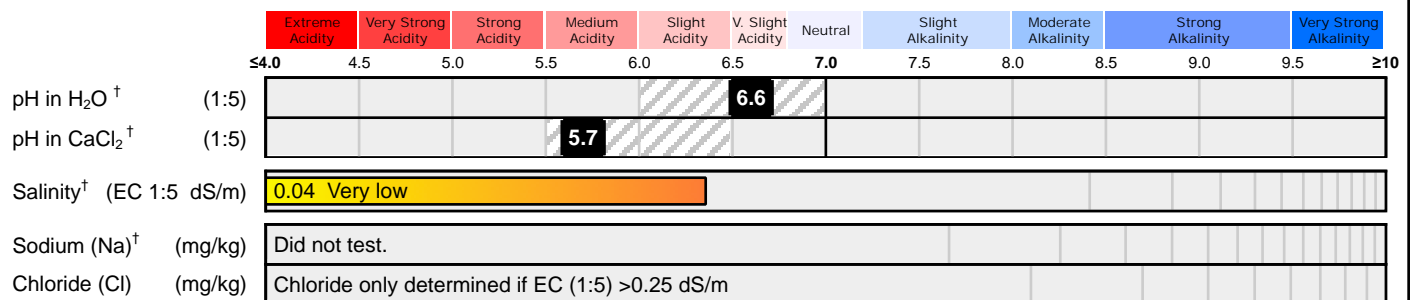
EAT - 3.2

This soil sample was analysed for properties related to healthy plant growth. It was found to be slightly acidic, not saline and not sodic. The cation balance is highly magnesian. The effective cation exchange capacity (eCEC) is low, indicating poor nutrient retention and holding capacity.

This sample is a light clay with low permeability. Combined with the magnicity, it may be prone to dispersion. Magnesium is elevated and may lead to an induced potassium deficiency. To buffer against deficiencies, incorporate potassium chloride at 20 g/sqm and gypsum at 200 g/sqm. The gypsum will help to raise the low calcium levels. These additions will further help to improve permeability and negate any tendency to disperse.

SOIL SAMPLE DEPTH (mm): 100 150 200 **FERTILITY RATING:** Low Moderate High

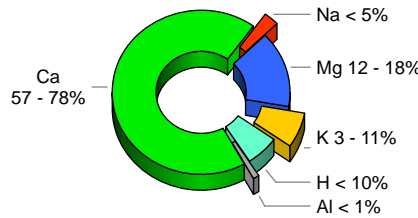
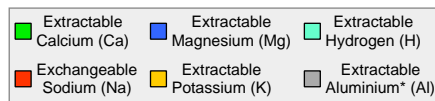
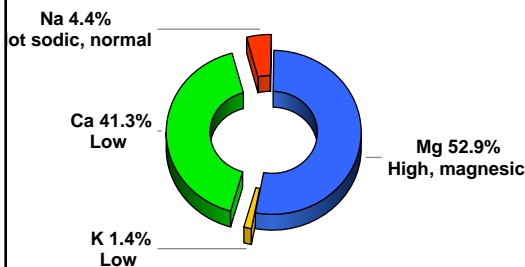
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.8	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	38.3	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.01	< 0.07
Comment: Acceptable		
K:Na	0.3	N/A
Sodium Absorption Ratio: 0.2 Low		
Electrochemical Stability Index (ESI): - Did not test.		

SOLUBLE CATIONS (meq/100g)

Na: 0.19 K: Ca: 1.80 Mg: 2.30



A member of the Australasian Soil and Plant Analysis Council
† This laboratory has been awarded a Certificate of Proficiency for specific soil and plant tissue analyses by the Australasian Soil and Plant Analysis Council (ASPAC). Tests for which proficiency has been demonstrated are highlighted in this report.

Disclaimer: Tests are performed under a quality system complying with ISO 9001:2008. Results are based on the analysis of the sample taken or received by SESL. Due to the variability of sampling procedures, environmental conditions and managerial factors, SESL does not accept any liability for a lack of performance based on its interpretation and recommendations. This document must not be reproduced except in full.



Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 02 9980 6554
Fax: 02 9484 2427
Em: info@sesl.com.au
Web: www.sesl.com.au



Batch N°: 22163 Sample N°: 1 Date Received: 19/4/12 Report Status: Draft Final

PLANT AVAILABLE NUTRIENTS									
Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	-						-	4.2	Did not test
Phosphate-P (PO ₄)	0						-	12.6	Did not test
Potassium (K) †	46.9						9.4	43.9	34.5
Sulphate-S (SO ₄)	-						-	13.6	13.6
Calcium (Ca) †	718						143.2	312.4	169.2
Magnesium (Mg) †	556						110.9	32.5	Drawdown
Iron (Fe)	-						-	110.1	Did not test
Manganese (Mn) †	-						-	8.8	Did not test
Zinc (Zn) †	-						-	1	Did not test
Copper (Cu)	-						-	1.3	Did not test
Boron (B) †	-						-	0.5	Did not test

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

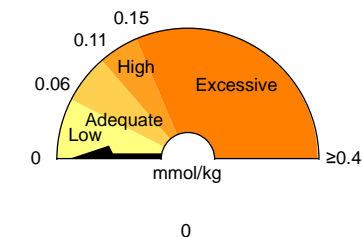
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **8.7**
Eff. Cation Exch. Capacity (eCEC): **8.7**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

- to achieve pH 6.0 (g/sqm): **0**
- to neutralise Al (g/sqm): -

Gypsum Application Rate

- to achieve 67.5% exch. Ca (g/sqm): **392**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: **Light Clay**
Typical clay content: **35 - 40%**
Size: **Fine**
Gravel content: **Gravelly**
Aggregate strength: **Moderate**
Structural unit: **Granular**
Potential infiltration rate: **Slow**
Permeability (mm/hr): **2.5 - 5 mm/hr**
Calculated EC_{SE} (dS/m): **0.34**
- **Non-saline. Salinity effects on plants are mostly negligible.**
Organic Carbon (OC%)[†]: **Did not test**
Organic Matter (OM%): -
Additional comments:

Consultant: Bronwyn Woodward

Authorised Signatory: Simon Leake

Date of Report: 30 Apr 2012

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)



A member of the Australasian Soil and Plant Analysis Council
† This laboratory has been awarded a Certificate of Proficiency for specific soil and plant tissue analyses by the Australasian Soil and Plant Analysis Council (ASPAC). Tests for which proficiency has been demonstrated are highlighted in this report.

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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Tel: 02 9980 6554
Fax: 02 9484 2427

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Em: info@sesil.com.au
Web: www.sesil.com.au



Batch N°: 22163 **Sample N°:** 2 **Date Received:** 19/4/12 **Report Status:** Draft Final

Client Name: O2 Environment & Engineering
Client Contact: Steven Chamberlain
Client Job N°:
Client Order N°:
Address: Unit 7a, 8 Grebe St
Peregian Beach QLD 4573

Project Name: Soil Sample Received 19/4/12
Location:
SESL Quote N°:
Sample Name: Site 2 Subsoil
Description: Soil
Test Type: SSCP, EAT

RECOMMENDATIONS

EAT - 3.2

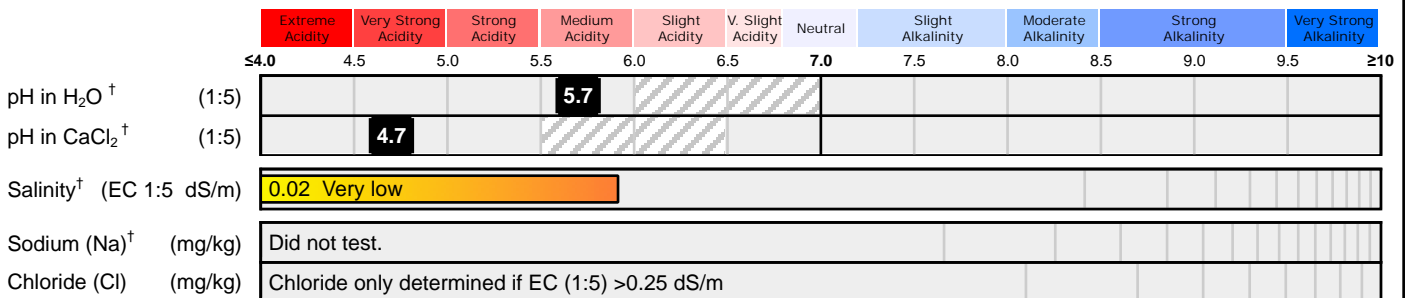
This soil sample was analysed for properties related to healthy plant growth. It was found to be strongly acidic, not saline and not sodic. The cation balance is dominated by hydrogen, leading to the strong acidity. The high acidity has increased the availability of aluminium, which is at levels likely to result in plant toxicities. The effective cation exchange capacity (eCEC) is very low, indicating poor nutrient retention and holding capacity. This is normal for sandy soils.

This sample is a highly permeable loamy sand.

Calcium and magnesium are both deficient, and can be improved through additions of lime at 150 g/sqm. This will help to raise the pH and increase the availability of many nutrients. Raising the pH will reduce the risk of aluminium toxicity.

SOIL SAMPLE DEPTH (mm): 100 150 200 **FERTILITY RATING:** Low Moderate High

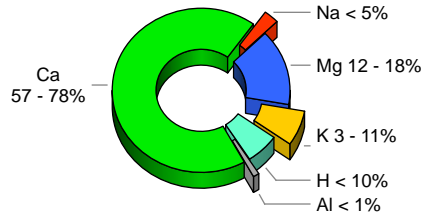
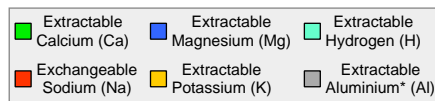
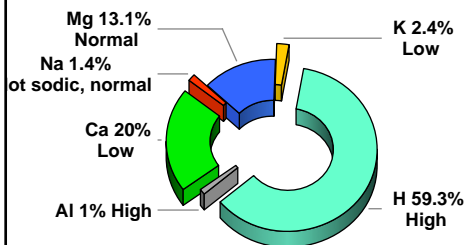
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

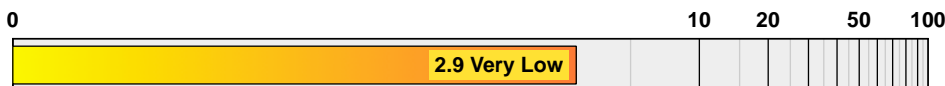
Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1.5	4.1 – 6.0
Comment: Calcium low		
Mg:K	5.4	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.07	< 0.07
Comment: High		
K:Na	1.8	N/A
Sodium Absorption Ratio: D.N.T.		

Electrochemical Stability Index (ESI):
- Did not test.

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:





Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Web: www.sesl.com.au



Batch N°: 22163 Sample N°: 2 Date Received: 19/4/12 Report Status: Draft Final

PLANT AVAILABLE NUTRIENTS									
Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	-						-	4.2	Did not test
Phosphate-P (PO ₄)	0						-	12.6	Did not test
Potassium (K) †	28.9						5.8	35.5	29.7
Sulphate-S (SO ₄)	-						-	13.6	13.6
Calcium (Ca) †	116						23.1	252.8	229.7
Magnesium (Mg) †	45.4						9.1	26.7	17.6
Iron (Fe)	-						-	110.1	Did not test
Manganese (Mn) †	-						-	8.8	Did not test
Zinc (Zn) †	-						-	1	Did not test
Copper (Cu)	-						-	1.3	Did not test
Boron (B) †	-						-	0.5	Did not test

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

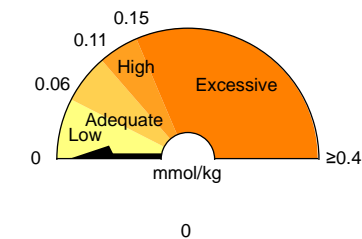
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): **7.7**
Sum of Base Cations (meq/100g⁻¹): **1.1**
Eff. Cation Exch. Capacity (eCEC): **2.9**
Base Saturation (%): **37.93**
Exchangeable Acidity (meq/100g⁻¹): **1.72**
Exchangeable Acidity (%): **59.31**

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **150**
– to neutralise Al (g/sqm): **4**

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **0**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: **Loamy Sand**
Typical clay content: **5 - 10%**
Size: **Fine**
Gravel content: **Not gravelly**
Aggregate strength: **Weak**
Structural unit: **Crumb**
Potential infiltration rate: **Very Rapid**
Permeability (mm/hr): **>120 mm/hr**
Calculated EC_{SE} (dS/m): **0.46**
– **Non-saline. Salinity effects on plants are mostly negligible.**
Organic Carbon (OC%)[†]: **Did not test**
Organic Matter (OM%): **-**
Additional comments:

Consultant: Bronwyn Woodward

Authorised Signatory: Simon Leake

Date of Report: 30 Apr 2012

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Thornleigh NSW 2120

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Tel: 02 9980 6554
Fax: 02 9484 2427
Em: info@sesl.com.au
Web: www.sesl.com.au



Batch N°: 22163 **Sample N°:** 3 **Date Received:** 19/4/12 **Report Status:** Draft Final

Client Name: O2 Environment & Engineering
Client Contact: Steven Chamberlain
Client Job N°:
Client Order N°:
Address: Unit 7a, 8 Grebe St
Peregian Beach QLD 4573

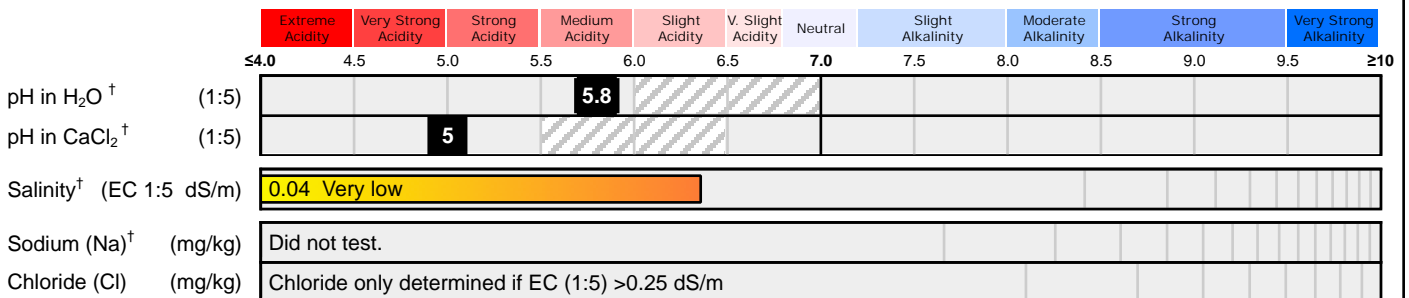
Project Name: Soil Sample Received 19/4/12
Location:
SESL Quote N°:
Sample Name: Site 2 Topsoil
Description: Soil
Test Type: RSCP

RECOMMENDATIONS

This soil sample was analysed for properties related to healthy plant growth. It was found to be moderately acidic, not saline and not sodic. The cation balance is dominated by hydrogen, leading to the strong acidity. The effective cation exchange capacity (eCEC) is very low, indicating poor nutrient retention and holding capacity (as expected of sandy soils). This sample is a highly permeable loamy sand. Of the plant available nutrients analysed, all were deficient. N in particular will prove limiting at these low levels. Split applications of urea at 20 g/m² (i.e. 2 x 20 g/sqm applications) will improve the nitrate levels. To improve levels of other nutrients, apply a multipurpose low P NPK fertiliser such as "native plant food". This product should be applied at 15 - 25 g/sqm. Current phosphate levels will not be harmful to P-sensitive plantings. Incorporating lime at 200 g/sqm will help to raise the pH and increase nutrient availability. Incorporating composted organic matter at 20% by volume will assist in improving the water holding capacity and CEC of the soil.

SOIL SAMPLE DEPTH (mm): 100 150 200 **FERTILITY RATING:** Low Moderate High

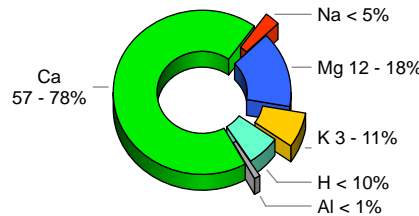
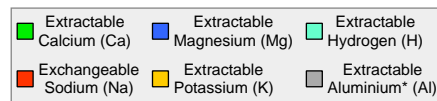
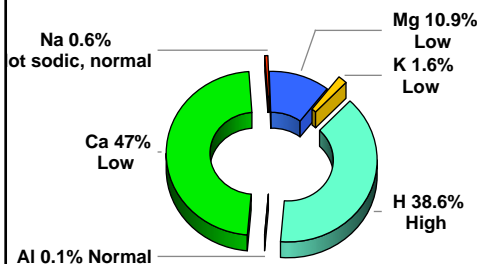
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	4.3	4.1 – 6.0
Comment: Balanced		
Mg:K	6.6	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.03	< 0.07
Comment: Acceptable		
K:Na	2.6	N/A
Sodium Absorption Ratio: D.N.T.		

Electrochemical Stability Index (ESI):
- Did not test.

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:





Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Thornleigh NSW 2120

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Tel: 02 9980 6554
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Web: www.sesl.com.au



Batch N°: 22163 Sample N°: 3 Date Received: 19/4/12 Report Status: Draft Final

PLANT AVAILABLE NUTRIENTS									
Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	9						1.8	4.2	2.4
Phosphate-P (PO ₄)	6.3						1.3	12.6	11.3
Potassium (K) †	51.6						10.3	43.9	33.6
Sulphate-S (SO ₄)	<3.20						0.6	13.6	13
Calcium (Ca) †	741						147.8	312.4	164.6
Magnesium (Mg) †	104						20.7	32.5	11.8
Iron (Fe)	-						-	110.1	Did not test
Manganese (Mn) †	-						-	8.8	Did not test
Zinc (Zn) †	-						-	1	Did not test
Copper (Cu)	-						-	1.3	Did not test
Boron (B) †	-						-	0.5	Did not test

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

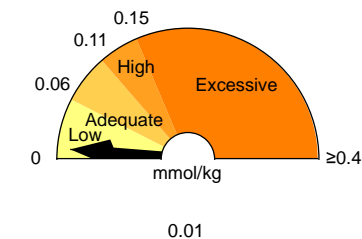
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): **7.5**
Sum of Base Cations (meq/100g⁻¹): **4.8**
Eff. Cation Exch. Capacity (eCEC): **7.9**
Base Saturation (%): **60.76**
Exchangeable Acidity (meq/100g⁻¹): **3.05**
Exchangeable Acidity (%): **38.61**

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **230**
– to neutralise Al (g/sqm): **1**

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **0**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: **Sandy Loam**
Typical clay content: **10 - 20%**
Size: **Fine**
Gravel content: **Not gravelly**
Aggregate strength: **Weak**
Structural unit: **Crumb**
Potential infiltration rate: **Rapid**
Permeability (mm/hr): **60 - 120 mm/hr**
Calculated EC_{SE} (dS/m): **0.56**
– **Non-saline. Salinity effects on plants are mostly negligible.**
Organic Carbon (OC%)[†]: **Did not test**
Organic Matter (OM%): **-**
Additional comments:

Consultant: Bronwyn Woodward

Authorised Signatory: Simon Leake

Date of Report: 30 Apr 2012

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Web: www.sesl.com.au



Batch N°: 22163	Sample N°: 4	Date Received: 19/4/12	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
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Client Name: O2 Environment & Engineering	Project Name: Soil Sample Received 19/4/12
Client Contact: Steven Chamberlain	Location:
Client Job N°:	SESL Quote N°:
Client Order N°:	Sample Name: Site 3 Topsoil
Address: Unit 7a, 8 Grebe St Peregian Beach QLD 4573	Description: Soil
	Test Type: RSCP

RECOMMENDATIONS

This soil sample was analysed for properties related to healthy plant growth. It was found to be moderately acidic, not saline and not sodic. The cation balance is highly magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity.

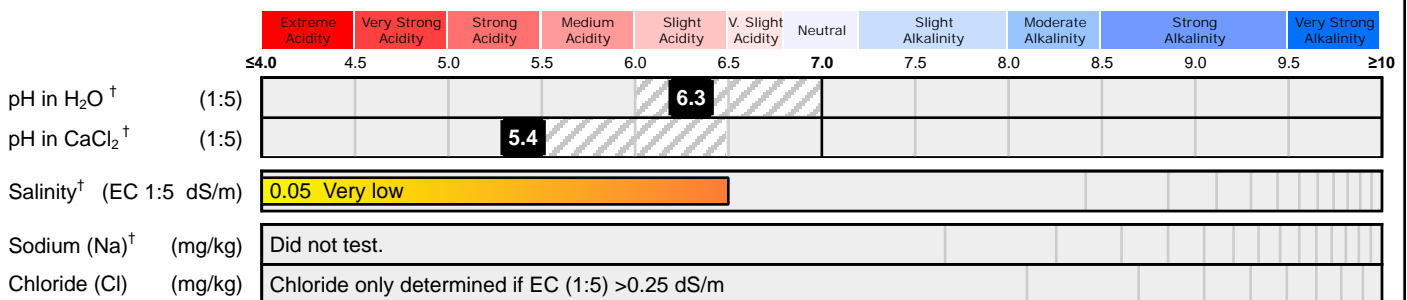
This sample is a highly permeable loamy sand. Of the plant available nutrients analysed, all except magnesium were deficient. N in particular will prove limiting at these low levels. Use split applications of urea at 20 g/m² (i.e. 2 x 20 g/sqm applications) to improve the nitrate levels.

Magnesium is elevated and may lead to an induced potassium deficiency. Incorporate composted organic matter at 20% by volume and gypsum at 200 g/sqm to raise the low calcium levels and improve the water holding capacity of the soil. These additions will further help to improve permeability and negate any tendency to disperse.

To improve nutrient levels, apply a multipurpose low P NPK fertiliser such as "native plant food". This product should be applied at 15 - 25 g/sqm. Current phosphate levels will not be harmful to P-sensitive plantings. Incorporating lime at 200 g/sqm will help to raise the pH and increase nutrient availability.

SOIL SAMPLE DEPTH (mm): 100 150 200 FERTILITY RATING: Low Moderate High

pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

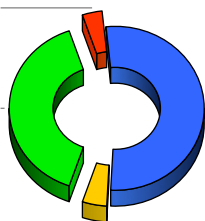
EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2

Na 3.7%
not sodic, normal

Ca 39.4%
Low

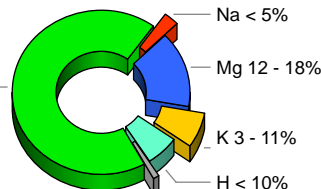
K 4.3%
Normal



ACTUAL

Mg 52.4%
High, magnesian

Ca 57 - 78%



IDEAL

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.8	4.1 - 6.0
Comment: Potential Calcium deficiency		
Mg:K	12.2	2.6 - 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.05	< 0.07
Comment: Acceptable		
K:Na	1.2	N/A
Sodium Absorption Ratio: D.N.T.		
Electrochemical Stability Index (ESI): - Did not test.		
SOLUBLE CATIONS (meq/100g)		
Na:	K:	Ca: Mg:

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



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Batch N°: 22163 Sample N°: 4 Date Received: 19/4/12 Report Status: Draft Final

PLANT AVAILABLE NUTRIENTS									
Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	0.2						0	4.2	4.2
Phosphate-P (PO ₄)	25.4						5.1	12.6	7.5
Potassium (K) †	267						53.3	60.6	7.3
Sulphate-S (SO ₄)	<3.20						0.6	13.6	13
Calcium (Ca) †	1246						248.6	431.7	183.1
Magnesium (Mg) †	1002						199.9	44.9	Drawdown
Iron (Fe)	-						-	110.1	Did not test
Manganese (Mn) †	-						-	8.8	Did not test
Zinc (Zn) †	-						-	1	Did not test
Copper (Cu)	-						-	1.3	Did not test
Boron (B) †	-						-	0.5	Did not test

Explanation of graph ranges:

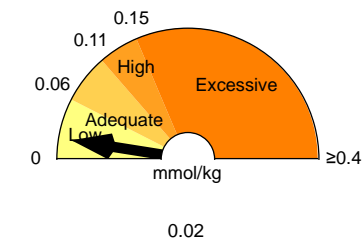
Very Low Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.	Low Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.	Marginal Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.	Adequate Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.	High The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.
---	--	---	--	---

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): **7.3**
Sum of Base Cations (meq/100g⁻¹): **15.8**
Eff. Cation Exch. Capacity (eCEC): **15.8**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

- to achieve pH 6.0 (g/sqm): **0**
- to neutralise Al (g/sqm): -

Gypsum Application Rate

- to achieve 67.5% exch. Ca (g/sqm): **761**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: **Loam**
Typical clay content: **10 - 25%**
Size: **Fine**
Gravel content: **Gravelly**
Aggregate strength: **Moderate**
Structural unit: **Granular**
Potential infiltration rate: **Rapid**
Permeability (mm/hr): **60 - 120 mm/hr**
Calculated EC_{SE} (dS/m): **0.48**
- Non-saline. Salinity effects on plants are mostly negligible.
Organic Carbon (OC%)[†]: **Did not test**
Organic Matter (OM%): -
Additional comments:

Consultant: Bronwyn Woodward

Authorised Signatory: Simon Leake

Date of Report: 30 Apr 2012

METHOD REFERENCES:
pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)



A member of the Australasian Soil and Plant Analysis Council
† This laboratory has been awarded a Certificate of Proficiency for specific soil and plant tissue analyses by the Australasian Soil and Plant Analysis Council (ASPAC). Tests for which proficiency has been demonstrated are highlighted in this report.

Disclaimer: Tests are performed under a quality system complying with ISO 9001:2008. Results are based on the analysis of the sample taken or received by SESL. Due to the variability of sampling procedures, environmental conditions and managerial factors, SESL does not accept any liability for a lack of performance based on its interpretation and recommendations. This document must not be reproduced except in full.



Appendix E Sediment Basin Construction and Operation Procedure

Standard Construction and Operation Procedure for Type F or Type D Sediment Basins



CLIENT:

STATUS:

Draft

REPORT NUMBER

Uncontrolled

Version d

ISSUE DATE:

June 2012

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Compliance with this procedure will not guarantee:

- (i) Compliance with any statutory obligations
- (ii) Compliance with specific water quality objectives
- (iii) Avoidance of environmental harm or nuisance.

Version Register

Issue	Author	Reviewer	Change Notes	Authorised for Release	
				Signature	Date
a	Terry Clark	Ben Starr	Correct flowchart	Ben Starr	23 Mar 2010
b	Ben Starr	Ben Starr	Update Section 5	Ben Starr	11 Nov 2010
c	Ben Starr	Ben Starr	Added Construction and Maintenance Section and Annexures	Ben Starr	05 Dec 2010
D	Kyle Robson	Steve Dudgeon	pH value changed	Kyle Robson	23 Sep 2011
E	Steve Dudgeon	Steve Dudgeon	Add additional info flocculants	Steve Dudgeon	1 June 2012

Transmission Register

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Annexure B Sediment Basin Discharge Authority (Form)

1. Introduction

This guideline applies specifically to the construction and operation of a Wet Type F (fine grained soils) or Type D (dispersive soils) sediment basin/s in South East Queensland. The document provides default construction specifications and outlines requirements for monitoring, treatment and discharge of sediment laden water from the basin/s (refer **Figure 1**) on site sized to detain a 5 day, 80th percentile rainfall event.

This guideline does not provide any site specific design information for sediment basins, including sizing, batter slopes, spillway weir, chute dimensions and stabilization requirements or energy dissipater requirements. The location, sizing and design of the sediment basin if required must be specified in the contractor's erosion and sediment control plan prepared by a Certified Professional in Erosion and Sediment Control (CPESC). Where any other specification, local requirement, or detail design requirement conflicts with the specifications of this guideline, those other local requirements override any guidelines recommended here.

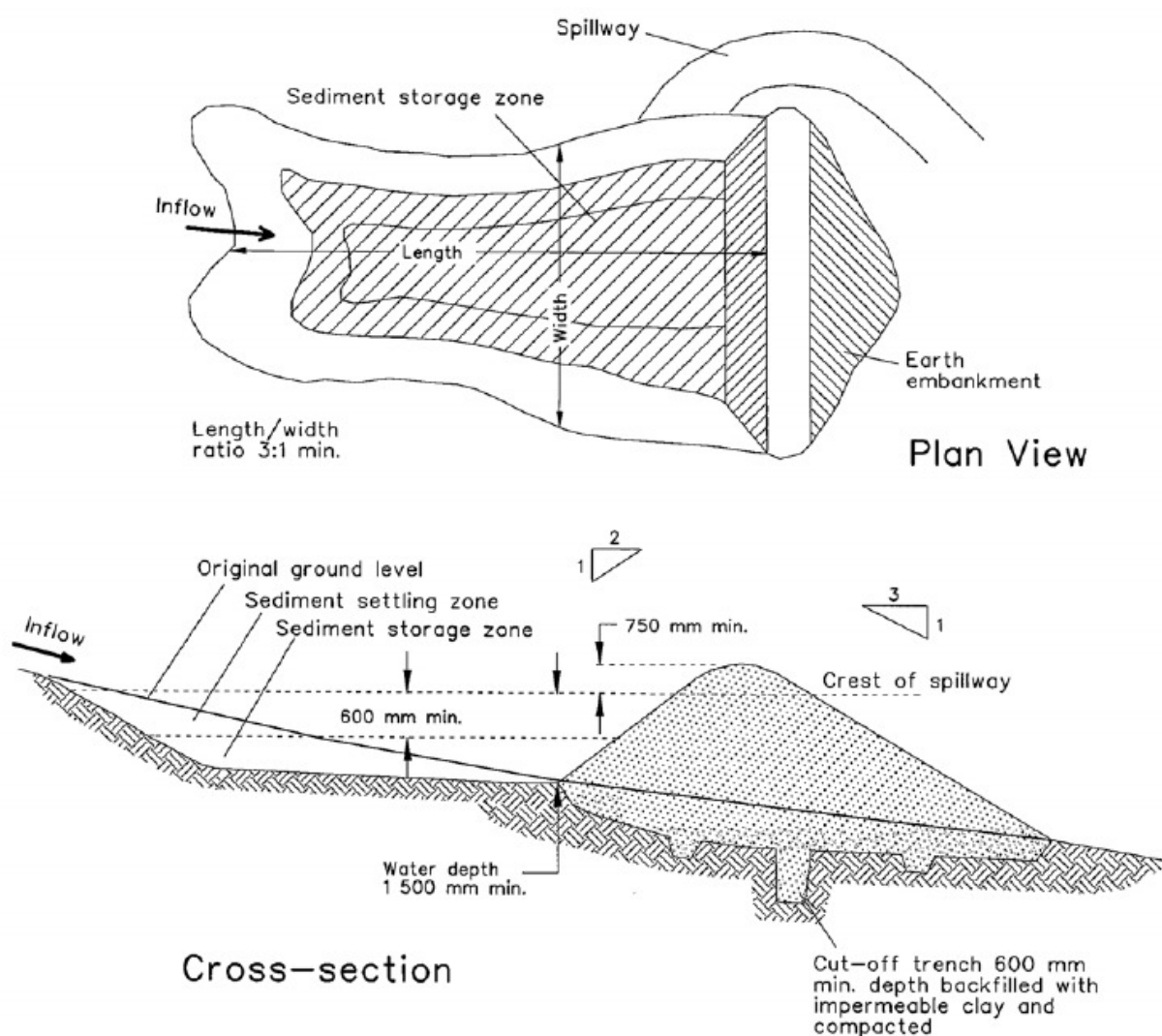


Figure 1 – Standard Drawing of Sediment Basin (Landcom 2004)

2. Sediment Basin Construction and Maintenance

The Basin Construction and Maintenance standard specifications provided in Section 2 of this report are reproduced from Section B3 of IECA 2008 "Best Practice Erosion and Sediment Control" document. This document should be referred to for additional supporting technical information relating to Basin monitoring and maintenance.

Appropriate construction, operation and maintenance of *Sediment Basins* is a critical component of construction site management and environmental protection.

Attached to the end of this section is an example "*Certification of Basin Construction*" form. This, or an equivalent form, should be submitted to the relevant regulatory authority for each Sediment Basin constructed. Regulatory authorities are encouraged to require the submission of such forms, as well as *As-constructed Plans*, as mandatory for all *sediment basins*.

2.1. Default specifications for Sediment Basin construction:

2.1.1. Materials

- Earth fill: clean soil with Emerson Class 2(1), 3, 4, or 5, and free of roots, woody vegetation, rocks and other unsuitable material. Soil with Emerson Class 4 and 5 may not be suitable depending on particle size distribution and degree of dispersion. Class 2(1) should only be used upon recommendation from geotechnical specialist. [*Alternatively, set a standard based on exchangeable sodium percentage - seek expert advice.*]
- Spillway rock: hard, angular, durable, weather resistant and evenly graded rock with 50% by weight larger than the specified nominal (d50) rock size. Large rock should dominate, with sufficient small rock to fill the voids between the larger rock. The diameter of the largest rock size should be no larger than 1.5 times the nominal rock size. The specific gravity should be at least 2.5.
- Geotextile fabric: heavy-duty, needle-punched, non-woven filter cloth, minimum bidim A24 or equivalent.

2.1.2. Construction

1. Notwithstanding any description contained within the approved plans or specifications, the Contractor shall be responsible for satisfying themselves as to the nature and extent of the specified works and the physical and legal conditions under which the works will be carried out. This shall include means of access, extent of clearing, nature of material to be excavated, type and size of mechanical plant required, location and suitability of water supply for construction and testing purposes, and any other like matters affecting the construction of the works.
2. Refer to approved plans for location, dimensions, and construction details. If there are questions or problems with the location, dimensions, or method of installation, contact the engineer or responsible on-site officer for assistance.
3. Before starting any clearing or construction, ensure all the necessary materials and components are on the site to avoid delays in completing the pond once works begin.
4. Install required short-term sediment control measures downstream of the proposed earthworks to control sediment runoff during construction of the basin.
5. The area to be covered by the embankment, borrow pits and incidental works, together with an area extending beyond the limits of each for a distance not exceeding five (5) metres all around must be cleared of all trees, scrub, stumps, roots, dead timber and rubbish and disposed of in a

suitable manner. Delay clearing the main pond area until the embankment is complete. [modify as necessary to limit total area of disturbance and any damage to protected vegetation]

6. Ensure all holes made by grubbing within the embankment footprint are filled with sound material, adequately compacted, and finished flush with the natural surface.

2.1.3. Cut-off trench:

7. Before construction of the cut-off trench or any ancillary works within the embankment footprint, all grass growth and topsoil must be removed from the area to be occupied by the embankment and must be deposited clear of this area and reserved for topdressing the completing the embankment.
8. Excavate a cut-off trench along the centre line of the earth fill embankment. Cut the trench to stable soil material, but in no case make it less than 600mm deep. The cut-off trench must extend into both abutments to at least the elevation of the riser pipe crest. Make the minimum bottom width wide enough to permit operation of excavation and compaction equipment, but in no case less than 600mm. Make the side slopes of the trench no steeper than 1:1 (H:V).
9. Ensure all water, loose soil, and rock are removed from the trench before backfilling commences. The cut-off trench must be backfilled with selected earth-fill of the type specified for the embankment, and this soil must have a moisture content and degree of compaction the same as that specified for the selected core zone.
10. Material excavated from the cut-off trench may be used in construction of the embankment provided it is suitable and it is placed in the correct zone according to its classification.

2.1.4. Embankment:

11. Scarify areas on which fill is to be placed before placing the fill.
12. Ensure all fill material used to form the embankment meets the specifications certified by a soil scientist or geotechnical specialist.
13. The fill material must contain sufficient moisture so it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction. Place fill material in 150 to 250mm continuous layers over the entire length of the fill area and then compact before placement of further fill.
14. Unless otherwise specified on the approved plans, compact the soil at about 1% to 2% wet of optimum and to 95% modified or 100% standard compaction.
15. Where both dispersive and non-dispersive classified earth-fill materials are available, non-dispersive earth-fill must be used in the core zone. The remaining classified earth-fill materials must only be used as directed by a geotechnical specialist.
16. Where specified, construct the embankment to an elevation 10% higher than the design height to allow for settling; otherwise finished dimensions of the embankment after spreading of topsoil must conform to the drawing with a tolerance of 75mm from the specified dimensions.
17. Ensure debris and other unsuitable building waste is not placed within the earth embankment.
18. After completion of the embankment all loose uncompacted earth-fill material on the upstream and downstream batter must be removed prior to spreading of topsoil.
19. Topsoil and revegetate/stabilised all exposed earth as directed within the approved plans.

2.1.5. Spillway construction:

20. The spillway must be excavated as shown on the plans, and the excavated material if classified as suitable, must be used in the embankment, and if not suitable it must be disposed of into spoil heaps.
21. Ensure excavated dimensions allow adequate boxing-out such that the specified elevations, grades, chute width, and entrance and exit slopes for the emergency spillway will be achieved after placement of the rock or other scour protection measures as specified in the plans.
22. Place specified scour protection measures on the emergency spillway. Ensure the finished grade blends with the surrounding area to allow a smooth flow transition from spillway to downstream channel.
23. If a synthetic filter fabric underlay is specified, place the filter fabric directly on the prepared foundation. If more than 1 sheet of filter fabric is required, overlap the edges by at least 300mm and place anchor pins at minimum 1m spacing along the overlap. Bury the upstream end of the fabric a minimum 300mm below ground and where necessary, bury the lower end of the fabric or overlap a minimum 300mm over the next downstream section as required. Ensure the filter fabric extends at least 1000mm upstream of the spillway crest.
24. Take care not to damage the fabric during or after placement. If damage occurs, remove the rock and repair the sheet by adding another layer of fabric with a minimum overlap of 300mm around the damaged area. If extensive damage is suspected, remove and replace the entire sheet.
25. Where large rock is used, or machine placement is difficult, a minimum 100mm layer of fine gravel, aggregate, or sand may be needed to protect the fabric.
26. Placement of rock should follow immediately after placement of the filter fabric. Place rock so that it forms a dense, well-graded mass of rock with a minimum of voids. The desired distribution of rock throughout the mass may be obtained by selective loading at the quarry and controlled dumping during final placement.
27. The finished slope should be free of pockets of small rock or clusters of large rocks. Hand placing may be necessary to achieve the proper distribution of rock sizes to produce a relatively smooth, uniform surface. The finished grade of the rock should blend with the surrounding area. No overfall or protrusion of rock should be apparent.
28. Ensure that the final arrangement of the spillway crest will not promote excessive flow through the rock such that the water can be retained within the settling basin an elevation no less than 50mm above or below the nominated spillway crest elevation.

2.1.6. Establishment of settling pond:

29. The area to be covered by the stored water outside the limits of the borrow pits must be cleared of all scrub and rubbish. Trees must be cut down stump high and removed from the immediate vicinity of the work.
30. Establish all required inflow chutes and inlet baffles, if specified, to enable water to discharge into the basin in a manner that will not cause soil erosion or the re-suspension of settled sediment.
31. Install a sediment storage level marker post with a cross member set just below the top of the sediment storage zone (as specified on the approved plans). Use at least a 75mm wide post firmly set into the basin floor.
32. If specified, install internal settling pond baffles. Ensure the crest of these baffles is set level with, or just below, the elevation of the emergency spillway crest.

33. Install all appropriate measures to minimise safety risk to on-site personnel and the public caused by the presence of the settling pond. Avoid steep, smooth internal slopes. Appropriately fence the settling pond and post warning signs if unsupervised public access is likely or there is considered to be an unacceptable risk to the public.

2.1.7. Maintenance of Sediment Basin

1. Inspect the sediment basin during the following periods:
 - (i) During construction to determine whether machinery, falling trees, or construction activity has damaged any components of the sediment basin. If damage has occurred, repair it.
 - (ii) After each runoff event. Inspect the erosion damage at flow entry and exit points. If damage has occurred, make the necessary repairs.
 - (iii) At least weekly during the nominated wet season (if any) otherwise at least fortnightly.
 - (iv) Prior to, and immediately after, periods of "stop work" or site "shutdown".
2. Clean out accumulated sediment when it reaches the marker board/post, and restore the original storage volume. Place sediment in a disposal area or, if appropriate, mix with dry soil on the site.
3. Do not dispose of sediment in a manner that will create an erosion or pollution hazard.
4. Check all visible pipe connections for leaks, and repair as necessary.
5. Check fill material in the dam for excessive settlement, slumping of the slopes or piping between the conduit and the embankment; make all necessary repairs.
6. Remove all trash and other debris from the basin and riser.
7. Submerged inflow pipes must be inspected and de-silted (as required) after each inflow event.

2.1.8. Removal of Sediment Basin

1. When grading and construction in the drainage area above a temporary sediment basin is completed and the disturbed areas are adequately stabilised, the basin must be removed or otherwise incorporated into the permanent stormwater drainage system. In either case, sediment should be cleared and properly disposed of and the basin area stabilised.
2. Before starting any maintenance work on the basin or spillway, install all necessary short-term sediment control measures downstream of the sediment basin.
3. All water and sediment must be removed from the basin prior to the dam's removal. Dispose of sediment and water in a manner that will not create an erosion or pollution hazard.
4. Bring the disturbed area to a proper grade, then smooth, compact, and stabilise and/or revegetate as required to establish a stable land surface.

3. Sediment Basin Operation

Type F and Type D sediment basins operate as 'wet' basins, Wet basins are designed to retain sediment laden water, allowing adequate time for the settlement of fine particles, either by gravitational means or use of chemical flocculants. In operating a wet basin the settled/treated water must be decanted from the basin as soon as a suitable water quality is achieved.

Type F and Type D sediment basins are typically designed for a maximum 5 day cycle; that being the filling, treatment and discharge of the basin within a maximum 5 day period.

The sediment basin procedure described in **Figure 2** below should be carried out daily, prior to commencement of works on site. If water is above the sediment storage zone in the basin, treatment, sampling and discharge should be achieved in the following 48 hours.

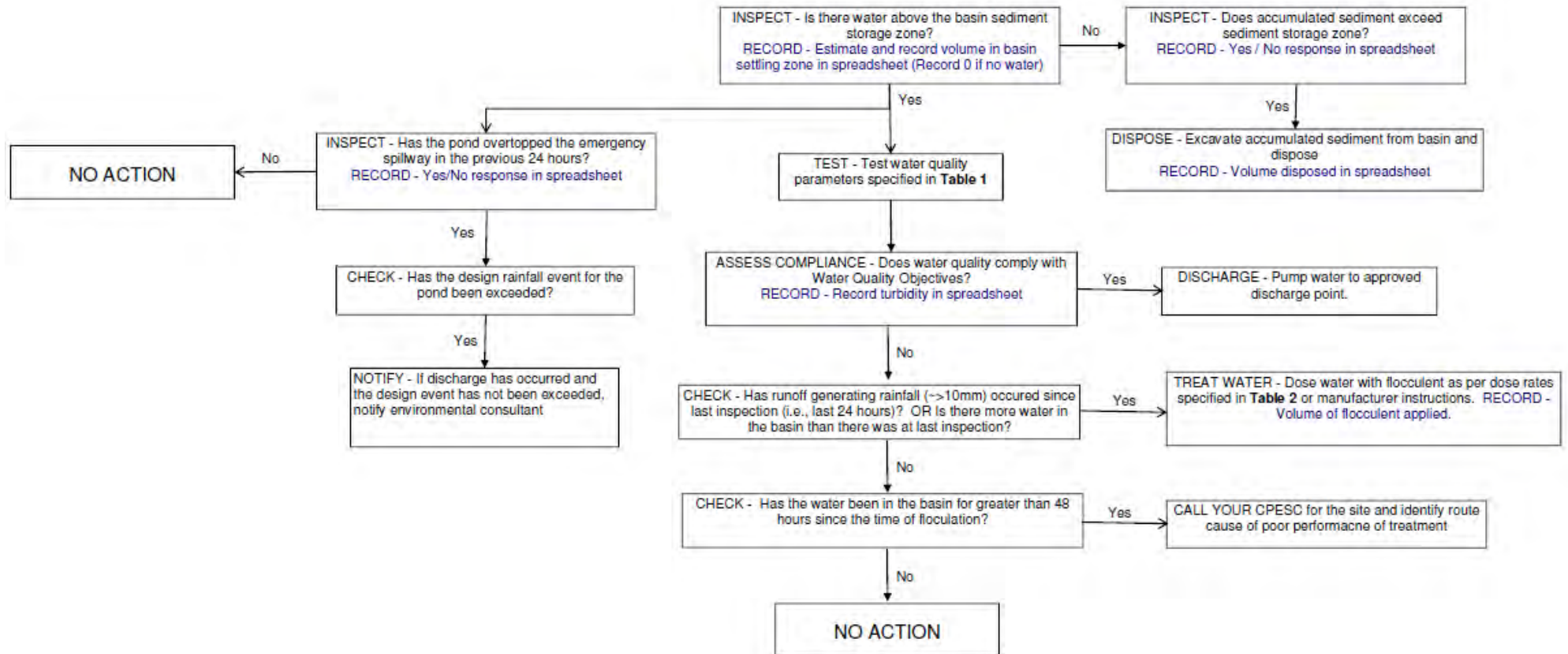


Figure 2 – Sediment Basin Procedure (Do Daily)

3.1. Monitoring

Monitoring of water quality in the sediment basin/s is to be conducted daily by the Contractors representative or other suitably qualified third party following runoff generating rainfall or when the water level is above the sediment storage zone. The site foreman is responsible for notifying the responsible party of such conditions. Recording and reporting of results is to be carried out as per **Section 4**.

Water quality is to be assessed against objectives outlined in **Table 1**.

Samples should be collected from the base of the settling zone and not at the surface; this may be achieved using a sample bottle fastened to the end of a pole. The bottle should be pushed with the opening facing down until it is submerged to the base of the settling zone. The sample can then be recovered and decanted into a sample bottle for submission to a laboratory or testing on site with a probe.

Until a site specific relationship is developed the Sunshine Coast Regional Council Maroon book (2007) notes that *'A turbidity reading of around 75 NTU roughly corresponds to 50 mg/L TSS in many of our catchments'*. Until a site specific calibration can be undertaken it is recommended that this figure is used as an interim water quality objective. Acceptability of the use of this correlation may vary from council to council.

Table 1 – Default Water Quality Objectives

Parameter	Target	Notes
TSS	50mg/L	Is achieved if turbidity target is met.
pH	6.5 – 8.5	Measure using calibrated pH probe
Turbidity	Initially 75 NTU	Measure using calibrated turbidity probe.

3.2. Records and Reporting

The following items are required to be recorded daily in a spreadsheet. This spreadsheet should be available in digital format upon request as part of any environmental audit or report/inspection by the regulating authority.

The spreadsheet should be arranged to readily allow the operator to identify if discharge has occurred

- Rainfall in previous 24 hours
- Running cumulative rainfall depth for the design size.
- Volume in settling zone (record 0 if water is below settling zone)
- Has spillway overtopped (yes/no)
- Volume of sediment disposed (record 0 if no sediment disposed of)
- Turbidity and pH of water daily
- Volume of flocculent applied (record 0 if no flocculent applied)

3.3. Treatment

Flocculation of captured water may be required to achieve water quality objectives. Bench testing is recommended to be carried out by a CPESC or other suitably qualified persons to identify the most suitable flocculants and appropriate dose rate for the site. Some example flocculants and rates are listed below.

3.3.1. Turbidity / Suspended Solids

If turbidity or suspended solids exceed the target water quality objective, treatment with a flocculent will be required. Some example flocculants and recommended rates are outlined in **Table 2**.

IMPORTANT Dose rates are required to be determined by on-site trials, carried out by a suitably qualified person. Over application of flocculent can result in environmental impacts.

Table 2 – Dose Rates

Compound	Indicative Dose Rate	Notes
Sedisolve™	5-8 L/100m ³	Aluminum based flocculent
Gypsum	32 kg/100m ³	Gypsum is not readily soluble in water.
PAC	5 to 8 mg/L (target aluminum concentration)	Aluminum based flocculent

3.3.1.1. Flocculants

Sedisolve

Sedisolve™2350 is a high quality, environmentally friendly, rapid acting flocculent for application to Sediment Basins. Sedisolve™2350 is an Aluminium Chlorohydrate-based product, manufactured to drinking water specifications with no cost penalty, i.e. very low impurities and it does not add heavy metals into treated water like some coagulants which are very low quality and contain heavy metals. Some key advantages are:

- Concentrated and 2 to 3 times more effective than PAC or Liquid alum.
- Easy to apply liquid - no dust like gypsum.
- Fast settling.(within hours)
- Excellent treated water clarity.
- Can be automatically dosed using Intelligent flocculant operation device (iFOD) reducing the risk of overdosing.
- Significantly lower aluminium residuals than PAC or alum in the treated water.
- Works over a wide pH range but optimal around 7-7.5, which is ideal for discharge.
- Reduced alkalinity consumption compared to PAC and alum, i.e.:less likely to need to correct the pH
- pH will not drop as much as when dosing PAC or alum
- Forms inert sludge unlike alum and PAC.
- Non Dangerous Good
- Contains no sulphates

Gypsum

Gypsum is often considered the least ecologically threatening flocculent; however it is also one of the least effective flocculants and can be difficult to apply in a manner that will allow the flocculent to work effectively. The application of gypsum will not generally impact pH levels, with only a slight increase in salinity resulting. Constraints and limitations of gypsum include a even application is required over the entire pond surface and a resulting scum deposit may form on equipment.

If high intensity storms are forecast it is recommended that gypsum dosage rates be increased to 70kg/100m³. Depending on the clay mineralogy this can achieve flocculation within 24 hours, allowing discharge within 2 days from the conclusion of a storm. Spreading gypsum evenly over the pond surface is essential, hand spreading of solid gypsum will not result in flocculation. The following procedure should be applied for the manual dosing of gypsum (see **Figure 3**):

1. Place required gypsum quantity (say 32kg/100m³ of water) in an approximately 50L drum perforated with 25mm holes at 150mm spacing;
2. Suspend the screened, re-circulating pump intake into the drum;
3. Lift the drum into the basin such that basin water can enter and circulate through the drum;
4. Using the pump, spray the gypsum-rich solution evenly over the surface of the basin until the gypsum is fully removed from the drum. The pump outlet must spray the mixture over a wide area rather than just discharging as a confined 'jet'.

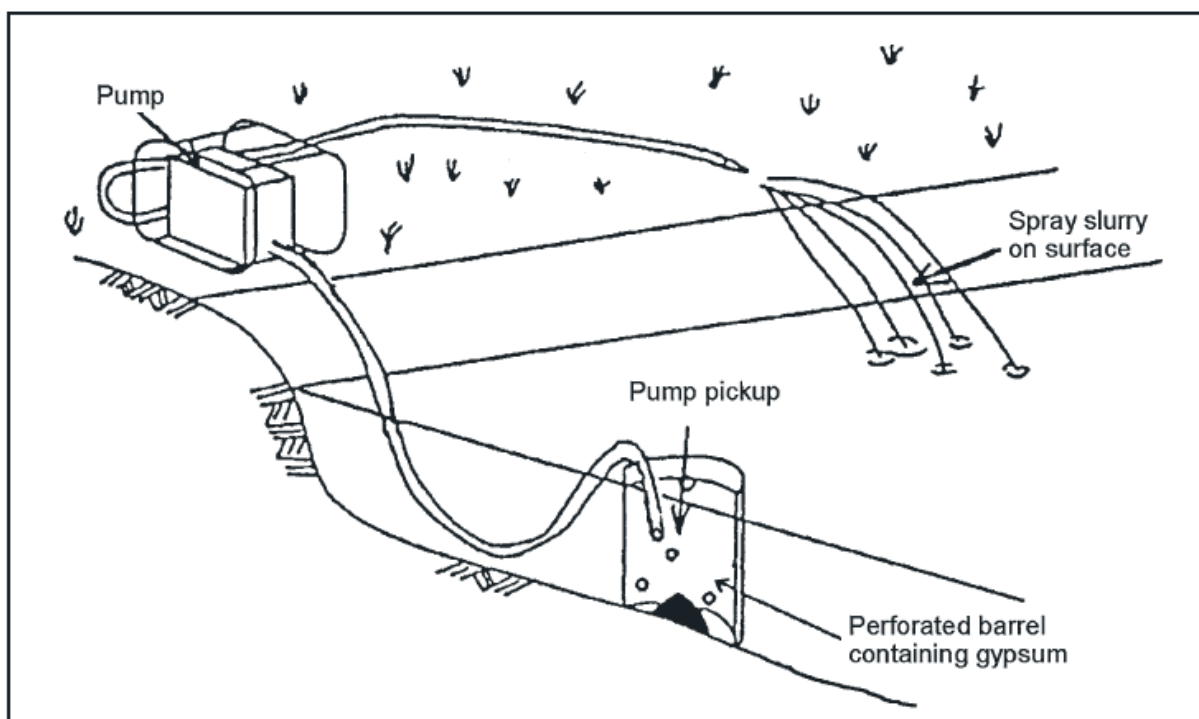


Figure 3 Application of Gypsum (taken from Landcom 2004 "Soils and Construction volume 1)

PAC (Poly Aluminium Chloride)

The use of PAC as a flocculant is only recommended under controlled circumstances and by users who are aware of the potential downstream risks to the environment. The advantage of PAC as a flocculant is the low dose rate required in comparison to gypsum, fast settling time and resulting stable sludge that binds pollutants.

As mentioned above in **Table 2** assessment of site specific dose rates must be undertaken by an environmental professional prior to use as overdosing will result in reduction of pH among other things. Residual alum concentrations remaining in the basin effluent should not exceed the ANZECC (2000) freshwater quality 'trigger value' of 0.055mg/L for aluminium at pH levels above 6.5. Continuous monitoring of water pH levels should be conducted when using PAC as a flocculent as pH levels lower than 5.5 will result in toxic concentrations of soluble aluminium, which can kill fish and other aquatic life.

3.3.2. pH Buffering

3.3.2.1. Increasing pH (treating acidic waters)

Liming rates for acidified water should be calculated with reference to **Table 3**.

Table 3 – Quantity of Pure Neutralising Agent Required to Raise From Existing Ph To Ph 7 for 1 Megalitre Of Low Salinity Acid Water. (From State Planning Policy 2/02 Guideline Acid Sulfate Soils)

Current Water pH	[H ⁺] (mol/L)	H ⁺ in 1 Megalitre (mol)	Aglime to neutralise 1 Megalitre (kg pure CaCO ₃)	Hydrated lime to neutralise 1 Megalitre (kg pure Ca(OH) ₂)	Sodium bicarbonate to neutralise 1 Megalitre (kg pure NaHCO ₃)
0.5	.316	316 228	15 824	11 716	26 563
1.0	.1	100 000	5004	3705	8390
1.5	.032	32 000	1600	1185	2686
2.0	.01	10 000	500	370	839
2.5	.0032	3200	160	118	269
3.0	.001	1000	50	37	84
3.5	.00032	320	16	12	27
4.0	.0001	100	5	4	8.4
4.5	.000032	32	1.6	1.18	2.69
5.0	.00001	10	0.5	0.37	0.84
5.5	.0000032	3.2	0.16	0.12	0.27
6.0	.000001	1	0.05	0.037	0.08
6.5	.00000032	.32	0.016	0.012	0.027

Notes on Table 5:

- 1 m³ = 1000 litre = 1 kilolitre = 0.001 Megalitre
- Correlations between current water pH and [H⁺] (mol/L) do not account for titratable acidity. The titratable acidity component should be included in any calculations of neutralising agent requirements.
- Agricultural lime has a very low solubility and may take considerable time to even partially react. While aglime has a theoretical neutralising value of 2 mol of acidity (H⁺), this tends to be only fully available when there is excess acid. This, together with its very low solubility, means that much more aglime beyond the theoretical calculation will generally be required.
- Hydrated lime is more soluble than aglime and hence more suited to water treatment. However, as Ca(OH)₂ has a high water pH, incremental addition and thorough mixing is needed to prevent overshooting the desired pH. The water pH should be checked regularly after thorough mixing and allowing sufficient time for equilibration before further addition of neutralising product.
- Weights of material given in the table above are based on theoretical pure material and hence use of such amounts of commercial product will generally result in under treatment.
- To more accurately calculate the amount of commercial product required, the weight of neutralising agent from the table should be multiplied by a purity factor (100/ Neutralising Value for aglime) or (148/ Neutralising Value for hydrated lime).
- If neutralising substantial quantities of ASS leachate, full laboratory analysis of the water will be necessary to adequately estimate the amount of neutralising material required.
- Neutralising agents such as hydrated lime Ca(OH)₂, quick lime CaO, and magnesium oxide MgO neutralise 2 mol of acidity (H⁺), while sodium bicarbonate NaHCO₃ and sodium hydroxide NaOH neutralise only 1 mol of acidity.

3.3.2.2. Reducing pH (treating basic waters)

Acid application rates for alkaline waters may be calculated with reference to **Table 4**.

Table 4 – Quantity of Acid Neutralising Agent (30-32% w/w mineral acid, as hydrochloric & sulphuric acids) Required to Reduce From Existing Ph To Ph 7 for 1 Megalitre Of Low Salinity Alkaline Water.

Current Water pH	Required Volume of Acid to Neutralise 1 Megalitre to pH 7.0 (Litres per 1,000 m ³)
7.4	8
7.6	12
7.8	16
8.0	20
8.2	24

Even distribution of neutralizing agent and suitable mixing is required to ensure effective neutralization occurs.

It should be noted that the volumes of acid listed within **Table 4** are for the specified concentration of acid. Prior to undertaking any pH buffering the manufacturer instructions of the neutralizing agent must be referred to, any dose rate information provided by the manufacturer must be followed in preference to the guideline dose rates provided in **Table 4**.

Validation testing of water pH must be carried out after a suitable mixing period (~2-4 hours depending on the size of the basin), to confirm that water is in the target pH range prior to discharge.

3.4. Discharge of Water

Prior to discharge of water from the sediment basin it is essential that the water quality complies with specified water quality objectives (see **Table 1**).

If possible, use water on site for dust suppression. Consumption of sediment basin water can be carried out without assessment of water quality. Care should be taken to ensure that this water does not runoff into waterways of drains.

After analytical results have been received and discharge of water authorized by the nominated suitably qualified person, water may be discharged to the receiving drainage line. When dewatering the sediment basin care should be taken so as to not re-suspend previously settled sediment. Intake pipes should be housed in an appropriate flow control chamber to prevent settled sediment being removed from the basin. Intake pipes must not rest on the bottom of the basin, or in any other location that will allow the entrainment of settled sediment.

An appropriate housing chamber for an inflow pipe may be formed from a section of PVC drainage pipe, sealed at one end and perforated along its length with inflow holes. An alternative is to suspend the inflow pipe from a floating raft that is designed to prevent the intake pipe from resting too close to the settled sediment. The intake pipe is normally placed inside a horizontal perforated PVC pipe attached to the underside of a floating raft. Perforations in the PVC pipe should only exist along the top of the pipe, thus minimizing the risk of settled sediment being entrained into the outlet.

Pump sizing should aim to discharge the basin's settling zone volume in less than 48 hours from the last runoff generating rainfall event.

Annexure A Certification of Basin Construction

Annexure B Sediment Basin Discharge Authority

Sediment Basin Discharge Authority

Client:

Date Authority Issued:

Site:

Date of Last Rainfall:

Basin Reference:

Maximum Volume of Basin (m³):

Inspecting Officer:

Volume in Basin at Sample time (m³):

NB: This authority is invalid if rainfall has occurred after last sample date and time

TABLE 1 – INITIAL ANALYSIS

Sample Date:		Sample Time:	
	pH	Turbidity (NTU)	SS (mg/L)
Discharge Limit	6.5-8.5	75	50
Sample 1.			
Sample 2.			
Sample 3.			
Average			

TABLE 2 – TREATMENT APPLIED (if required)

Treatment Date:		Treatment Time:	
	HCL	Lime	Gypsum/PAC (Cross out which)
Dose Rate:			
Total Volume/Mass applied			

TABLE 3 – VALIDATION SAMPLING (if any)

Sample Date:		Sample Time:	
	pH	Turbidity (NTU)	SS (mg/L)
Discharge Limit	6.5-8.5	75	50
Sample 1.			
Sample 2.			
Sample 3.			
Average			

AUTHORITY TO DISCHARGE

Authority to discharge sediment basin water is given subject to conditions stipulated in the site sediment basin operation procedure or site erosion and sediment control plan.

Print Name:

Signature:



Appendix F Technical Notes

The following technical notes apply to the implementation of erosion and sediment control measures on site.

General

1. Additional erosion and sediment control measures must be implemented as development progresses. Progressive staged Erosion and Sediment Control Plans (ESCPs) must be submitted for approval as site conditions change from those considered within the most current ESCP.
2. Where there is a high probability that serious or material environmental harm may occur as a result of sediment leaving the site, appropriate additional erosion and sediment control measures must be implemented such that all reasonable and practicable measures are being taken to prevent or minimise such harm. Only those works necessary to minimise or prevent environmental harm shall be conducted on-site prior to approval of the amended Erosion and Sediment Control Plan (ESCP).

Land Clearing

3. All reasonable and practicable efforts must be taken to delay the removal of, or disturbance to, existing ground cover (organic or inorganic) prior to land- disturbing activities.
4. Bulk tree clearing must occur in a manner that minimises disturbance to existing ground cover (organic or inorganic).
5. Vegetation removed during tree clearing should be mulched on site and reused for erosion control. Refer to IECA fact sheets
6. Disturbance to natural watercourses (including bed and banks) and their associated riparian zones must be limited to the minimum practicable. Management of ESC around watercourses should involve maintenance of a minimum 20 m buffer of vegetation adjacent to watercourse crossings until such time as the crossing is imminent and suitable erosion and sediment controls are established.
7. No land clearing shall be undertaken unless preceded by the installation of adequate drainage and sediment control measures, unless such clearing is required for the purpose of installing such measures, in which case, only the minimum clearing required to install such measures shall occur.
8. Prior to land clearing, areas of protected vegetation, and significant areas of retained vegetation must be clearly identified (e.g. with high-visibility tape, or light fencing) for the purposes of minimising the risk of unnecessary land clearing.
9. All reasonable and practicable measures must be taken to minimise the removal of, or disturbance to, those trees, shrubs and ground covers (organic or inorganic) that are intended to be retained.
10. All land clearing must be in accordance with the Federal, State and local government Vegetation Protection/Preservation requirements and/or policies.
11. Land clearing is limited to the minimum practicable during those periods when soil erosion due to wind, rain or surface water is possible.

Site Access

12. Site access must be restricted to the minimum practical number of locations
13. Site exit points must be appropriately managed to minimise the risk of sediment being tracked onto public roadways.
14. Stormwater runoff from access roads and stabilised entry/exit points must drain to an appropriate sediment control device.

Soil and Stockpile Management

15. All reasonable and practicable measures must be taken to obtain the maximum benefit from existing topsoil.
16. Stockpiles of erodible material that has the potential to cause environmental harm if displaced, must be:
 - (i) Appropriately protected from wind, rain, concentrated surface flow and excessive up-slope stormwater surface flows.
 - (ii) Located at least 2m from any hazardous area, retained vegetation, or concentrated drainage line.
 - (iii) Located up-slope of an appropriate sediment control system.
17. A suitable flow diversion system must be established immediately up-slope of a stockpile of erodible material that has the potential to cause environmental harm if displaced.

Site Management

18. All office facilities and operational activities must be located such that any liquid effluent (e.g. process water, wash-down water, effluent from equipment cleaning, or plant watering), can be totally contained and treated within the site.
19. The construction schedule must aim to minimise the duration that any and all areas of soil are exposed to the erosive effects of wind, rain and surface water.
20. Land-disturbing activities must be undertaken in accordance with the Erosion and Sediment Control Plan and associated development conditions.
21. Land-disturbing activities must be undertaken in such a manner that allows all reasonable and practicable measures to be undertaken to:
 - (i) Allow stormwater to pass through the site in a controlled manner and at non- erosive flow velocities up to the specified design storm discharge;
 - (ii) Minimise soil erosion resulting from rain, water flow and/or wind;
 - (iii) Minimise adverse effects of sediment runoff, including safety issues;
 - (iv) Prevent, or at least minimise, environmental harm resulting from work-related soil erosion and sediment runoff;
 - (v) Ensure that the value and use of land/properties adjacent to the development (including roads) are not diminished as a result of the adopted ESC measures.
22. All erosion and sediment control measures must conform to the standards and specifications contained in:

- (i) The Environmental Management Plan; and
 - (ii) The approved ESCP and supporting documentation;
23. Any works that may cause significant soil disturbance and are ancillary to any activity for which regulatory body approval is required, must not commence before the issue of that approval.
 24. Additional and/or alternative ESC measures must be implemented in the event that site inspections, the site's Monitoring and Maintenance Program, or the regulatory authority, identifies that unacceptable off-site sedimentation is occurring as a result of the work activities.
 25. Land-disturbing activities must not cause unnecessary soil disturbance if an alternative construction process is available that achieves the same or equivalent outcomes at an equivalent cost.
 26. Sediment (including clay, silt, sand, gravel, soil, mud, cement and ceramic waste) deposited off the site as a direct result of an on-site activity, must be collected and the area appropriately cleaned/rehabilitated as soon as reasonable and practicable, and in a manner that gives appropriate consideration to the safety and environmental risks associated with the sediment deposition.
 27. Adequate waste collection bins must be provided on-site and maintained such that potential and actual environmental harm resulting from such material waste is minimised.
 28. Concrete waste and chemical products, including petroleum and oil-based products, must be prevented from entering an internal water body, or an external drain, stormwater system, or water body.
 29. All flammable and combustible liquids, including all liquid chemicals if such chemicals could potentially be washed or discharged from the site, are stored and handled on-site in accordance with relevant standards such as AS1940 The storage and handling of flammable and combustible liquids.
 30. Site spoil must be lawfully disposed of in a manner that does not result in ongoing soil erosion or environmental harm.
 31. All fill material placed on site must comprise only natural earth and rock, and is to be free of contaminants, be free draining, and be compacted in layers not exceeding 300mm to 90% modified maximum dry density in accordance with AS 1289.

Drainage Control

32. All drainage control measures must be applied and maintained in accordance with ESCP.
33. Wherever reasonable and practicable, stormwater runoff entering the site from external areas, and non-sediment laden (clean) stormwater runoff entering a work area or area of soil disturbance, must be diverted around or through that area in a manner that minimises soil erosion and the contamination of that water for all discharges up to the specified design storm discharge.
34. During the construction period, all reasonable and practicable measures must be implemented to control flow velocities in such a manner than prevents soil erosion along drainage paths and at the entrance and exit of all drains and drainage pipes during all storms up to the relevant design storm discharge.
35. Wherever reasonable and practicable, "clean" surface waters must be diverted away from sediment control devices and any untreated, sediment-laden waters.

Erosion Control

36. All erosion control measures must be applied and maintained in accordance with ESCP.
37. All temporary earth banks, flow diversion systems, and embankments associated with constructed sediment basins must be machine-compacted, seeded and mulched for the purpose of establishing a temporary vegetative cover within 10 days after grading.

Sediment Control

38. All sediment control measures must be applied and maintained in accordance with ESCP.
39. Optimum benefit must be made of every opportunity to trap sediment within the work site, and as close as practicable to its source.
40. Sediment traps must be installed and operated to both collect and retain sediment.
41. The potential safety risk of a proposed sediment trap to site workers and the public must be given appropriate consideration, especially those devices located within publicly accessible areas.
42. Suitable all-weather maintenance access must be provided to all sediment control devices.
43. Sediment control devices must be de-silted and made fully operational as soon as reasonable and practicable after a sediment-producing event, whether natural or artificial, if the device's sediment retention capacity falls below 75% of its design retention capacity.
44. Materials, whether liquid or solid, removed from sediment control devices during maintenance or decommissioning, must be disposed of in a manner that does not cause ongoing soil erosion or environmental harm.
45. As-Constructed plans must be prepared for all constructed sediment basins and associated emergency spillways. Such plans must appropriately verify the basin's dimensions, levels and volumes of each basin.
46. Constructed sediment basins must be maintained and fully operational throughout the construction period and until each basin's catchment area achieves the specified percentage of ground cover on all soil surfaces.
47. Settled sediment must be removed from sediment basins when the volume of the sediment exceeds the designated sediment storage volume, or the design maximum sediment storage elevation.

Site Rehabilitation

48. All disturbed areas must be suitably stabilised in accordance with the revegetation plan or final design drawings

Sediment Basin Rehabilitation

49. Required drainage, erosion and sediment control measures during the decommissioning and rehabilitation or a sediment basin must comply with same standards specified for the normal construction works.
50. Upon decommissioning of a sediment basin, all water and sediment must be removed from the basin prior to removal of the embankment (if any). Any such material, liquid or solid, must be disposed of in a manner that will not create an erosion or pollution hazard.
51. A basin's catchment conditions associated with the staged decommissioning of the basin from a Type 1 to a Type 2 sediment trap must comply with the specified sediment control standard.

52. If an alternative, permanent, outlet structure is to be constructed prior to stabilisation of the up-slope catchment area, then this outlet structure must not be made operational if it will adversely affect the required operation of the sediment basin.
53. The permanent stormwater treatment features (e.g. vegetation and filtration media) must be appropriately protected from the adverse effects of sediment runoff.
54. Sediment basin must not be decommissioned until all up-slope site stabilisation measures have been implemented and are appropriately working to control soil erosion and sediment runoff in accordance with the specified ESC standard.
55. Immediately prior to the construction of the permanent stormwater treatment device, appropriate flow bypass conditions must be established to prevent sediment-laden water entering the device.

Site Monitoring

56. All water quality data, including dates of rainfall, dates of testing, testing results and dates of water release, must be kept in an on-site register. The register is to be maintained up to date for the duration of the approved works and be available on-site for inspection.
57. Sediment basin water quality samples must be taken at a depth no greater than 200mm above the level of settled sediment.
58. All environmentally relevant incidents must be recorded in a field log that must remain accessible to all relevant regulatory authorities.

Site Maintenance

59. All erosion and sediment control measures, including drainage control measures, must be maintained in proper working order at all times during their operational lives.
60. All drainage, erosion and sediment control measures must be inspected:
 - (i) At least daily (when work is occurring on-site);
 - (ii) At least weekly (when work is not occurring on-site);
 - (iii) Within 24 hours of expected rainfall; and
 - (iv) Within 18 hours of a rainfall event of sufficient intensity and duration to cause runoff on-site).

Appendix G Temporary Crossing Factsheet

Temporary Watercourse Crossings: Culvert

DRAINAGE CONTROL TECHNIQUE

Low Gradient		Velocity Control		Short Term	✓
Steep Gradient		Channel Lining		Medium-Long Term	
Outlet Control		Soil Treatment		Permanent	

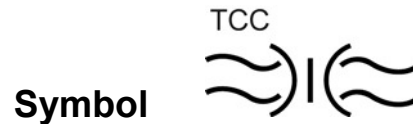


Photo 1 – Temporary culvert formed from recycled steel pipes



Photo 2 – Temporary crossing of minor drainage channel

Key Principles

1. Significant bank damage can occur during the installation and removal of these temporary watercourse crossings; therefore, extreme care must be taken to minimise such damage.
2. It is important to minimise the risk of sediment-laden runoff from the approach roads being allowed to discharge directly into the watercourse without passing through an appropriate sediment trap or vegetative filter.
3. Critical design parameters are the flood immunity of the road surface and the structural integrity of the culverts during flood flows.
4. Critical operational issue is the minimisation of harm to the watercourse, including any sediment releases.

Design Information

The material contained within this fact sheet has been supplied for use by persons experienced in hydraulic engineering.

Temporary culvert crossing require both structural and hydraulic design. Their design requires input from both structural and hydraulic specialists.

Design parameters include expected traffic loads, required flood immunity, and expected hydraulic and debris loadings. The following information is supplied for general reference purposes only.

Culvert Structure:

Consideration should be given to the potential damage caused to the watercourse if the culverts wash away during a flood event. In critical locations it may be necessary to tether the pipes to the watercourse banks using cables or chains to prevent individual components of the culvert being washed down the watercourse during severe floods.

Erosion and Sediment Control Model Code of Practice (Instream Works)

Compliance with a given Performance Criterion can only be achieved by:

- (i) complying with the Acceptable Solution; or
- (ii) formulating an alternative solution which complies with the Performance Criterion, or is shown to be at least equivalent to the acceptable solutions; or
- (iii) a combination of (i) and (ii).

Unless otherwise indicated, all outcomes listed within the Acceptable Solution must be satisfied in order to comply with the Acceptable Solution.

Attachment A forms part of this Code. The Attachment provides essential information and requirements not otherwise provided within the Code.

In the event of a conflict over the desired outcome of a *Performance Criterion* or an *Acceptable Solution*, then the outcome shall be that which best achieves the *objective* of the Code, that being:

To protect the environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

To achieve this objective a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm.

In assessing all reasonable and practicable measures, appropriate consideration must be given to:

- (i) the nature of the potential harm; and
- (ii) the sensitivity of the receiving environment; and
- (iii) the current state of technical knowledge for the activity; and
- (iv) the likelihood of successful application of the various measures that might be undertaken; and
- (v) the financial implications of the various measures relative to the type of activity.

The various recommendations presented in this guideline are an indication of what may be considered *reasonable and practicable* for the construction industry.

This model code of practice does not provide all the information necessary to adequately control soil erosion and sediment runoff in all situations. Users of the Code should always make their own site-specific evaluation, testing and design, and refer to their own advisers and consultants as appropriate.

Specifically, the adoption of this model code of practice will not necessarily guarantee:

- (i) compliance with any statutory obligations or licence conditions;
- (ii) avoidance of all environmental harm or nuisance.

SITE PLANNING AND DESIGN			
Performance Criteria		Acceptable Solution	
P1	Adequate data is obtained to allow appropriate site planning and design.	A1	<p>(a) The extent and complexity of data collection is commensurate with the potential environmental risk, and the extent and complexity of the instream disturbance.</p> <p>(b) Adequate soil data is obtained for the site to:</p> <ul style="list-style-type: none"> (i) identify dispersive soils; (ii) identify potential acid sulfate soils; (iii) assess site revegetation/stabilisation works; (iv) select and design ESC measures.
P2	The design and layout of instream works minimise the risk of environmental harm occurring during the construction phase.	A2	<p>(a) Potential high-risk instream activities are identified during site planning.</p> <p>(b) Environmental risk, cost and safety are appropriately considered when determining the construction/maintenance process.</p> <p>(c) The design and layout of the instream works do not cause unnecessary soil disturbance if an alternative design or layout (which reduces the potential environmental harm) is available that achieves the same or equivalent project outcomes at a reasonable cost.</p> <p>(d) Site planning minimises the duration that any and all areas of soil will be exposed to the erosive effects of wind, rain and flowing water, in part through the progressive and prompt stabilisation of disturbed areas.</p> <p>(e) Instream sediment control measures are not employed if there is an appropriate off-stream sediment control process.</p> <p>(f) Development of the Erosion and Sediment Control Plan is an integral part of site planning.</p> <p>(g) Essential ESC control measures are appropriately integrated into the project's design and costing.</p> <p>(h) Adequate space is provided for the installation and maintenance of essential ESC measures.</p> <p>(i) The number of temporary watercourse crossings is minimised.</p>
P3	The programming of instream works minimises the risk of environmental harm occurring during the construction phase.	A3	<p>(a) Instream disturbances are programmed to occur during the least erosive and environmentally damaging period of the year.</p> <p>(b) Instream works that require the construction of a weir or cofferdam, or an alteration in stream flow conditions, including flow velocity, bed roughness or flow rate, are not programmed for those periods when essential fish migration is expected to occur.</p>
P4	The design and layout of instream works minimise the risk of post-construction environmental harm.	A4	<p>(a) Flow velocities at the inlet and outlet of permanent drainage systems (e.g. stormwater pipes) are controlled to minimise ongoing erosion.</p> <p>(b) To the maximum degree reasonable and practicable, instream works are designed to minimise potential environmental harm during operational works and ongoing maintenance.</p>

EROSION AND SEDIMENT CONTROL PLAN (ESCP)			
Performance Criteria		Acceptable Solution	
P5	An Erosion and Sediment Control Plan (ESCP) is prepared prior to site disturbance that provides sufficient information to achieve the required environmental protection.	A5	<p>(a) The design standard of drainage, erosion and sediment controls (whether instream or off-stream) comply with the requirements of the relevant regulatory authority, or where such a standard does not exist, are designed in accordance with current best practice.</p> <p>(b) As a minimum, the standard of drainage, erosion and sediment controls are commensurate with the site conditions, (e.g. soil type, flow rate and erosion hazard), type of watercourse, local environmental values, and the type, cost and scope of the works.</p> <p>(c) The level of information and detail supplied in the ESCP is commensurate with the potential environmental risk, and the complexity of the proposed works; and is of sufficient clarity to allow on-site personnel to appropriately implement the plan.</p>
P6	The ESCP is prepared by, or under the supervision of, suitably qualified and experienced personnel.	A6	<p>(a) The qualifications and experience of the personnel preparing and/or supervising the preparation of the ESCP is commensurate with the potential environmental risk, and the extent and complexity of the soil disturbance.</p> <p>(b) On sites with a soil disturbance greater than 50m², the ESCP is signed-off by a suitably qualified and experienced professional.</p> <p>(c) On sites with a flow diversion barrier extending over one-third of the channel width, or a temporary structure extending over the full channel width (e.g. watercourse crossing or instream sediment trap) the ESCP is signed-off by an engineer experienced in waterway hydraulics.</p>
P7	The ESCP remains relevant, at all times, to the current site conditions.	A7	<p>(a) The ESCP remains both effective and flexible, and is based on anticipated soil, weather, stream flow, and construction conditions (as may vary from time to time).</p> <p>(b) The ESCP is appropriately amended if the implemented works fail to achieve the <i>objective</i> of the ESCP, the required performance standard, or the State's environmental protection requirements, or otherwise if there is the risk of serious or material environmental harm.</p>

SITE ESTABLISHMENT			
Performance Criteria		Acceptable Solution	
P8	Site personnel are provided with all necessary information prior to site establishment.	A8	The Development Approval Conditions, Waterways Permit/Licence, Erosion and Sediment Control Plan, Monitoring and Maintenance Program, Site Rehabilitation Plan, and any other document required for the management of soil erosion and sediment control, are provided to the principal contractor prior to the commencement of land disturbing activities.

P9	Appropriate personnel are engaged to monitor the site prior to commencement of site disturbance.	A9	<p>(a) Prior to the commencement of any instream disturbance, appropriately trained and experienced personnel are engaged to undertake regular ESC audits of the site.</p> <p>(b) Prior to commencement of site works, a “chain of command” in relation to the implementation, modification, and maintenance of ESC measures is established.</p>
P10	Site establishment does not cause unnecessary soil disturbance or environmental harm.	A10	<p>(a) No land-disturbing activities occur on the site until all appropriate ESC measures have been constructed in accordance with the ESCP and best practice erosion and sediment control.</p> <p>(b) All site office facilities and operational activities are located such that all effluent, including wash-down water, can be totally contained and treated within the site.</p>
P11	Site access is appropriately managed to minimise the risk of environmental harm.	A11	<p>(a) All reasonable and practicable measures are taken to ensure stormwater runoff from site access tracks and stabilised entry/exit systems, drains to an appropriate sediment control device.</p> <p>(b) Wherever reasonable and practicable, access tracks, whether temporary or permanent, are located a distance from the top of bank of at least 30m, or the width of the stream (measured at the top of the bank), whichever is the lesser.</p>

SITE MANAGEMENT

Performance Criteria		Acceptable Solution	
P12	The work site is managed such that environmental harm is minimised.	A12	<p>(a) No land-disturbing activities (instream or off-stream) are undertaken prior to appropriate consideration being given to erosion and sediment control issues.</p> <p>(b) All works subject to an Erosion and Sediment Control Plan (ESCP) are carried out in accordance with the ESCP (as amended from time to time) unless circumstances arise where compliance with the ESCP would increase the potential for environmental harm as assessed by a recognised authority.</p> <p>(c) All ESC measures are installed, operated and maintained in accordance with current best management practice.</p> <p>(d) Land-disturbing activities are undertaken in such a manner that allows all reasonable and practicable measures to be undertaken to:</p> <ul style="list-style-type: none"> (i) allow stormwater and stream flow to pass through the site in a controlled manner and at non-erosive flow velocities; and (ii) minimise soil erosion resulting from wind, rain and flowing water; and (iii) minimise the duration that disturbed soils are exposed to the erosive forces of wind, rain and flowing water; and (iv) prevent, or at least minimise, environmental harm (including public nuisance and safety issues) resulting from work-related soil

			<p>erosion and sediment runoff.</p> <p>(e) Site spoil is lawfully disposed of in a manner that does not result in ongoing soil erosion or environmental harm.</p>
P13	Those responsible for erosion and sediment control are appropriately trained and equipped.	A13	Site managers and/or the nominated responsible ESC personnel achieve and maintain a good working knowledge of the correct installation and operational procedures of all ESC measures used on the site.
P14	Disturbance to ESC measures by on-site personnel is minimised.	A14	<p>(a) On-site personnel are appropriately instructed and educated as to the purpose and operation of adopted drainage, erosion and sediment control (ESC) measures, and the need to maintain such measures in proper working order at all times.</p> <p>(b) Unnecessary disturbance to ESC measures by on-site personnel, sub-contractors and construction traffic (including site management and material delivery vehicles) is minimised.</p>
P15	The adopted ESC measures remain relevant at all times to the current site conditions.	A15	<p>(a) Performance of the site's ESC measures is monitored in accordance with the site's Monitoring and Maintenance Program.</p> <p>(b) The adopted erosion and sediment control measures are appropriately amended if site conditions significantly change, or are expected to significantly change, from those conditions assumed during development of the ESCP.</p> <p>(c) The adopted erosion and sediment control measures are appropriately amended if the implemented works fail to achieve the "objective" of the ESCP, or the required performance standard, or the State's environmental protection requirements, or unacceptable environmental harm is occurring or is likely to occur.</p>
P16	The work site is appropriately prepared for imminent construction activities and weather conditions.	A16	<p>(a) Adequate supplies of drainage, erosion and sediment control, and relevant pollution clean-up materials, are retained on-site during the construction period.</p> <p>(b) Appropriate short-term drainage control measures (e.g. flow diversion around soil disturbances and recently opened trenches) are installed and operational prior to impending storms or increased stream flows.</p>
P17	Land disturbing activities do not cause unnecessary soil disturbance.	A17	<p>(a) Land disturbing activities do not cause unnecessary soil disturbance if an alternative construction process (that reduces potential environmental harm) is available that achieves the same or equivalent project outcomes at a reasonable cost.</p> <p>(b) The extent of unnecessary soil disturbance, including disturbances outside the designated work area, is minimised.</p>
P18	Damage to retained or protected vegetation is minimised.	A18	(a) Prior to the commencement of land disturbing activities within any given area, all protected vegetation and significant areas of retained vegetation within that area, are appropriately identified to minimise the risk of disturbance to such areas.

			(b) No damage is allowed to occur to roots, trunk or branches of retained vegetation, unless under the direction of an appropriate Vegetation Management Plan.
P19	Adopted work practices minimise the release of pollutants into receiving waters.	A19	<p>(a) Emergency and pollution control procedures are commensurate with the site conditions, local environmental values, and the type, cost, scope and complexity of the works.</p> <p>(b) All liquid chemicals, including petroleum products, that could potentially be washed or discharged from the site in association with sediment, are stored and handled on-site in accordance with relevant standards such as AS1940.</p> <p>(c) Adequate supplies of erosion control, sediment control, and pollution clean-up materials are retained on-site during the construction period.</p> <p>(d) Cement-laden runoff, concrete waste, and chemical products (including petroleum and oil-based products), are managed on-site in accordance with current best management practice.</p> <p>(e) All equipment is washed down (cleaned) well away from the water's edge, and in a manner that prevents sediment-laden water entering the waters.</p> <p>(f) All non water-soluble pollutants washed or blown onto waters are collected and secured as soon as practicable.</p> <p>(g) All waste receptors are sealed and/or covered outside working hours to prevent the entry of water and vermin, or wind disturbance of the contained material.</p>
P20	Adopted work practices minimise the release of pollutants into tidal waters.	A20	<p>(a) No erodible material is stockpiled within 40m from the high tide mark.</p> <p>(b) Sediment deposition within the voids between natural and introduced rock located within the tidal zone is minimised.</p> <p>(c) All materials being transported by boats or barges are adequately secured during transportation.</p> <p>(d) Drip pans are placed under all vehicles and motorised equipment placed on docks, barges, or other structures that extend over water bodies, if the vehicle or equipment is expected to be idle for more than 1 hour.</p> <p>(e) All barges are fitted with watertight curbs or toe boards to contain spills and prevent materials, tools, and debris from leaving the barge.</p> <p>(f) All appropriate measures are deployed to provide secondary containment for any spills while materials and/or equipment are being transferred on and off barges to (e.g. floating sediment curtains).</p>

P21	Environmental harm, safety issues, and nuisance or damage to public and private property resulting from off-site sediment deposits, material spills, and/or the adopted ESC measures is minimised.	A21	<p>(a) Sediment and other material originating from the work area, or as a result of the transportation of materials to or from the work area, that collect on sealed roads, or within gutters, drains or drainage channels outside the immediate work area, is removed:</p> <ul style="list-style-type: none"> (i) immediately if rain is occurring or imminent; or (ii) immediately if considered a safety hazard; or (iii) if items (i) or (ii) do not apply, as soon as practicable, but before completion of the day's work. <p>(b) The adopted ESC measures do not adversely affect drainage or flooding conditions within neighbouring properties.</p>
P22	Potential safety risks to site workers and the public as a result of ESC measures are minimised.	A22	All stream flow diversion and ESC measures are installed and operated in a manner that does not cause a safety risk to the public or site personnel.
P23	Potential harm to wildlife as a result of ESC measures is minimised.	A23	<p>(a) Disturbance to wildlife habitats is limited to the minimum necessary to complete the approved works.</p> <p>(b) Synthetic (plastic) reinforced fabrics are not placed within, or adjacent to, bushland areas, riparian zones and watercourses if such materials are likely to cause harm to wildlife or wildlife habitats.</p> <p>(c) The design of temporary instream structures does not adversely impact on terrestrial and aquatic passage along the waterway.</p> <p>(d) To the maximum degree reasonable and practicable, instream disturbances are programmed to occur during periods of least impact to fish migration.</p> <p>(e) Sediment traps, flow diversion systems and isolation barriers allow appropriate egress of wildlife where such wildlife could enter such areas.</p> <p>(f) Site rehabilitation procedures and outcomes are compatible with site conditions and local environmental values (including local wildlife).</p>

SITE DISTURBANCE

Performance Criteria		Acceptable Solution	
P24	Potential environmental harm resulting from land clearing is minimised.	A24	<p>(a) All land clearing is conducted in accordance with State and local government Vegetation Protection and/or Preservation requirements and/or policies.</p> <p>(b) No instream disturbances are undertaken prior to development of a Vegetation Management Plan.</p> <p>(c) No instream soil disturbance occurs until the principal instream works are ready to commence.</p> <p>(d) Controls placed on the extent and duration of soil disturbance are commensurate with the potential erosion risk and/or erosion hazard.</p>

			<p>(e) To the maximum degree reasonable and practicable, disturbance to deep-rooted vegetation on slopes susceptible to mass movement is minimised, if not totally avoided.</p> <p>(f) Compliance with Performance Criterion P18.</p>
P25	Disturbance to natural watercourses is minimised.	A25	<p>(a) Disturbance to natural watercourses (including bed and bank vegetation) and their associated riparian zones is limited to the minimum necessary to complete the approved works.</p> <p>(b) The number, location, type and size of temporary watercourse crossing are such that the overall adverse impact on the environment is minimised.</p> <p>(c) All temporary watercourse crossings, including their approach roads, employ appropriate drainage, erosion and sediment controls to minimise sediment inflow into the watercourse.</p>
P26	Disturbance to tidal and intertidal areas including any associated riparian zones is minimised.	A26	<p>(a) Disturbance to aquatic vegetation, particularly seagrasses and mangroves, is minimised.</p> <p>(b) Vehicle/boat damage to seawalls (e.g. due to wave and wash conditions) is minimised.</p>

SOIL AND STOCKPILE MANAGEMENT

Performance Criteria		Acceptable Solution	
P27	Maximum benefit is obtained from existing topsoil.	A27	<p>(a) The topsoil is managed (i.e. stripped, treated, stockpiled and reused) in accordance with the recommendations of an approved Vegetation Management Plan or similar.</p> <p>OR</p> <p>(b) Topsoil is stripped, stockpiled, placed, and where necessary treated, in accordance with current best practice.</p>
P28	Environmental harm caused by the temporary stockpiling of erodible material is minimised.	A28	<p>Stockpiles of erodible material are:</p> <ul style="list-style-type: none"> (i) appropriately protected from wind, rain and surface flows in accordance with current best practice; and (ii) located at least 2m from hazardous areas, retained vegetation; and (iii) located up-slope of an appropriate sediment control system.
P29	Exposed dispersive soils are managed such that the risk of ongoing soil erosion is minimised.	A29	Construction details for drainage systems and bank stabilisation works within dispersive soil areas clearly demonstrate how these soils will be managed to prevent future erosion problems.
P30	Exposed potential acid sulfate soils are appropriately managed.	A30	<p>(a) If acid sulfate soils conditions exist on site, then appropriate warnings are placed on the ESCP.</p> <p>(b) All exposed actual or potential acid sulfate soils are managed in accordance with current best practice.</p> <p>(c) On-site personnel involved in the disturbance of actual or potential acid sulfate soils are appropriately trained and/or supervised.</p>

MANAGEMENT OF STREAM FLOW			
Performance Criteria		Acceptable Solution	
P31	Temporary drainage control measures are designed, constructed and maintained to an appropriate standard.	A31	<p>(a) The standard of stream flow control complies with the requirements of the relevant regulatory authority, or where such a standard does not exist, flow controls are designed in accordance with current best practice.</p> <p>(b) The adopted stream flow control measures remain relevant, at all times, to the current and imminent site conditions.</p> <p>(c) Instream flow diversion structures are structurally sound during a 1 in 2 year ARI channel flow.</p> <p>(d) Wherever reasonable and practicable, isolation barriers do not isolate more than 30% of the channel width at any given time, otherwise not more than 50%, while channel flows are occurring.</p>

DRAINAGE CONTROL			
Performance Criteria		Acceptable Solution	
P32	Temporary drainage control measures are designed, constructed and maintained to an appropriate standard.	A32	<p>(a) The standard of drainage control complies with the requirements of the relevant regulatory authority, or where such a standard does not exist, drainage controls are designed in accordance with current best practice.</p> <p>(b) The adopted drainage control measures remain relevant, at all times, to the current and imminent site conditions.</p>
P33	Stormwater movement through the site is appropriately managed to minimise soil erosion.	A33	<p>(a) If the overbank drainage area up-slope of a soil disturbance exceeds 1500m², and the average monthly rainfall exceeds 45mm, all stormwater discharged from this area (up to the design storm) is diverted around or through the soil disturbance in a manner that minimises soil erosion.</p> <p>(b) Appropriate drainage controls are installed above an exposed stream bank to minimise soil erosion on the bank.</p> <p>(c) Flow velocities within flow diversion channels and at the entrance and exit of all drainage structures (including <i>Chutes</i>, and <i>Slope Drains</i>) are controlled in such a manner that prevents soil erosion during all discharges up to the relevant design discharge.</p>
P34	Stormwater movement through the site is appropriately managed to minimise environmental harm.	A34	<p>(a) Overbank stormwater runoff passing around or through the work site does not cause erosion to the banks of water bodies.</p> <p>(b) All reasonable and practicable measures are taken to ensure stormwater runoff entering an area of soil disturbance is diverted around or through that area in a manner that minimises soil erosion and contamination of that water for all discharges up to the specified design discharge.</p>

			(c) Adequate drainage controls (e.g. cross drainage systems and/or longitudinal drainage) are applied to access tracks to minimise erosion on, and sediment runoff from, such areas.
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EROSION CONTROL			
Performance Criteria		Acceptable Solution	
P35	Erosion control measures are designed, installed and maintained to an appropriate standard.	A35	<p>(a) The standard of erosion control complies with the requirements of the relevant regulatory authority, or where such a standard does not exist, erosion controls are designed in accordance with current best practice.</p> <p>(b) As a minimum, the type and degree of erosion control are commensurate with the expected site conditions, soil type, stream flow, potential environmental risk, and the type, cost and scope of the works.</p> <p>(c) The adopted erosion control measures remain relevant, at all times, to the current and imminent site conditions.</p>
P36	The control of soil erosion is given appropriate priority.	A36	<p>(a) Wherever reasonable and practicable, priority is given to the prevention, or at least minimisation, of soil erosion, rather than allowing soil erosion to occur and trying to trap the resulting sediment.</p> <p>(b) The existence of best practice sediment control measures within a given sub-catchment does not diminish the need for the application of current best-practice erosion control measures.</p>
P37	Soil erosion is minimised.	A37	<p>(a) Existing ground covers are protected from damage and retained as long as practicable.</p> <p>(b) Site activities are carried out in a manner that minimises the duration that any and all disturbed soil surfaces are exposed to the erosive forces of wind, rain and flowing water.</p> <p>(c) All temporary erosion control measures are appropriately anchored to the soil as appropriate for the expected flow conditions.</p> <p>(d) Mechanical equipment does not enter the channel if alternative equipment or construction procedures are available that would allow the works to be conducted from an overbank location.</p>
P38	Soil erosion resulting from stream flow is minimised.	A38	<p>(a) All reasonable and practicable steps are taken to apply best practice erosion control measures to completed channel works, or otherwise stabilise such works, prior to an anticipated increase in stream flow.</p> <p>(b) Bed and bank stabilisation and revegetation methods are appropriate for the expected stream flow conditions such that ongoing soil erosion is minimised.</p> <p>(c) Dispersive soils are either treated, or covered with a layer of non-dispersible soil (200mm minimum) before being covered with vegetation, rock, mulch, or erosion control blankets.</p>

SEDIMENT CONTROL			
Performance Criteria		Acceptable Solution	
P39	Sediment control measures are designed, installed, operated and maintained to an appropriate standard.	A39	<p>(a) The standard of sediment control complies with the requirements of the relevant regulatory authority, or where such a standard does not exist, sediment controls are designed in accordance with current best practice.</p> <p>(b) As a minimum, the type and degree of sediment controls are commensurate with the expected site conditions, soil type, stream flow, potential environmental risk, and the type, cost and scope of the works.</p> <p>(c) Instream sediment control measures are designed for the expected base flow (i.e. stream flow not affected by flood flows or storm runoff).</p> <p>(d) The adopted sediment control measures remain relevant at all times to the current and imminent site conditions.</p>
P40	Sediment contamination of instream waters is minimised.	A40	<p>(a) All reasonable and practicable measures are taken to prevent, or at least minimise, the release of sediment from overbank areas into waters.</p> <p>(b) Wherever reasonable and practicable, instream disturbances are managed in accordance with the following hierarchy:</p> <ol style="list-style-type: none"> (i) minimise, if not totally avoid, direct contamination of stream flows (e.g. through the use of flow diversion systems and the appropriate timing of instream works); (ii) treatment of sediment-laden water within off-stream sediment traps; (iii) treatment of sediment-laden water within instream sediment traps. <p>(c) A suitable off-stream sediment trap is placed down-slope of any off-stream soil disturbance prior to the disturbance occurring.</p> <p>(d) Appropriate stream flow and/or sediment controls are installed and made operational before any instream soil disturbance occurs.</p>
P41	Sediment displaced off site by vehicular traffic is minimised.	A41	<p>(a) Number of site entry/exit points is limited to the minimum practical number.</p> <p>(b) Site entry/exit points are appropriately designed and stabilised to minimise sediment being washed off the site or into adjacent waters.</p> <p>(c) Sediment-laden stormwater runoff from access tracks and stabilised entry/exit systems drains to an appropriate sediment control device.</p>
P42	Sediment-related environmental harm resulting from de-watering activities is minimised.	A42	<p>(a) Flow diversion barriers, or other appropriate systems, are used to minimise the quantity of watering entering excavations and trenches.</p> <p>(b) As a minimum, sediment control measures implemented for the control of sediment-laden discharge from de-watering activities are designed to satisfy current best practice.</p>

SITE STABILISATION AND REHABILITATION			
Performance Criteria		Acceptable Solution	
P43	Site rehabilitation, including site revegetation, is designed, installed and maintained to an appropriate standard.	A43	<ul style="list-style-type: none"> (a) A Site Stabilisation Plan or similar is prepared and approved by the relevant regulatory authority prior to site establishment. (b) The standard of site rehabilitation complies with the requirements of the relevant regulatory authority or, where such a standard does not exist, complies with current best practice. (c) As a minimum, the type and degree of site rehabilitation is commensurate with the expected site conditions, soil type, stream flow, potential environmental risk, and the type, cost and scope of the works.
P44	Site rehabilitation methods and procedures minimise the risk of environmental harm.	A44	<ul style="list-style-type: none"> (a) Site revegetation (excluding temporary revegetation conducted for purposes of erosion control) is conducted in accordance with a Site Stabilisation Plan or similar, where such a plan exists. (b) Disturbed soil surfaces are appropriately stabilised to minimise the risk of short-term soil erosion. (c) All temporary ESC measures are removed and the land rehabilitated as soon as practicable after their use is no longer needed.
P45	Site rehabilitation methods, procedures and outcomes are compatible with site conditions and local environmental values.	A45	<ul style="list-style-type: none"> (a) The qualifications and experience of the personnel preparing and/or supervising the preparation of any Site Stabilisation Plan, Vegetation Management Plan, or similar, is commensurate with the potential environmental risk, and the extent and complexity of the works. (b) Plant selection and landscape design are compatible with identified environmental values.

SITE INSPECTION AND MONITORING			
Performance Criteria		Acceptable Solution	
P46	A Monitoring Program is prepared by, or under the supervision of, suitably qualified and experienced personnel.	A46	(a) A Water Quality Monitoring Program is prepared and approved by the relevant regulatory authority prior to site establishment. (b) The qualifications and experience of the personnel preparing and/or supervising the preparation of the Monitoring and Maintenance Program is commensurate with the potential environmental risk, and the extent and complexity of the works.
P47	The performance of the site's drainage, erosion and sediment control measures is regularly monitored.	A47	(a) The extent and complexity of site monitoring (including water quality monitoring) is commensurate with the potential environmental risk, and the extent and complexity of the works. (b) A record is maintained of the site's compliance and non-compliance with erosion and sediment control approval requirements. (c) All site monitoring data including environmental incidents, rainfall records, dates of water quality testing, testing results, and records of controlled water releases for the site, are kept in a register.
P48	The site's stream flow, drainage, erosion and sediment control measures remain relevant at all times to the current site conditions.	A48	All stream flow and ESC measures are inspected by site personnel: <ul style="list-style-type: none"> (i) at least daily (when work is occurring on-site); (ii) at least weekly (when work is not occurring on-site); (iii) within 24-hours of expected rainfall; and (iv) within 18-hours of a rainfall event of sufficient intensity and duration to cause runoff on the site.

SITE MAINTENANCE			
Performance Criteria		Acceptable Solution	
P49	All ESC measures are maintained in proper working order at all times during their required operational life.	A49	(a) All ESC measures are maintained in proper working order for the duration of the period in which their operation is required in order to satisfy the required treatment standard, and/or the objective of the ESCP. (b) All sediment control measures are maintained in accordance with the requirements of the relevant regulatory authority, or where such a standard does not exist, in accordance with current best practice. (c) As a minimum, the maintenance of all ESC measures is commensurate with the expected site conditions, and potential environmental risk.
P50	The maintenance of ESC measures does not cause environmental harm.	A50	All materials removed from ESC devices during maintenance or decommissioning, whether solid or liquid, is lawfully disposed of in a manner that does not cause ongoing soil erosion or environmental harm.

Attachment A

SITE PLANNING AND DESIGN

The *intent* of the Site Planning and Design section is to:

- Enable erosion and sediment control issues to appropriately influence the planning and design of instream works for the purpose of minimising their overall adverse environmental impact.
- Enable planners and designers to recognise that along with consideration of the operational phase of a development, appropriate consideration must be given to how something is to be constructed and maintained, and the potential adverse impacts of the construction and maintenance phases.
- Take all reasonable and practicable measures to actively avoid foreseeable soil erosion problems and associated environmental hazards during the construction phase.

The term “maintenance phase” refers to such activities as the de-silting of instream structures such culverts, stormwater pipes, and permanent instream sediment traps.

Acceptable Solution A1(a)

Data collection may include: soil testing, identification of potential site constraints, and development of a Conceptual Erosion and Sediment Control Plan (where such data and/or plans are considered reasonably necessary to enable appropriate site planning and design). Appropriate site planning and design refers to the aim of minimising the potential environmental harm (both during the construction and operational phases) of the instream works.

The “potential environmental risk” relates to the potential of a land-disturbing activity to cause harm, whether material, serious, reversible or irreversible, to an environmental value, including nuisance to a neighbouring property or person. The potential environmental risk is related, in part, to the assessed Erosion Hazard.

Acceptable Solution A1(b)

Data collection necessary to assist the design of site revegetation is outlined in Sections C3 and C9 of IECA (2008).

Acceptable Solution A2(a)

Construction activities that are deemed to represent a high to extreme erosion hazard include:

- Any disturbance of high to extreme hazard areas, or a problematic soil that could result in unmanageable soil erosion and/or environmental harm.
- Any construction or building activity, or procedure, that could potentially cause “serious” environmental harm.
- Any soil disturbance that could cause the transformation of significant quantities of potential acid sulfate soils (PASS) into actual acid sulfate soils (AASS), such as to cause “material” or “serious” environmental harm.

Acceptable Solution A2(f)

Ideally, Erosion and Sediment Control Plans (ESCPs) should be developed in close association with construction planning because the needs and limitations of the construction process represent an important component of the ESCP. In theory, a construction process cannot be finalised without reference to an ESCP, and an ESCP cannot be finalised without knowledge of the construction process.

Acceptable Solution A2(g)

Essential ESC control measures includes any instream sediment control and flow diversion systems, and bank and overbank drainage, erosion or sediment control measures.

Acceptable Solution A2(h)

The most critical issue is ensuring sufficient space is available to construct and maintain all *Sediment Basins* and flow diversion systems.

Acceptable Solution A2(i)

“Temporary” watercourse crossings refer to those crossings constructed for use only during the construction phase.

Acceptable Solution A3(a)

Minimising the potential environmental harm can be achieved, in part, by scheduling major land disturbances, and disturbances to high and extreme erosion risk areas, for the least erosive periods of the year.

The least erosive period of the year is usually the period of lowest stream flow. The least environmentally damaging period of the year usually relates to periods of no, or minimum, fish migration. Refer to State fisheries authorities for advice.

Acceptable Solution A4(a)

Ongoing erosion problems can result from any of the following:

- changes to the volume, duration, frequency or rate of stormwater runoff;
- excessive (i.e. erosive) flow velocities;
- inappropriate distribution of flow velocities throughout the depth and width of flow discharged from a stormwater drain into a receiving water;
- inappropriate direction of flow discharged from a stormwater drain into a receiving water.

Acceptable Solution A4(b)

“Ongoing maintenance” refers to such activities as the de-silting of instream structures such as culverts, stormwater pipes, and permanent instream sediment traps.

EROSION AND SEDIMENT CONTROL PLAN (ESCP)

The *intent* of this section is to ensure Erosion and Sediment Control Plans (ESCPs):

- are appropriate for the site conditions, which may vary from time to time;
- are prepared by, or under the supervision of, suitable personnel;
- are able to achieve the required design standard and environmental protection.

Acceptable Solution A5(a)

Such a clause shall not reduce the responsibility of applying and maintaining, at all times, all necessary sediment control measures in accordance with the sediment control standard.

Acceptable Solution A5(b)

Refer to A1(a) for discussion on “environmental risk”.

It is recognised that the degree of erosion and sediment control is related to the type, cost and scope of works in addition to the environmental risk. This association is acknowledged within the terms of current best practice erosion and sediment control as defined within this document (2008 conditions).

Acceptable Solution A5(c)

On very minor works, such as regular council maintenance activities, or the installation of minor services, the ESCP may be represented by standard drawings prepared by the principle company/organisation as part of an in-house Code of Practice. The key *intent* is to ensure that appropriate consideration is given to erosion and sediment control requirements before works commence.

For instream works with a soil disturbance greater than 50m², the Erosion and Sediment Control Plan (including supporting documentation and construction specifications) must include:

- (i) North point and plan scale.
- (ii) Site and easement boundaries and adjoining roadways.
- (iii) Construction access points.
- (iv) Site office, car park and location of stockpiles.
- (v) Proposed construction activities and limits of disturbance.
- (vi) Retained vegetation including protected trees.
- (vii) General soil information and location of problem soils.
- (viii) Location of critical environmental values (where appropriate).
- (ix) Existing site contours (unless the provision of these contours adversely impacts the clarity of the ESCP).
- (x) Final site contours including locations of cut and fill.
- (xi) General layout and staging of proposed works.
- (xii) Location of all drainage, erosion and sediment control measures.

- (xiii) Full design and construction details (e.g. cross-sections, minimum channel grades, channel linings,) for all drainage and sediment control devices, including *Flow Diversion Barriers* and instream sediment traps.
- (xiv) Construction specifications for adopted ESC measures (as appropriate).
- (xv) Site revegetation requirements (if not contained within separate plans).
- (xvi) Site Monitoring and Maintenance Program, including the location of proposed water quality monitoring stations.
- (xvii) Technical notes relating to:
 - site preparation and land clearing;
 - extent, timing and application of erosion control measures;
 - temporary ESC measures installed at end of working day;
 - temporary ESC measure in case of impending storms or elevated stream flows, or emergency situations;
 - installation sequence for ESC measures;
 - application rates (or at least the minimum application rates) for mulching and revegetation measures;
 - legend of standard symbols used within the plans.
- (xviii) Calculation sheets for the sizing of ESC measures.
- (xix) A completed Erosion and Sediment Control Plan checklist such as presented in (*insert publication*).
- (xx) Any other relevant information the regulatory authority may require to properly assess the ESCP.

The ESCP must clearly state that no land-disturbing activities shall occur on the site until all associated perimeter ESC measures, including flow diversion barriers, sediment traps and temporary drainage controls, have been constructed in accordance with the ESCP and current best practice erosion and sediment control procedures.

Acceptable Solution A6(a) & (b)

A suitably qualified and experienced professional is defined as a person with:

- (i) training and/or qualifications in erosion and sediment control that are recognised by the regulatory authority; and
- (ii) professional affiliations with an engineering, environmental engineering, soil science, and/or scientific organisation (e.g. the International Erosion Control Association; Engineers Australia; Environment Institute of Australia and New Zealand; or the Australian Society of Soil Science Inc.) and
- (iii) at least 2 years experience in the management of erosion and sediment control that can be verified by an independent third party.

ESCPs for high-risk sites should be reviewed by a suitably qualified and experienced third party reviewer prior to its implementation.

The assessment and categorisation of high-risk sites may be defined by the relevant regulatory authority; otherwise, refer to the discussion in Chapter 3 and Appendix F of IECA (2008).

Acceptable Solution A6(c)

The *intent* is to ensure the adoption of appropriate design procedures for temporary instream structures, and to minimise the risk of avoidable harm to the waterway.

Acceptable Solution A7(a)

The timing and degree of ESC specified in the Erosion and Sediment Control Plan(s) needs to be appropriate for the given soil properties, expected weather conditions, and susceptibility of the receiving waters to environmental harm resulting from sediment-laden runoff. Current (2008) best practice design standard of the drainage, erosion and sediment control measures are outlined in Chapter 4 of IECA (2008).

Acceptable Solution A7(b)

Additional and/or alternative erosion and sediment control measures must be implemented, and a revised Erosion and Sediment Control Plan (ESCP) must be prepared and submitted to relevant regulatory authority for approval (where required) in the event that:

- (i) site conditions significantly change from those previously anticipated; or

- (ii) there is a high probability that serious or material environmental harm might occur as a result of sediment leaving the site; or
- (iii) the implemented works fail to achieve the adopted ESC standard, or the State's environmental protection requirements; or
- (iv) site inspections indicate that the implemented works are failing to achieve the "objective" of this ESCP.

SITE ESTABLISHMENT

The *intent* of this section is to ensure that during site establishment:

- on-site personnel are provided with all necessary information to fully comply with all legal requirements, minimise environmental harm, and achieve the objective of the ESCP; and
- land disturbing activities proceed in a manner consistent with the objective of the ESCP.

Acceptable Solution A8

Supply of such material is relevant only to that material that exists, or is required to exist.

Acceptable Solution A9(a)

On low-risk site, ESC audits (including site inspections and water quality monitoring) may be performed by site personnel; however, as the risk of environmental harm increases, the need for third-party site inspections and water quality monitoring increases.

In reference to instream works, "low-risk sites" would include works conducted within dry-bed channels during periods when stream flow is highly unlikely.

Personnel undertaking ESC audits of a site must, collectively, have the following capabilities:

- (i) an understanding of the local environmental values that could potentially be affected by the proposed works; and
- (ii) a good working knowledge of the site's Erosion and Sediment Control (ESC) issues, and potential environmental impacts, that is commensurate with the complexity of the site and the degree of environmental risk; and
- (iii) a good working knowledge of current best practice ESC measures for the given site conditions and type of works; and
- (iv) ability to appropriately monitor, interpret, and report on the site's ESC performance, including the ability to recognise poor performance and potential ESC problems; and
- (v) ability to provide advice and guidance on appropriate measures and procedures to maintain the site at all times in a condition representative of current best practice, and that is reasonably likely to achieve the required ESC standard; and
- (vi) a good working knowledge of the correct installation, operational and maintenance procedures for the full range of ESC measures used on the site.

Acceptable Solution A9(b)

The construction industry's method of dealing with workplace safety issues is a good model for the development of an appropriate "chain of command" for the protection of environmental values. The aim is to produce a fair, reasonable and practicable approach based on environmental risk.

As in workplace safety, the responsibility of environmental protection, and therefore erosion and sediment control, rests with **all** site personnel, whether or not the work site is the normal place of work of any and all personnel. Establishing a "chain of command" does **not** diminish the responsibility of each and every person to take all reasonable and practicable measures to minimise environmental harm resulting from their actions as per their "environmental duty of care".

Acceptable Solution A10(a)

The exception to this clause is land disturbance necessary to provide access and allow the installation the initial ESC measures.

In general, initial land-disturbing activities should be limited to the establishment of the site compound, site entry/exit points, temporary drainage controls (including drain stabilisation measures), haul road(s), perimeter sediment controls, installation of flow diversion barriers, and any sediment basins/traps required for the first stage of works.

Acceptable Solution A10(b)

“Operational activities” include such things as material stockpiles, storage areas, or concrete waste receptors.

Acceptable Solution A11(a)

It is recognised that it may not be practicable for **all** stormwater runoff from **all** areas of site entry/exit paths to be directed to a sediment trap; however, such areas must be limited to the minimum practicable.

SITE MANAGEMENT**Acceptable Solution A12(a)**

Where appropriate, an Erosion and Sediment Control Plan is prepared (in accordance with Section G3.3), and where necessary approved by a relevant regulatory authority, prior to commencing any land-disturbing activities.

Acceptable Solution A12(b)

The potential for environmental harm must be assessed by a recognised expert or authority.

Acceptable Solution A12(c)

Refer to A1(a) for a discussion on “potential environmental risk”.

Acceptable Solution A12(d)

Applies to all land-disturbing activities, whether planned or unplanned, and especially to any works that are required to be conducted without an associated Erosion and Sediment Control Plan.

Acceptable Solution A12(d)(iv)

Includes ensuring that the value and use of land/properties adjacent to the development (including roads) are not diminished as a result of work-related soil erosion and sediment runoff.

Acceptable Solution A13

“Responsible ESC personnel” are those persons employed or contracted by the landowner and/or developer as the principal officer(s) responsible for ensuring appropriate application of the planned ESC measures and for the provision of advice in response to unplanned ESC issues.

Acceptable Solution A14(a)

Recommended training requirements are discussed in Section 6.19 of IECA (2008).

Acceptable Solution A14(b)

Necessary disturbance to ESC measures would include the short-term removal of an ESC measure to allow the installation of services under the ESC measure, or to allow vehicular or material access.

Performance Criterion P15

Performance Criteria P15 and P16 require work sites to be appropriately prepared for both current and imminent site conditions. Compliance with these criteria requires ESCPs to be living documents that remain both effective and flexible, and thus are able to appropriately adapt to changing site conditions.

Acceptable Solution A15(b)

A significant change in site conditions includes:

- unseasonable weather conditions;
- unseasonable stream flow;
- exposure of problematic soil conditions not previously anticipated;
- significant change in construction methodology, staging or programming of earthworks and/or site stabilisation activities;
- significant change in the development design or layout;
- an unprogrammed site shutdown.

Performance Criterion P16

Performance Criteria P15 and P16 require work sites to be appropriately prepared for both current and imminent site conditions. Compliance with these criteria requires ESCPs to be living documents that remain both effective and flexible, and thus are able to appropriately adapt to changing site conditions.

Acceptable Solution A18(a)

Appropriate identification depends on the level of risk of damage to protected or retained vegetation. Appropriate identification does not necessarily mean markers, signs or fencing; however, such measures may be appropriate in some areas.

Acceptable Solution A19(b)

AS1940 *The storage and handling of flammable and combustible liquids* (as amended from time to time).

In addition to the above:

- Impervious bunds must be constructed around all storage areas containing more than 1m³ of petroleum and oil-based products such that the enclosed volume is large enough to contain 110% of the volume held in the largest, individual storage tank.
- On-site personnel involved in the handling and storage of flammable and combustible liquids, including all liquid chemicals, must be appropriately trained and/or supervised, as required in order to allow such personnel to appropriately perform such activities.

Acceptable Solution A19(d)

Current (2008) best practice requires that all reasonable and practicable measures are taken to:

- (i) prevent the release of cement-laden runoff, concrete waste, and chemical products (including petroleum and oil-based products), into an internal or external water body, completed internal drainage systems, or any external drainage system, excluding those on-site drains and water bodies specifically designed to contain and/or treat such material;
- (ii) ensure all solid and liquid waste from concrete production, concreting equipment (including delivery and placement vehicles), is fully contained within the property;
- (iii) ensure cement residue from work activities is:
 - retained on a pervious surface (e.g. a grassed or open soil area, or excavated trench); or
 - filtered through a fine-grained, porous, earth embankment; or
 - collected and disposed of in a manner that minimise ongoing environmental harm.

Acceptable Solution A19(e)

Current (2008) best practice requires that wherever practicable, the washing of tools and painting equipment is carried out in a manner that:

- (i) complies with current State guidelines, policies and legislation; and
- (ii) fully contains any contaminated waste water for later treatment and/or lawful disposal; or
- (iii) appropriately filters (e.g. through a fine-grained, porous earth embankment) any contaminated liquid prior to its release from the immediate work area; or
- (iv) appropriately infiltrates all contaminated liquid matter into an area of porous grass or open soil.

Acceptable Solution A21(a)

“Sediment and other material” includes clay, silt, sand, gravel, soil, mud, cement and fine-ceramic waste.

Acceptable Solution A21(b)

Sealed surfaces include sealed roads and car parks.

In circumstances where the washing/flushing of sealed surfaces is required, all reasonable and practicable sediment control measures must be employed to prevent, or at least minimise, the release of sediment into receiving waters. Only those measures that will not cause safety issues or adverse property flooding to third parties shall be employed.

Acceptable Solution A22

“Appropriate consideration” includes taking all reasonable and practicable measures to minimise safety risks. As a general rule, safety issues take a higher priority than ESC issues; however, this does **not** mean that the existence of potential safety issues diminishes the ESC standard required of a work site.

Public safety risks include potential damage to public vehicles resulting from the use of inappropriate kerb-inlet sediment traps on public roads. The potential safety risk of a proposed sediment trap to site workers and the public must be given appropriate consideration **before** its installation, especially those sediment traps located within publicly accessible areas.

Sediment and sediment-laden runoff must not settle or collect on public roadways where such material could result in a traffic or safety hazard.

Performance Criterion P23

The protection of wildlife does not diminish the required ESC standard, or the need to take all reasonable and practicable measures to minimise environmental harm resulting from soil erosion and displaced sediment.

Acceptable Solution A23(c)

Refer to Witheridge (2002) for guidelines on the design of fish-friendly watercourse crossings.

Acceptable Solution A23(b)

Synthetic reinforced fabrics include “plastic” reinforced *Erosion Control Blankets, Mats and Meshes*.

SITE DISTURBANCE

Acceptable Solution A24(d)

Operational restrictions on the extent and duration of land disturbance, including land clearing only apply when such land disturbance is at risk, or potentially at risk, of erosion by wind, rain or flowing water.

The potential erosion risk is related (in part) to the potential rainfall erosivity as defined in Section 4.4 of IECA (2008). The potential erosion hazard may be identified through the application of an appropriate Erosion Hazard Assessment scheme such as those discussed in Chapter 3 and Appendix F of IECA (2008).

Acceptable Solution A24(e)

The full impact of the removal of deep-rooted vegetation from steep slopes may not be evident for 5 to 10 years, or until such time as the plant root system begins to fail (assuming that the root system remains within the soil profile after removal of the upper portion of the plant). Planners and designers must appreciate that plants provide many essential roles besides the provision of “scenery”.

Periods of high and extreme erosion potential refers to the variation in the erosion hazard throughout a calendar year based on variations in the rainfall erosivity as described in Appendix E of IECA (2008). Periods of high to extreme erosion potential include:

- periods of high to extreme erosion risk as defined in Section 4.4 of IECA (2008); and
- periods of strong winds sufficient to cause significant dust problems.

Acceptable Solution A25(a)

The extent of unnecessary soil disturbance, including disturbances outside the designated work area, must be minimised at all times.

Wherever reasonable and practicable, land clearing must be limited to the current stage of works. Current (2008) best practice recommends that land clearing not extend beyond the parameters indicated in Table I11 of IECA (2008).

Table I11 of IECA (2008) does not imply that land clearing should occur to the full extent of these limits, rather than all reasonable and practicable measures are taken to limit land clearing to no more than these limits. In all cases, land clearing must be limited to the minimum necessary to complete the approved works.

SOIL AND STOCKPILE MANAGEMENT

Performance Criterion A27

Applies to all areas of proposed soil disturbance, including footprint of proposed stockpiles prior to placement of soil within such areas. Does not include any material best described as subsoil.

Acceptable Solution A27(b)

Current (2008) best practice recommendations for the management of topsoil are presented in Table 6.2 of IECA (2008).

Acceptable Solution A28(ii)

The diversion of overbank, stormwater is recommended during those periods when rainfall is possible and the overbank catchment area exceeds 1500m².

Current (2008) best practice recommendations for the protection of sand and soil stockpiles from the erosive effects of wind and rainfall are presented in Table 4.6.1 of IECA (2008).

Acceptable Solution A28(iv)

Current (2008) best practice recommendations for the selection of an appropriate sediment control system is presented in Table 4.6.2 of IECA (2008).

Short-term stockpiles of erodible material located outside of an appropriate sediment control zone must be covered if it is raining, or if rain is imminent or possible.

Acceptable Solution A29

Dispersive soils normally need to be stabilised (i.e. treated with gypsum or lime depending on desired pH adjustment) and/or buried under a layer of non-dispersive soil prior to placement of channel lining (whether rock, gabion, synthetic material, or concrete), or initiation of revegetation.

Acceptable Solution A30

Within Queensland, guidelines on the management of acid sulfate soils is provided in State Planning Policy 2/02 *Guideline: Planning and Managing Development Involving Acid Sulfate Soils*, and Dear, et al. 2002, *Queensland Acid Sulfate Soil Technical Manual – Soil Management Guidelines*. Department of Natural Resources and Mines, Indooroopilly, Queensland.

DRAINAGE CONTROL

The *intent* of this section is to take all reasonable and practicable measures to prevent, or at least minimise, environmental harm and public nuisance resulting from the exposure of soil to the erosive forces of flowing water. It is not the intent to unfairly burden those performing land-disturbing activities with the cost and inconvenience of installing and maintaining drainage control measures if there is no risk of such environmental harm and public nuisance.

Acceptable Solution A32(a)

Current (2008) best practice construction phase drainage standards are presented in Table 4.3.1 of IECA (2008). Drainage systems must be designed to have a minimum non-erosive hydraulic capacity (excluding 150mm freeboard) in accordance with this table.

Acceptable Solution A32(b)

Construction Drainage Plans are normally prepared for sites with a soil disturbance exceeding 50m². Further discussion on the requirements of *Construction Drainage Plans* is presented in Acceptable Solution A11(d).

Acceptable Solution A33(b)

Sandbag flow diversion banks, catch drains, and flow diversion banks are examples of appropriate drainage systems that can be used to divert stormwater around excavations and other soil disturbances.

EROSION CONTROL

The *intent* of this section is to take all reasonable and practicable measures to prevent, or at least minimise, environmental harm and public nuisance resulting from the exposure of soil, sand, silt, mud or cement to the erosive forces of wind, rain and flowing water. It is not the intent to unfairly burden those performing land-disturbing activities with the cost and inconvenience of installing and maintaining erosion control measures if there is no risk of such environmental harm and public nuisance.

Acceptable Solution A35(a)

Current (2008) best practice (construction phase) land clearing and site rehabilitation standards are presented in Table I11 of IECA (2008). Unless otherwise stated by the relevant regulatory authority, the potential erosion risk is based on the rating outlined in Tables I9 and I10 of IECA (2008).

In addition, all temporary earth banks, flow diversion systems, and off-stream *Sediment Basin* embankments should be machine-compacted, seeded and mulched within ten (10) days of formation for the purpose of establishing a vegetative cover, unless otherwise stated within an approved Site Stabilisation Plan, Revegetation Plan, or Vegetation Management Plan.

Acceptable Solution A35(b)

Erosion control measures primarily focus on the control of fine sediments such as clay and silt-sized particles. Thus, with respect to the value of “erosion control measures”, potential environmental harm is strongly related to the susceptibility of the receiving waters to environmental harm resulting from turbid runoff (i.e. suspended fine sediments).

Erosion control measures need to be appropriate for the land slope and the expected wind, rain and hydraulic conditions. Application of effective drainage control measures should help to control hydraulic conditions such that damage to adopted erosion control measures during regular rainfall events is minimised.

Acceptable Solution A35(c)

This clause requires compliance with Performance Criteria P15 and P16.

Acceptable Solution A36(a)

Such a clause shall not reduce the responsibility to apply and maintain, at all times, all necessary sediment control measures.

The minimisation of soil erosion requires the application of effective drainage and erosion control throughout each and all sub-catchments.

Acceptable Solution A37(b)

Compliance with this clause requires:

- soil disturbance within any sub-catchment to be delayed as long as possible, and ideally, not until the principal on-site activities within that area are ready to commence;
- soil disturbance at any given time to be limited to the minimum necessary to perform the required works;
- the extent of unnecessary soil disturbance, including disturbances outside the designated work area, to be minimised.

The stabilisation of non-completed earthworks that are likely to be exposed to rainfall is discussed in Table I11 of IECA (2008).

Compliance with the requirements outlined within Table I11 of IECA (2008) does not diminish the need to apply all reasonable erosion control measures as soon as practicable.

Acceptable Solution A38(c)

Dispersive soils normally need to be stabilised (i.e. treated with gypsum or lime depending on desired pH adjustment) and/or buried under a layer of non-dispersive soil prior to placement of channel lining (whether rock, gabion, synthetic material, or concrete), or initiation of revegetation.

SEDIMENT CONTROL

The *intent* of this section is to take all reasonable and practicable measures to prevent, or at least minimise, environmental harm and public nuisance resulting from the exposure, placement, or displacement of sediment (including soil, sand, silt, mud and cement). It is not the intent to unfairly burden those performing land-disturbing activities with the cost and inconvenience of installing and maintaining sediment control measures if there is no risk of such environmental harm and public nuisance.

Acceptable Solution A39(a)

Current (2008) best practice (construction phase) sediment control standards are presented in Table 4.5.1 of IECA (2008).

Acceptable Solution A39(b)

Relevant site conditions include the soil type, design flow rate, flow condition (i.e. sheet flow or concentrated flow) and erosion hazard.

Unless otherwise noted within this document, or specified by the regulatory authority, the design storm for off-stream sediment traps (excluding de-watering and instream sediment control measures) must be taken as 0.5 times the 1 in 1 year ARI peak discharge.

The “potential environmental risk” is discussed in Acceptable Solution A1(a), and is summarised in Table 5.1 of IECA (2008).

Acceptable Solution A42(a)

The *intent* of this clause is to minimise the quantity of water that needs to be de-watered from excavations and trenches. Thus, if water does not need to be de-watered from such areas, then the clause does not apply.

Acceptable Solution A42(b)

Current (2008) best practice sediment control standards for de-watering activities are outlined in Table 4.5.13 of IECA (2008).

Alternatively, Table 4.5.14 of IECA (2008) presents a water quality standard for de-watering operations based on Nephelometric Turbidity Units (NTU).

Appropriate sediment controls placed down-slope of material stockpiles during the de-watering of such stockpiles are summarised in Table 4.5.14 of IECA (2008).

SITE STABILISATION AND REHABILITATION

Acceptable Solution A43(a)

Site Stabilisation Plans, Landscape Plans, and/or Vegetation Management Plans must show progressive stabilisation of exposed soil for the purposes of erosion control, including but not limited to, all of the following:

- (i) schedule for stabilisation of exposed soil areas; and
- (ii) specifications for subsoil and topsoil preparation and application; and
- (iii) specification of stabilisation by mulching or other appropriate surface treatment (note, grass seeding without adequate mulching is generally not considered best practice); and
- (iv) details on the type and application rate of any tackifiers to be used in the application of mulches (including *hydromulch*, *Bonded Fibre Matrix*, and *Compost Blankets*).

Water Quality Monitoring Programs must document proposed water quality monitoring, and include:

- (i) location of all instream water quality monitoring stations;
- (ii) water quality monitoring, sampling, and analysis procedures and standards.

Acceptable Solution A43(b)

Current (2008) best practice site rehabilitation standards are presented in Table I11 of IECA (2008). Unless otherwise stated by the relevant regulatory authority, the potential erosion risk is based on the rating outlined in Tables I9 and I10 of IECA (2008).

Acceptable Solution A44(a)

Temporary revegetation conducted for the purpose of erosion control must be conducted in accordance with a Site Stabilisation Plan, Landscape Plan, Revegetation Plan, or Vegetation Management Plan, where such a plan specifically refers to such activities.

Acceptable Solution A44(b)

The type of permanent vegetation applied to completed earthworks must be compatible with the anticipated long-term land use, current and ongoing erosion risk, environmental requirements (including weed control), and associated components of the site rehabilitation.

Performance Criterion P45

Local environment includes local wildlife.

SITE INSPECTION AND MONITORING**Acceptable Solution A46(b)**

Personnel preparing and/or supervising the preparation of the Monitoring and Maintenance Program must, collectively, have the following capabilities:

- (i) an understanding of the local environmental values that could potentially be affected by the proposed works; and
- (ii) a good working knowledge of the site's Erosion and Sediment Control (ESC) issues, and potential environmental impacts, that is commensurate with the complexity of the site and the degree of environmental risk; and
- (iii) a good working knowledge of current best practice Erosion and Sediment Control measures appropriate for the given site conditions and type of works; and
- (iv) a good working knowledge of the correct installation, operational and maintenance procedures for the full range of ESC measures used on the site.

Refer to A1(a) for discussion on "potential environmental risk".

Acceptable Solution A47(a)

Discussion on scheduling and conducting site inspections by internal and external parties is provided in Chapter 7 of IECA (2008).

In those instances where specific site monitoring stations are identified within the Monitoring and Maintenance Program, then:

- during periods of water discharge from the site, water quality samples are collected at each monitoring station at least once on each calendar day until such discharge stops; and
- a minimum of 3 water samples are taken and analysed, and the average result used to determine quality.

Current (2008) best-practice procedures for "high-risk" sites, requires regular ESC audits to be:

- (i) undertaken by a person suitably qualified and experienced in erosion and sediment control that can be verified by an independent third-party (this person must not be an employee or agent of the principal contractor); and
- (ii) conducted on the next business day following a rainfall event in which greater than 10 mm of rainfall has been recorded by the Bureau of Meteorology rain gauge nearest to the site; and
- (iii) conducted at intervals of not more than one (1) calendar month commencing from the day of site disturbance until all disturbed areas have been adequately stabilised against erosion to the acceptance of the relevant regulatory authority; and
- (iv) conducted using an appropriate Site Inspection Checklist.

"High-risk sites" are work sites that:

- satisfy the requirements of a high-risk site as defined by either the State or local government; or
- satisfy the requirements of those risk categories greater than high-risk (such as extreme-risk) where such categories have been defined (i.e. score a hazard rating equal to or greater than the "critical hazard value").

Discussion on the assessment of *erosion hazard* and *site risk assessment* is presented in Chapter 3 and Appendix F of IECA (2008).

ESC audits must include, as a minimum:

- copies of all original Site Inspection Checklists; and
- non-conformance and corrective action reports;
- sediment basin water quality and site discharge water quality monitoring results;
- a plan showing the areas of completed soil stabilisation; and
- rainfall records including date and rainfall depth.

Acceptable Solution A48

Discussion on scheduling and conducting of site inspections is provided in Chapter 7 of IECA (2008).

SITE MAINTENANCE

Performance Criterion P49

Proper working order includes maintaining the required hydraulic capacity and operational effectiveness.

Acceptable Solution A49(b)

Current (2008) best practice requirements for the maintenance of sediment control devices requires these devices to be maintained and made fully operational as soon as reasonable and practicable in accordance with Table 6.1 of IECA (2008).

Reference

IECA 2008, *Best Practice Erosion and Sediment Control*. International Erosion Control Association (Australasia), Picton NSW.

Appendix D
Concept Dewatering, Hydrotest Water and
Land Release Management Plan
(DHWLRMP)

Concept Dewatering, Hydrotest, Water and
Land Release Management Plan
Marine Crossing – Gas Transmission Pipeline



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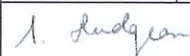
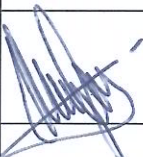
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1. Introduction

O2 was commissioned by Downes Group on behalf of GLNG Operations P/L (herein the Client) to prepare a Dewatering, Hydrotest Water and Land Release Management Plan for the proposed works associated with the Gas Transmission Pipeline Narrows Marine Crossing construction.

The area of interest is located approximately 16km north of Gladstone. The location is commonly called the 'Narrows'.

This plan describes physical controls and processes that are expected to result in general compliance with the objectives in Section 1.2. Should the controls indicated in this document not achieve the identified performance criteria for any reason, it is the responsibility of the operator to notify the nominated specialist so that a revision of the plan can be undertaken.

This plan should be read in conjunction with the O2 Marine Crossing – Gas Transmission Pipeline: Stormwater Management and Erosion and Sediment Control Plan (Document Number R001631).

1.1. Environmental Approvals and Legislative Requirements

This plan is provided to meet the following requirements:

Dewatering – Relating to dewatering tunnelling operations to meet requirements as set out in **5.2 (a) & 5.3** of the DERM additional information request (375042/BNE45992) and Condition 32 (e), (m) & (n) of the EPBC Approval (22/10/2010).

Hydrotest water – To meet requirements as set out in **5.1** of the DERM additional information request (375042/BNE45992), Appendix 3 Part 3 Condition 3 e) of the CG (May 2010) Report and Condition 37 (d) of the EPBC Approval (22/10/2010).

Land Release – In accordance with **5.1** (Hydrotest Water) of the DERM additional information request (375042/BNE45992) and **5.3** (Dewatering) in accordance with **5.1** (Hydrotest Water) of the DERM additional information request (375042/BNE45992)

1.2. Objectives and Targets

This Dewatering, Hydrotest Water and Land Release plan has been developed in accordance with the following guidelines:

- Queensland Water Quality Guidelines (Department of Environment and Resource Management, 2009)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000)

The objective of this plan is to minimise harmful impacts on receiving land and waters during the operational period.

1.3. Proposed Works

The summary of relevant works below is based on information provided by GLNG Operations Pty Ltd in a File Note titled 'Preliminary Narrows Crossing Information for Environmental Studies (Ref: 3301-GLNG-3-4-3.3-0004).



The Marine Crossing Project is the construction of a 4.3km long, 3.4m internal diameter tunnel from the mainland to Curtis Island across a channel of tidal sea water to provide access for an LNG pipe to connect to the processing facility on Curtis Island near Gladstone, QLD.

The Areas of Interest associated with the project include the following:

- Launch pad and receptor pad for tunnel boring activities located on the mainland and Curtis Island respectively
- Tunnel between the mainland and Curtis Island
- Pipeline laid within the tunnel

The draft site layout plan provided by client is shown below in Figure 1, with layout details of the launch and receptor pads provided in Figure 2 and Figure 3 respectively.

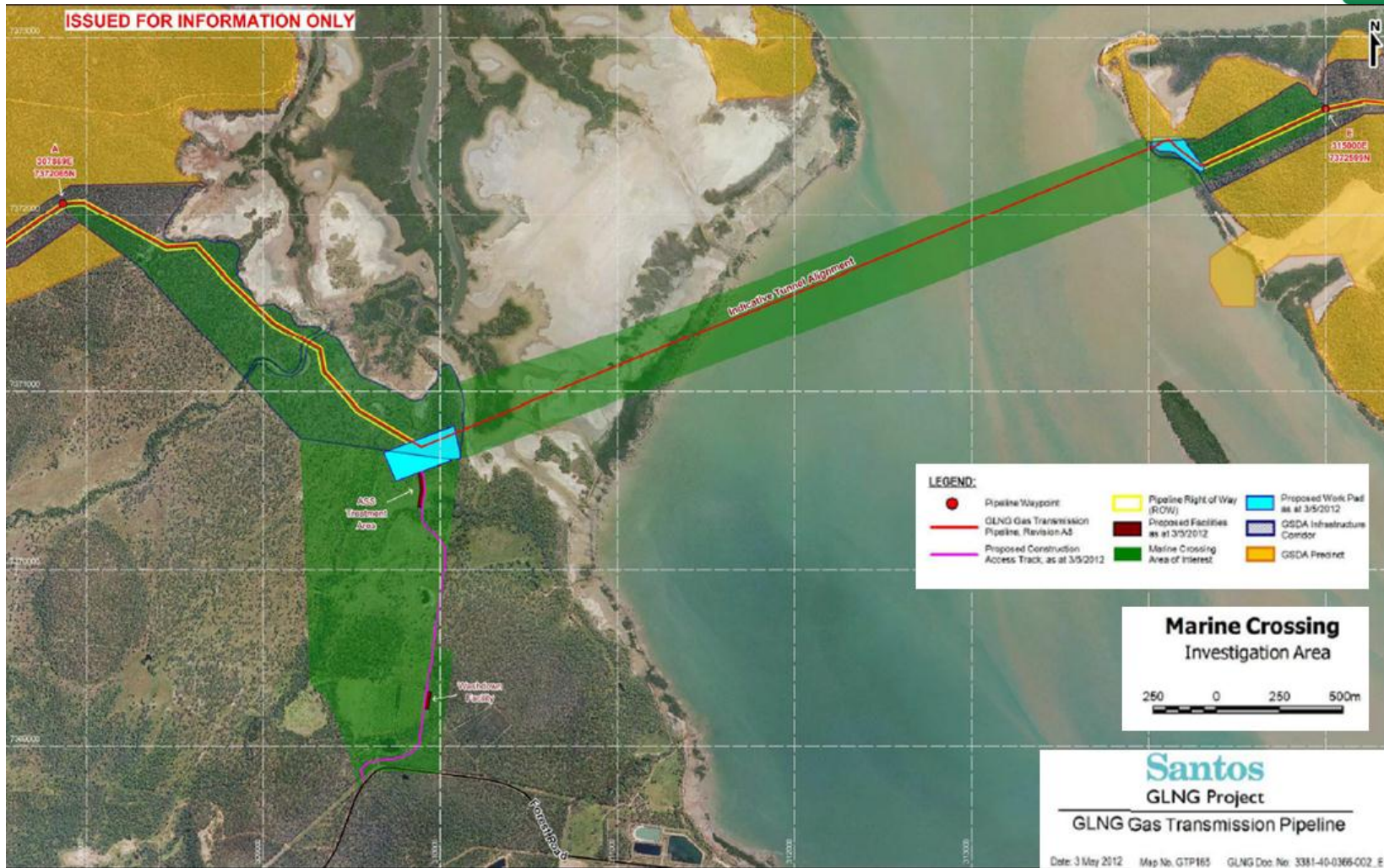


Figure 1: Site Layout Plan

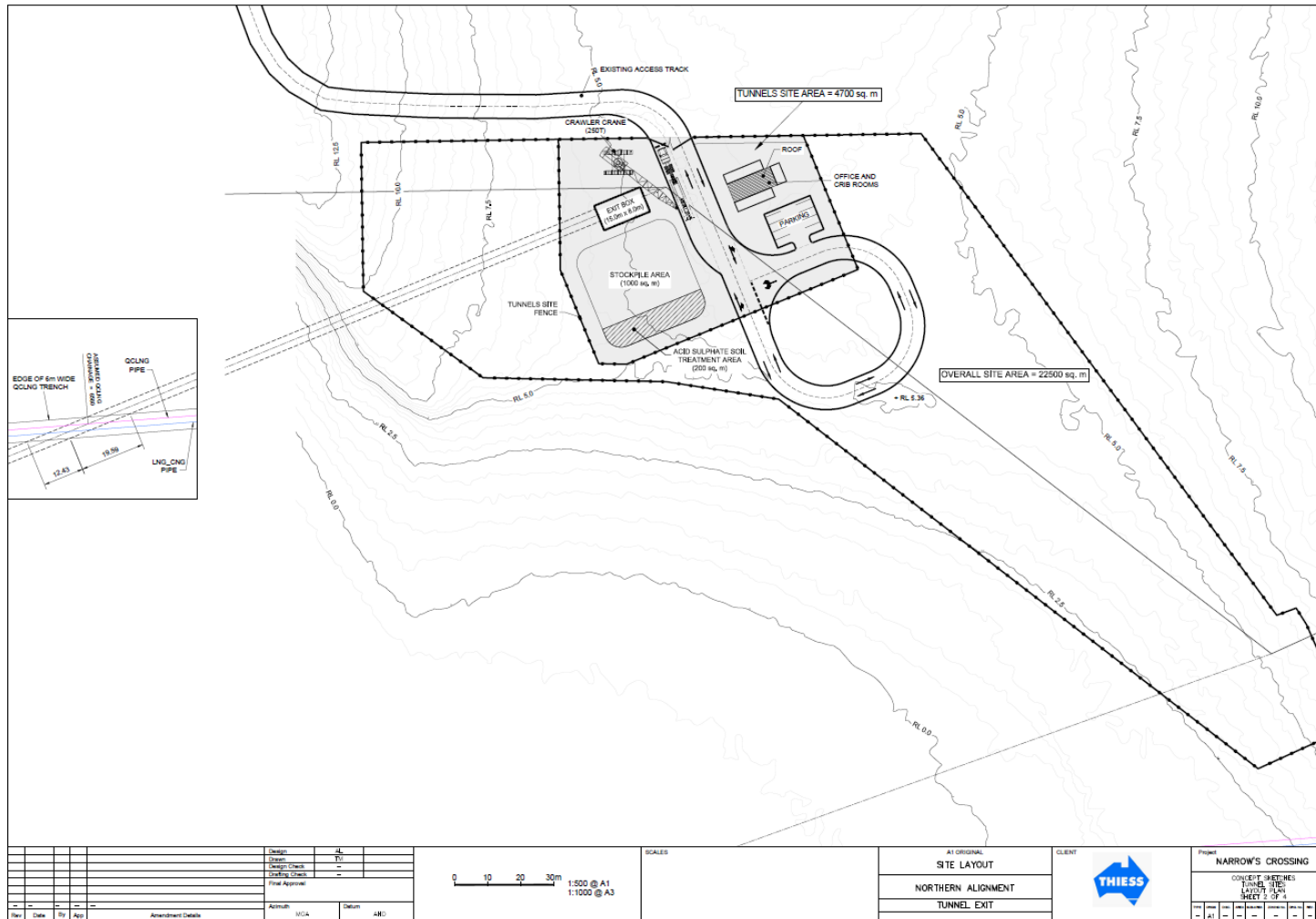


Figure 3: Receptor pad infrastructure draft drawing

2. Site Description

The site was inspected on the 4th and 13th of April 2012. Most areas were able to be accessed with the exception of the pipeline from the launch pad to Humpy Creek (marked in yellow dotted line). Figure 4 displays all photo points and sites inspected (red dots).



Figure 4: Photo and inspection points

2.1. Site Drainage

Downes Group provided a report 'Site Value Assessment and Water Mouse Habitat Assessment Report (2012)'. The following information is an extract from their findings in regard to aquatic values.

The site has four constructed waterholes / dams which are all very stable and mostly well vegetated with a range of macrophytes and aquatic plants (native and exotic).

Areas from the access gate and southern parts of the "orchard" appear to drain towards a drainage line. This drainage line was flowing at the time of inspection following significant rainfall in the week prior to the site visit. This drainage line flows into the southern dam.

The second dam will be bypassed (in fairly close proximity) by the proposed access track with no impacts anticipated. This area is open and relatively flat with good opportunities to manage surface erosion and stormwater impacts.

The third larger central dam capture runoff from areas from within and to the south of the proposed pad and is a large and well established landscape feature. Drainage patterns for the pad area appear to flow mostly from the east either north to the small *Baumea articulata* and *Eleocharis* packed waterhole, or south to the large third central dam. Areas draining to the southern dam are presently wet on the site with numerous sedges and wetland plants interspersed with grazing grasses.

Water birds and ducks were observed in all dams and an active and inquisitive population of Double Barred Finches (*Taeniopygia bichenovi*) observed in the northern *Baumea* dam. The northern dam is unique in that it remains freshwater despite the estuarine influence observable in lower lying areas around the landscape feature to the east and north.

The existing proposed location of the pad is well positioned avoiding both drainage features (dams) to the north and south, and positioned such that the seaward edge of the clearing is perched on the top of the existing natural ridgeline. Due to the topography and possibly soil type there is minimal intertidal zone with the open forest dropping immediately into tidal mudflats. A mangrove community is located approximately 50m from the edge of the mudflats

2.2. Acid Sulphate Soils

An investigation of acid sulphate soils (ASS) carried out for the Environmental Impact Statement for the project indicates that both Actual ASS (AASS) and Potential ASS (PASS) occur within the upper levels of the estuarine sediments in the area. Further details can be found in the Acid Sulfate Soil Management Plan (ASSMP) prepared by Golder as part of the Environmental Management Plan.

3. Methodology

The summarised methodology in relation to dewatering and hydrotesting below is based on information provided by Downes Group in the following reports:

- Preliminary Narrows Crossing Information For Environmental Studies (Document Number: 3301-GLNG-4-3.3-0004)
- Hydrotest Conceptual Plan – Marine Crossing (Company Doc. No. 3380-SAIP-4-1.3-XXXX)
- Hydrotest Water Management Plan (Company Doc. No. 3380-SAIP-4-1.3-1840)

The tunnel construction will be carried out by a Tunnel Boring Machine (TBM) beginning at the launching pad on the mainland and concluding at the receptor pad on Curtis Island.

Once the tunnel construction is complete, the pipe will be installed with welding taking place immediately before the tunnel entrance.

Hydrotesting will then be carried out on the pipe section.

The water for the tunnel construction will be sourced, treated and discharged separately from the water for the hydrotesting.

Each of these activities is described in more detail in the following sections.

3.1. Tunnel Boring

The tunnel will be constructed by a Tunnel Boring Machine (TBM) that will place waterproof concrete segments as it progresses through to the receptor pad on Curtis Island.

The concrete segmental rings and the grout placed between them is substantially watertight, however a small quantity of water is expected to infiltrate the tunnel. Over the period of 13 months the estimated total infiltration of water is expected to be between 2,500m³ to 5,000m³. Infiltration of water into the tunnel will cease when the tunnel is flooded.

The client advises that, based on past experience with similar tunnels, water imported by tankers from approved Gladstone Area Water Board sources will be used at the commencement of tunnelling and periodically during operations.

Water is considered a valuable resource and will be recycled to the greatest practical extent for use in tunnel construction. Water for this purpose will be processed through a dedicated site water treatment plant located at the launch pad and stored in tanks for reuse.

The majority of this water will ultimately be returned to the tunnel either as a component of the 6000 m³ of grout required or when the tunnel is flooded.

Water will also be used during construction for dust suppression and housekeeping on the pad.

On completion the tunnel will be flooded with any water remaining in the tanks holding (treated) tunnel water, and the balance made up with seawater sourced from the Narrows.

If it is considered inappropriate to use this water to flood the tunnel once it has been completed, the water will be treated to a standard suitable for discharge.

A small amount of Bentonite may be stored and used on site as a contingency measure to lubricate parts of the tunnelling operation and will be used as a component of the grout which will be fixed between the segments.

The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) regulates international cooperation on environmental protection in the North-East Atlantic region. The OSPAR Commission is the mechanism by which the European Community and fifteen Governments of the western coasts and catchments of Europe co-operate to protect the marine environment of the North-East Atlantic. Bentonite is listed in the OSPAR Commission's List of Substances/Preparations Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment (PLONOR). (OSPAR Commission, 2012)

3.2. Hydrotesting

The tunnel section will be constructed from the mainland end in the direction of Curtis Island. During the tunnel construction, pipe will be welded and pretested in readiness for installation. Installation of the pipe will not take place until the tunnel is completed and the tunnelling infrastructure that is not required for the pipe installation has been removed.

Hydrotesting, or hydrostatic pressure testing, is the testing of a section of pipeline with water to establish the strength and leak tightness of the test section and to confirm the maximum allowable operating pressure.

All sections of pipe to be tested are cleaned with a pig and compressed air to remove any construction debris prior to filling with water for hydrotesting.

The hydrotest water will be water that has been used for testing inland sections of pipe. Once testing of the upstream sections is complete, the water will be transferred to the pond at the pad and testing of the mainland sections of pipe will be carried out. When the tunnel is complete and the pipe has been installed, hydrotesting of the pipe in the tunnel and on Curtis Island will be carried out. Water will then be returned to the pond at the pad for land release.

3.2.1. Water Supply for Hydrotests

Water for hydrotesting the mainland section of the pipeline will be transferred from the adjoining mainland pipeline sections. This water will be reused water from hydrotesting of inland sections of pipe and will originally have been raw water sourced from bores to the west in the Arcadia Valley or near Bauhinia Downs.

On completion of the adjoining mainline test section, water will be transferred into a pond constructed at the launch pad. The pond will be approximately 15,000 m³ in capacity with a maximum water depth of approximately 5 to 6 metres and freeboard of approximately 1m to manage the risk of uncontrolled release, based on a Q10 event. The pond will be lined to prevent losses due to infiltration and avoid contamination from groundwater infiltration or interception of any acid sulphate soils at the location. A sump will allow most of the water to be removed.

Water cannot be passed through the mainline test section once it has been dewatered and dried. Any additional water (if required) must be obtained via road tankers from the Gladstone Area Water Board or other available water sources of suitable quality.

3.2.2. Water Quality

The desired water quality for hydrotest water is essentially fresh water with dissolved solids of less than 2,000 ppm. There is no intention of using biocide or corrosion inhibitors and the pipe will be cleaned by a pig and compressed air prior to hydrotesting.

A study conducted by the CSIRO (G. Tjandraatmadja, 2005) found that the quality of the used hydrotest water did not represent a hazard to the environment, provided that the source water was of adequate quality. The source water quality was identified as the primary driver of the quality of used hydrotest water.

The water will need to be assessed for Sulphate Reducing Bacteria (SRB) and turbidity prior to use for hydrotesting.

If both SRB and sufficient sulphate availability is detected in the water, measures will be taken to prevent the growth of SRB. The preferred method is to increase the pH to a minimum of pH10 by the addition of sodium bicarbonate, sodium carbonate and sodium hydroxide.

The presence of suspended solids encourages the growth of SRB. Removal of suspended solids by settlement will assist in controlling SRB. Aeration of the water also reduces SRB activity.

3.2.3. Water Treatment

If any pH adjustment has been carried out prior to hydrotesting, pH correction to pH6.5 – pH8.5 will be carried out in the pond by acid dosing prior to disposal.

3.3. Water Disposal

The water associated with tunnelling activities will be treated by the site treatment plant and ultimately either used to flood the tunnel or be discharged appropriately according to the ASSMP.

The hydrotest water will essentially be raw fresh water and should require minimal treatment before discharge. Any treatment that is required, such as pH correction in the case that SRB are found in the source water, will occur within the pond. The hydrotest water is anticipated to be ultimately discharged to land.

3.3.1. Water Balance

The following information was provided by the Client on 30 May 2012 in Santos GLNG Project – Marine Crossing Comment Sheet – Water packages: Hydrotest, Dewatering, Land Release.

The volume of pipeline to be hydrotested is approximately 10,000m³. An extra 5,000m³ of water will account for evaporation and pre-testing. 15,000m³ of water will be collected and stored over a period of 6 months in the pond lined with impervious lining. The hydrotesting will be carried out over a 6 month period and final disposal of hydrotesting water will be via controlled discharge to land at the end of the 12 months.

The design groundwater infiltration into the tunnel is 1L/hr/100m, resulting in approximately 2,500m³ to 5,000m³ over 13 months being passed through the treatment plant. Some of this water may be lost in the spoil that is being exported from the site.

The volume of water required for the drilling operations is unknown. This water will also be passed through the treatment plant.

5,000m³ of water from the treatment plant will be used to create 6,000m³ of grout for the tunnel. Some water from the treatment plant will be used to wash down the surrounds and for dust suppression. Any remaining treated water will either be used to flood the tunnel or will be released via control release, as appropriate.

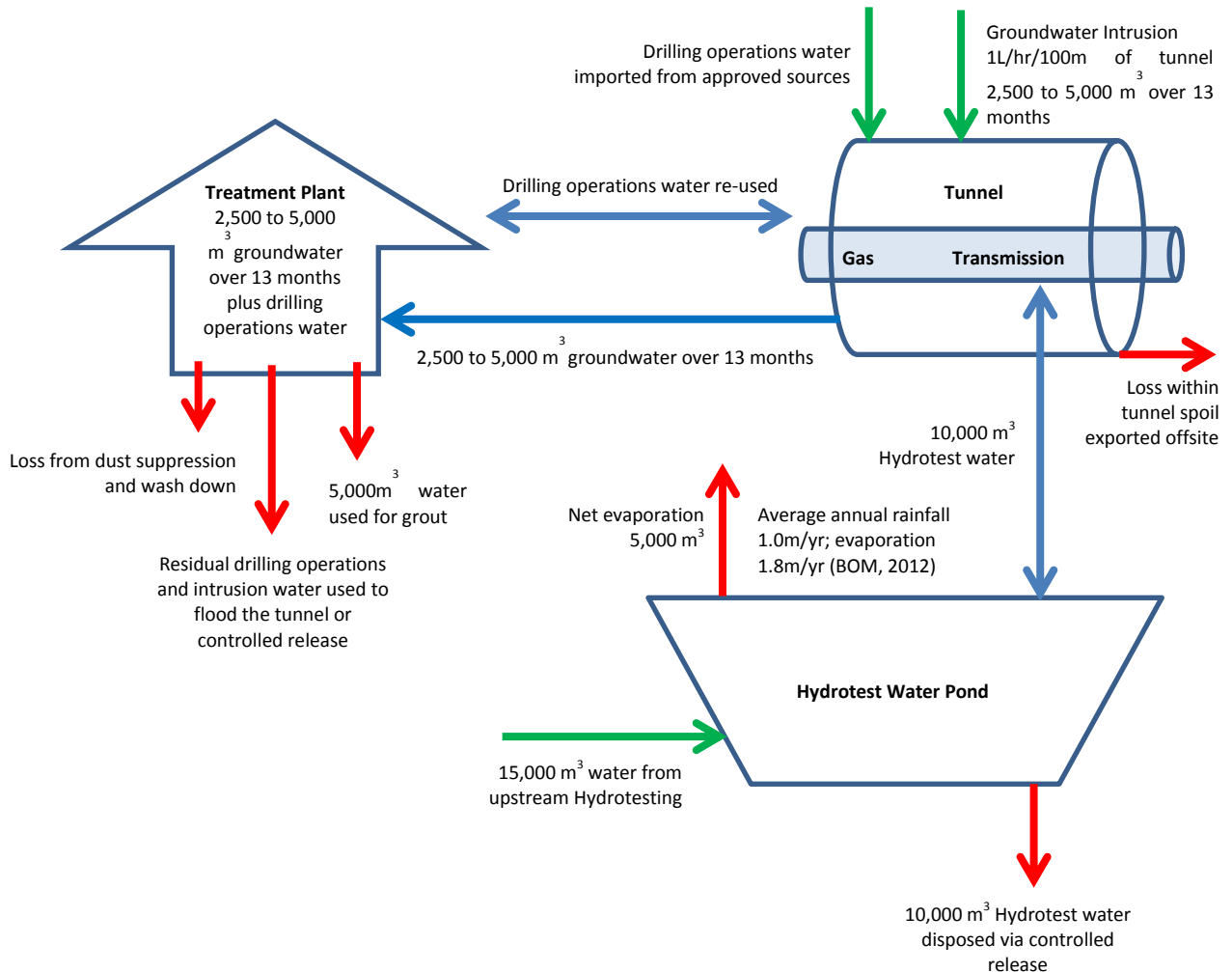


Figure 5: A schematic for water around the site

At this stage, it is understood that at least 10,000m³ of water will require controlled release to land.

3.3.2. Controlled Land Release

Possible locations for land release are shown in

Figure and include areas that are at least 100m from water courses, 100m landward of Highest Astronomical Tide (HAT) and avoid areas of significant vegetation.

The most appropriate site for discharge will be selected prior to discharge. Key considerations for site selection include:

- Locations must be a minimum 100m from watercourses and 100m landward of (HAT)
- Areas of saturated soil or high ground water table will be avoided - simple permeability tests will be carried out to confirm the existing groundwater level and the permeability of the soil

- Soil erosivity – sites will be chosen to minimise erosion and erosion and sediment control techniques will be employed where necessary
- Discharge or infiltration into disturbed grassland is preferred and areas of significant vegetation will be avoided
- Minimisation of flows into existing dams

The method, rate, surface area and timing of discharge will be determined based on the volume of water to be released, soil properties of the chosen location and the weather conditions. Discharge events will be planned for appropriate weather conditions and forecasts. If applicable, release areas may be rotated to minimise impacts.

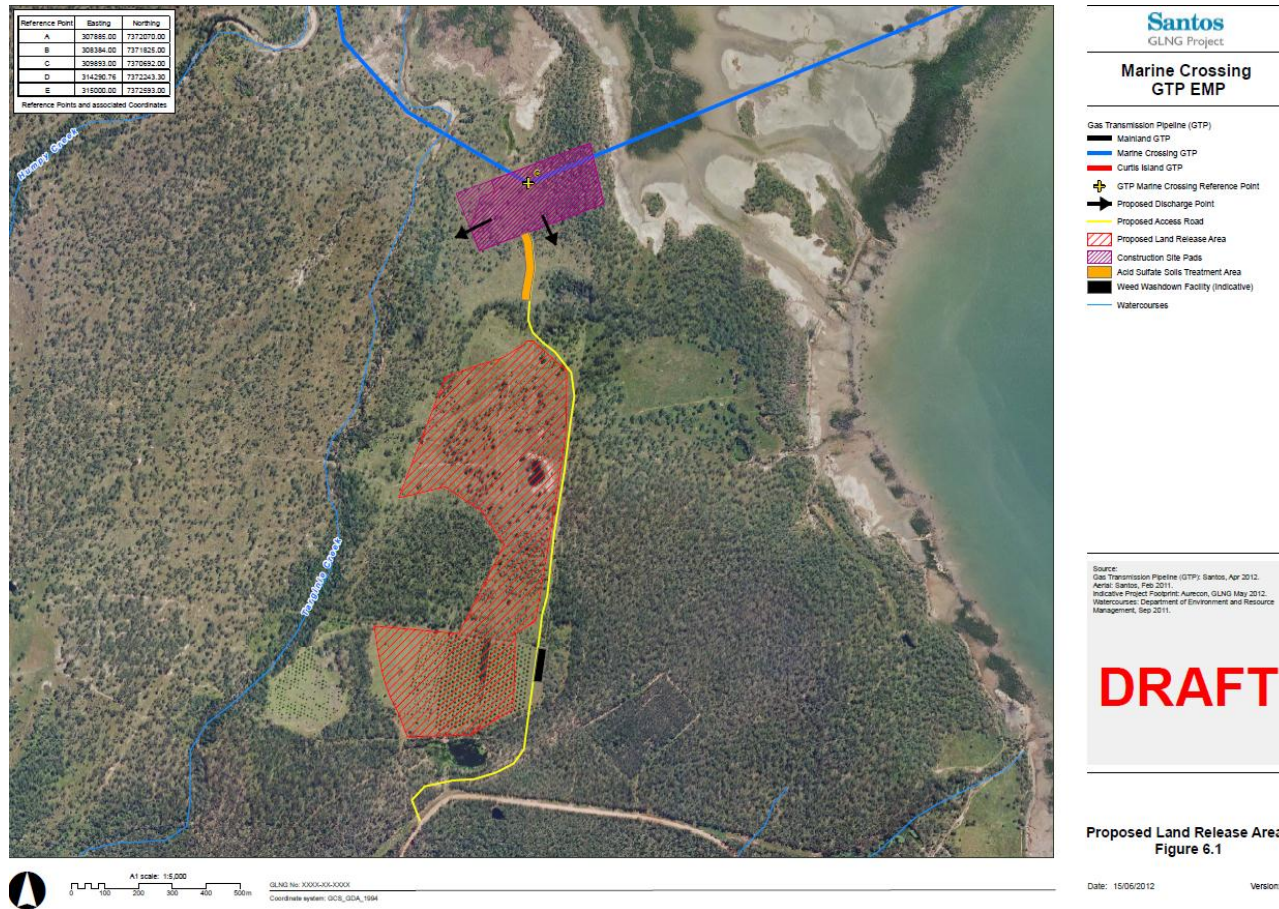


Figure 6: Suggested locations for controlled land release

4. Dewatering, Hydrotesting and Land Disposal Management

The following sections contain recommendations for monitoring, performance criteria and contingency planning for tunnelling water, hydrotest water and controlled land release.

4.1. Dewatering

Any dewatering activity should strive to minimise the radius of influence of the cone of depression and any impacts on sensitive surface water receptors near the operation. It is anticipated that there will be minimal dewatering relating to the project's tunnelling operations.

Given the likelihood that groundwater will be acidic or otherwise need treatment, the Acid Sulphate Soil Management Plan produced by Golder Associates will describe the management and treatment of all groundwater. Refer to the following for the dewatering details:

- Draft Acid Sulphate Soil Management Plan, GLNG Pipeline Route
- Phase 1 Acid Sulphate Soil Investigation

Prior to discharge, the groundwater would be field tested and treated in accordance with the Golder ASSMP. In the event the volume of tunnelling water generated is higher than anticipated, the number of temporary holding and treatment tanks may be increased or other contingencies will need to be considered.

According to the Golder ASSMP, groundwater levels will be monitored prior to and during tunnel construction via installed groundwater wells adjacent to the launch pad. If drawdown is found to be excessive, a contingency strategy can be implemented to recharge the aquifer by circulating groundwater from dewatering operations back behind the sheet piles. This would negate the possible impacts of lowered groundwater levels and the potential oxidation of surrounding sediments.

4.2. Hydrotesting

Any hydrotesting activity should strive to minimise any impacts on the environment.

The cleanest and most practical water source for hydrotesting water will be chosen to minimise treatment requirements prior to disposal via controlled land release.

Hydrotesting water will essentially be raw water from bores to the west of the site.

There is no intention of chemically treating the water prior to hydrotesting. However, if sulphate, SRB and turbidity levels are found to be high enough to encourage SRB growth, the water will require pH correction prior to hydrotesting to minimise the risk of corrosion. The pH will then be corrected post-hydrotesting to the range of pH6.5 – pH8.5.

4.2.1. Monitoring and Performance Criteria

Water quality analysis will be carried out upon completion of the hydrotesting.

If necessary, the water will be treated to conform with the limits set out in Table 1 for disposal of water to land. The water will be monitored on the release line to ensure that these criteria are met. Water will be returned for treatment if the criteria are not met.

Table 1: Water quality limits for disposal of hydrostatic water to land

Parameter	Parameter Maximum Value
pH	pH 6.5 - 8.5 (Range)
Arsenic (mg/L)	2
Cadmium (mg/L)	0.05
Chromium (mg/L)	1
Copper (mg/L)	5
Iron (mg/L)	10
Lead (mg/L)	5
Manganese (mg/L)	10
Zinc (mg/L)	5
Nitrogen (mg/L)	5
Phosphorus (mg/L)	1
Electrical Conductivity (µS/cm)	2000

4.2.2. Contingency Plans

Contingency plans will be developed once more is known about the site to address actions required if performance criteria are not met. Contingency plans will include but are not limited to implementation of the following:

- Additional treatment methods in the event that performance criteria are not met

4.3. Controlled Land Release

Controlled land release relates primarily to the hydrotest water but may also apply to residual water from tunnelling operations if this water is not fully used to produce the grout or to flood the tunnel.

Land discharge of appropriate water could be undertaken either via infiltration or irrigation of a nearby orchard. The controlled discharge will be to appropriate discharge structures 100m from water course and 100m landward of Highest Astronomical Tide (HAT) to dissipate energy to reduce erosion, protect the water quality of nearby water bodies and reduce the potential for the introduction of new species.

There is no intention of chemically treating the water prior to hydrotesting. However, if pH correction or flocculation is required to minimise the risk of corrosion, the requirements for discharge water quality will be taken into consideration when determining dosing procedures.

Disposal to land will require erosion protection, runoff controls and sediment interception to minimise impacts on the receiving environment. Refer to Marine Crossing – Gas Transmission Pipeline: Stormwater Management and Erosion and Sediment Control Plan for more details.

Control measures will be used to maintain stable landforms. The energy dissipation technique can be selected with reference to section 8.06 of Queensland Urban Drainage Manual (Natural Resources and Water, 2007). Suggested energy dissipation techniques could include a Rock Pad, Rock Mattress or Riprap Basin (See Figure 7).

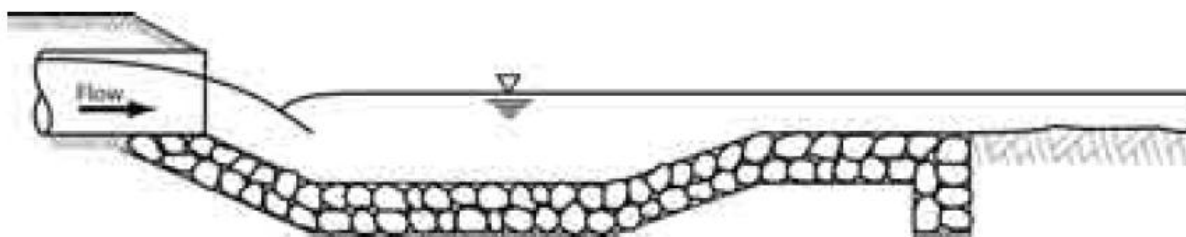


Figure 7: Riprap basin (QUDM pg 8-28) (Natural Resources and Water, 2007)

4.3.1. Monitoring and Performance Criteria

Sampling will be carried out on all outgoing streams prior to discharge in order to verify compliance with the water quality criteria in Table 1 (above) and any specific conditions of relevant environmental permits.

Discharge locations and downstream land and water bodies will be visually inspected for signs of erosion or increased turbidity on a daily basis. Groundwater and surface water quality sampling will be carried out during discharge activities to monitor for adverse changes to the environment. Refer to section 4.1.

4.3.2. Contingency Plans

Contingency plans will be developed once more is known about the site to address actions required if performance criteria are not met. Contingency plans will include but are not limited to implementation of the following:

- Additional treatment methods in the event that performance criteria are not met
- Alternative disposal options if the preferred method is considered to be causing environmental harm
- A reduction of discharge rates if the discharge is considered to be causing environmental harm
- Addition of further erosion protection, runoff controls and sediment interception measures if adverse changes are observed at or downstream of the controlled discharge location
- Reviewing and updating the surface water quality sampling requirements upon the advice of the Site Environmental Officer, such as in the case where the initial round of sampling indicates that there may be an issue with the hydrotest discharge water quality
- Addition of a comprehensive suite of monitoring at an appropriate frequency if discharge, groundwater or surface water quality adversely varies significantly compared to pre-discharge conditions
- Additional assessment of the causes of water quality deterioration if long term water quality is considered to have degraded for reasons directly attributable to discharge activities. This may include assessment of soil and groundwater quality, and development of a suitable management strategy



5. Reporting and Notification

Operators shall record and report the results of all monitoring sampling and surveys monthly.

If any non-compliance or adverse environmental effects are observed, the operator will notify the Client immediately and include suggestions for additional mitigation and management measures.



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Appendix E

Landscape and Rehabilitation Plan (LRMP)

GLNG Project

Landscape Rehabilitation Management Plan for the GLNG Gas Transmission Pipeline Corridor

Document Number: 3380-GLNG-3-1.3-0037

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DATE	REV	REASON FOR ISSUE	AUTHOR	ENDORSED	APPROVED
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May 2012	4	Revised Draft for SEWPaC Second Review	AW	IB	AB

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1. Introduction

1.1 Background and context

The GLNG project involves the development of coal seam gas resources in the Bowen and Surat Basins around Roma, construction of a pipeline from the gas fields to the coast, and construction of up to three processing trains at a liquefied natural gas (LNG) plant and export facility on Curtis Island, off Gladstone.

On 16 July 2007, the Coordinator-General declared the Project to be a 'significant project' for which an environmental impact statement (EIS) is required in accordance with Part 4 of the *State Development and Public Works Organisation Act 1971* (Qld).

Following the preparation of the EIS and the SEIS, the CG Report for the GLNG Project was issued in May 2010, and the approvals of the four relevant referred components were granted under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth) in October 2010.

This Landscape Rehabilitation Management Plan (LRMP) has been prepared in accordance with the following conditions outlined in the CG Report, the EPBC Act approval and the DERM Environmental Authority.

CG Report conditions

- Appendix 3 - Gas Pipeline, Part 2 – General Conditions
 - Condition 3
 - Condition 17
- Appendix 3 – Gas Pipeline, Part 3 & 4 – Environmental Conditions
 - Condition 1(d)
 - Condition 3(d)
 - Condition 4(f-g)
 - Condition 5(a & e)
 - Schedule E14.7, E30-E36
 - Schedule J

EPBC Act approval conditions

- Condition 3a
- Condition 3d
- Condition 8(e)i

DERM Environmental Authority No.: PEN102664411

- Schedule E30 – E36
- Schedule H
- Schedule J22-J24

1.2 Purpose of this plan

This LRMP is applicable to the Gas Transmission Pipeline (GTP) component of the Project which commences approximately 40km east of Injune, then travels north along the eastern side of Arcadia Valley. The GTP will approach Gladstone from the south-west through the Callide Infrastructure Corridor State Development Area (CICSDA) and the Gladstone State Development Area (GSDA) before crossing Port Curtis between Friend Point and Laird Point to Curtis Island and the proposed LNG Facility. A number of associated ancillary sites comprising accommodation camps and stockpile facilities, in addition to access tracks and roads will be constructed and are also addressed within this LRMP.

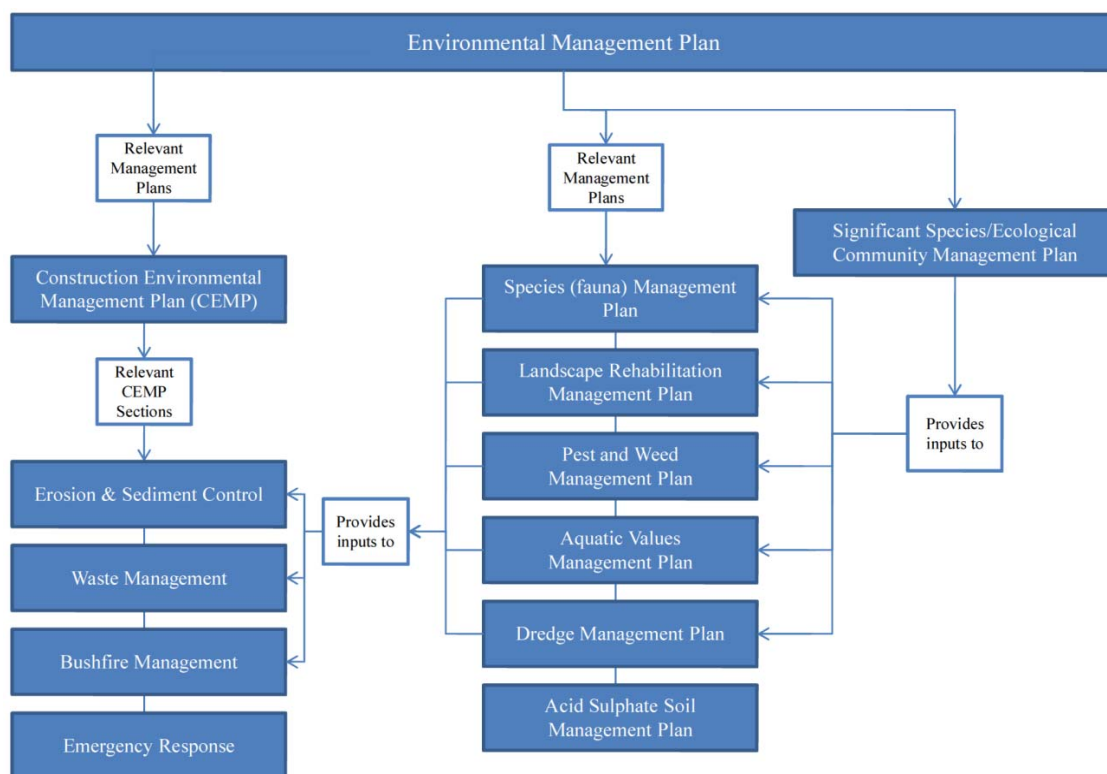
The purpose of this LRMP is to provide management measures to be implemented during and post construction of the GTP Corridor to rehabilitate the GTP Right of Way (ROW) to meet relevant approval conditions.

The LRMP will act as a tool to assist both the proponent and the Principal Contractor in determining the extent of compliance required by Principal Contractor's staff and sub-contractors with regards to the regulations and guidelines applicable to the GLNG pipeline project.

The LRMP is a live document and will be updated as required during construction of the Project. It is designed to:

- Minimise area of overall disturbance;
- Create a safe, stable and non-polluting landform;
- Undertake a comprehensive revegetation and rehabilitation program of all disturbed areas;
- Revegetation and rehabilitation undertaken in a timely manner;
- Preservation of downstream receiving environments;
- Ensure compliance with relevant approval conditions specified by the Coordinator-General, the Department of Environment and Resource Management (DERM), Queensland Primary Industries and Fisheries (QPIF) and DSEWPC; and
- Ensure compliance with commitments under the EIS and SEIS.

1.2.1 Relationship between this plan and other GTP Corridor Management Plans



2. Legislative and Regulatory Framework

It should be noted that the information provided in this plan regarding relevant legislation, policies, regulations, standards and guidelines might not be a complete representation of all statutory requirements relevant to landscaping and rehabilitation practices. It is the responsibility of Contractors to determine all statutory and other requirements relevant to their package of works.

2.1 Applicable Legislation

The rehabilitation and landscaping of disturbed areas are not legislated under any one specific Act. However, it is enforced by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC)¹, Department of Environment and Resource Management (DERM)² and the Department of Employment, Economic Development and Innovation (DEEDI)³, often as a condition outlined in approvals for the disturbance and/or clearing of native vegetation.

Key environmental legislation relating to the LRMP includes the following:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Nature Conservation Act 1992*
- *Nature Conservation (Wildlife) Regulation 2006*
- *Nature Conservation (Protected Plants) Conservation Plan 2000*
- *Nature Conservation (Protected Areas) Regulation 1994*
- *Nature Conservation (Koala) Conservation Plan 2005*
- *Nature Conservation (Forest Reserves) Regulation 2000*
- *Fisheries Act 1994*
- *Fisheries Regulation 2008*
- *Land Protection (Pest and Stock Route Management) Regulation 2003*
- *Great Barrier Reef Marine Park Act 1975*
- *Great Barrier Reef Marine Park Amendment Act 2007*
- *Animal Care and Protection Act 2001*
- *Coastal Protection and Management Act 1995*
- *Environmental Protection Act 1994*
- *Marine Parks Act 1982*
- *Water Act 2000*
- *Vegetation Management Act 1999*
- *Petroleum and Gas (Production and Safety) Act 2004*
- *Land Protection (Pest and Stock Route Management) Act 2002*

2.1.1 Policies, Standards and Guidelines

Activities will be undertaken in consideration of the relevant components of the following industry Codes of Practice:

- Australian Petroleum Production and Exploration Association's (APPEA) Code of Environmental Practice (2008); and
- Australian Pipeline Industry Association's (APIA) Code of Environmental Practice (Operations) (2005).

Relevant standards include:

- Australian Standard 4801:2000 Occupational Health and Safety Management Systems – Specification with guidance for use, and AS/NZS ISO 14001:1996 Environmental Management Systems;
- AS2885.1-1997 Gas and Liquid Petroleum - Design and Construction;
- Road Landscape Manual (Department of Main Roads (DMR), 2004) available for download from <http://www.mainroads.qld.gov.au/>. Consultation with the Project civil engineers and landscape architects is recommended when referring to this document;
- Ergon Energy has requirements pertaining to the amount of clearance required both under and directly adjacent to existing powerlines. This information is available for download at <http://www.ergon.com.au/>;
- These guidelines will be followed as a minimum around all powerlines regardless of ownership;
- Riparian Land Management Technical Guidelines Volumes 1 and 2 (Lovett & Price 2002);
- A Rehabilitation Manual for Australian Streams Volumes 1 And 2 (Rutherford *et al.* 2000);
- Guidelines for Protecting Australian Waterways (Bennett *et al.* 2002);
- Principles of Riparian lands Management (Lovett & Price 2007); and
- Code of Environmental Practice – Onshore Pipelines (APIA 2005).

¹ Formerly the Department of Environment, Water, Heritage and the Arts.

² Formerly the Environmental Protection Agency and the Department of Natural Resources and Water.

³ Formerly the Department of Primary Industries and Fisheries.

- Soil Erosion and Sediment Control - Engineering Guidelines for Queensland Construction Sites (Institution of Engineers Australia 1996)
- Saltwater Wetland Rehabilitation Manual (Department of Environment and Climate Change 2008)
- Wetland Rehabilitation Guidelines for the Great Barrier Reef catchment (WetlandCare Australia 2008)
- Santos EHSMS Standards as per the CEMP.

2.2 EIS Commitments and Approval Conditions

In addition to the commitments outlined within the EIS and SEIS, this Plan will need to adopt any relevant statutory approval conditions. As of November 2010, this Plan has addressed all commitments within the EIS/SEIS and all relevant approval conditions determined by the Co-ordinator General.

2.2.1 Approvals, Licenses and Permits

A Coordinator-General's Report was provided for the Project in May 2010. Additional approvals/permits applicable to LRMP are as follows:

- Permit to collect seed / cuttings from a threatened species outside the corridor (NC Act);
- Permit to clear native vegetation (NC Act);
- Permit to clear marine plants (Fisheries Act);
- Licence to construct a waterway barrier within a defined watercourse;
- Environment Authority for the Pipeline Licence; and
- EPBC Act Approval.

2.3 Offsets Package

An Environmental Offset proposal for the GLNG Project has been developed by Ecofund Queensland on behalf of the Proponent. The proposal outlines the environmental offset requirements for each component of the Project under both Queensland and Australian Government offset policies. The extent of offsets was based on information contained in the EIS and SEIS. The Package also included options for offset delivery and examples of properties that may be suitable to meet the identified offset requirements.

3. Environmental Management Framework

3.1 Santos Environment Health, Safety and Management System (EHSMS)

This section provides an introduction to the EHSMS for operations. An overview of the Santos EHSMS is provided together with further information on key components of the system considered to be specifically relevant to the construction of the pipeline.

The framework has been developed to ensure compliance with Australian Standard 4801:2000 Occupational Health and Safety Management Systems – Specification with guidance for use, and AS/NZS ISO 14001:1996 Environmental Management Systems – Specification with guidance for use. The Santos EHSMS applies to all Santos operations.

3.2 Overall EHSMS Structure

The EHSMS framework consists of multiple layers, the key components being management and hazard standards.

The documents that make up each level of the EHSMS are maintained in electronic form on a central server (The Well) that is accessible to all GLNG employees.

3.3 EHSMS Management Standards

Management Standards are documents which define the requirements necessary to ensure that environmental, health and safety risk is systematically managed. Management standards have been developed as part of the EHSMS.

3.4 EHSMS Hazard Standards

Hazard Standards detail the controls required to manage the risks of specific hazards to acceptable levels. These apply to all Santos operations. They contain specific requirements for planning and undertaking activities and include checklists and references to internal and external approvals and controls.

4. Existing Environment

4.1 Flora

The design of the GTP RoW has considered the ecological values of the vegetation communities and habitat within and adjacent to the footprint. This has been achieved by positioning the GTP in areas which have already been historically cleared for agricultural activities or, where possible, co-positioning the GTP adjacent to existing linear infrastructure, such as the existing Jemena Gas Pipeline where it traverses remnant vegetation communities.

State Forests and Timber Reserves directly impacted by the GTP include the Expedition State Forest, Callide Timber Reserve and Targinie State Forest (refer to mapping provided within the SSMP for specific locations).

4.1.1 Species

As part of the GLNG EIS process, flora assessments of the mainland component of the GTP RoW were undertaken in 2008. The surveys identified the presence of approximately 320 flora species within the GTP RoW.

Additional surveys undertaken in 2010 targeted significant flora species (EPBC Act and *Nature Conservation Act 1992* [NC Act] listed Endangered, Vulnerable, Near Threatened [EVNT]; and NC Act Type A Restricted Plants) and ecological communities (including *Vegetation Management Act 1999* [VM Act] listed Endangered and Of Concern Regional Ecosystems [REs] and EPBC listed Threatened Ecological Communities [TECs]). These surveys resulted in the detection of an additional 14 significant plant species.

The majority of the species identified from the GTP RoW during the 2008/2010 survey periods are listed as Least Concern under the provisions of the NC Act and are not listed under the provisions of the EPBC Act. However, a number of conservation significant flora (ie Type A restricted plants and EVNT species), including *Cycas megacarpa* (Cycad), *Gonocarpus urceolatus* (Raspweed), *Acacia gittinsii* (Gittin's wattle) and *Solanum johnsonianum* (NCN) are known to occur within the Project footprint.

The EIS and SEIS surveys also noted a number of introduced weed species, of which 10 are declared species under the *Queensland Land Protection (Pest and Stock Route Management) Act 2002* (LP Act). Three of the species observed (*Cryptostegia grandiflora* [Rubber vine], *Lantana camara* [Lantana] and *Parthenium hysterophorus* [Parthenium weed]) are also listed as Weeds of National Significance (WONS) under the provisions of the EPBC Act.

A summary of the vegetation communities, associated habitats and identified flora present within the GTP RoW is available in the EIS, SEIS, SSMP and the Weed Management Plan (WMP).

4.1.2 Regional Ecosystems

The majority of the Project area (approximately 80%) has been historically cleared for agriculture, and as such, a large portion of the GTP is considered pastoral grazing land (Fairview, Arcadia Valley and Calliope) or irrigated cropping (Zamia, Mimosa and Dawson catchments).

However, the GTP RoW also intercepts areas mapped as remnant vegetation under DERM's RE Mapping (approximately 60 RE communities). This includes REs which are also listed as TECs under the provisions of the EPBC Act. Table 1 outlines RE communities present within the GTP RoW.

Table 4.1 Regional Ecosystems within the GTP ROW

RE Code	RE Description
11.1.2	Very sparse samphire forbland on marine clay plains.
11.1.4	Mid-dense mangrove forest/woodland on marine clay plains.
11.3.1/11.3.2	Mid-dense <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains and sparse <i>Eucalyptus populnea</i> woodland on alluvial plains.
11.3.2	Sparse <i>Eucalyptus populnea</i> woodland on alluvial plains.
11.3.2/11.3.4/11.3.25	Sparse <i>Eucalyptus populnea</i> woodland on alluvial plains, sparse <i>E.tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains and mid-dense <i>E. tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.
11.3.2/11.3.25	Sparse <i>Eucalyptus populnea</i> woodland on alluvial plains and mid-dense <i>E. tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.
11.3.2/11.3.39	Sparse <i>Eucalyptus populnea</i> woodland on alluvial plains and sparse <i>E.melanophloia</i> +/- <i>E. chloroclada</i> open-woodland on undulating plains and valleys with sandy soils.
11.3.3/11.3.4	Sparse <i>E.coolabah</i> woodland on alluvial plains and sparse <i>E.tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains.
11.3.4/11.3.25	Sparse <i>E.tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains and mid-dense <i>E. tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.
11.3.4/11.3.26	Sparse <i>E.tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains and mid-dense <i>E.moluccana</i> or <i>E.microcarpa</i> woodland to open forest on margins of alluvial plains.
11.3.4/11.3.26/11.11.15	Sparse <i>E.tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains, mid-dense <i>E.moluccana</i> or <i>E.microcarpa</i> woodland to open forest on margins of alluvial plains and sparse <i>E.crebra</i> woodland on deformed and metamorphosed sediments and interbedded volcanics.
11.3.4/11.8.4	Sparse <i>E.tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains and sparse <i>E.melanophloia</i> woodland on Cainozoic igneous rocks (hillsides).
11.3.17	Sparse <i>E.populnea</i> woodland with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on alluvial plains.
11.3.25	Mid-dense <i>E. tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.
11.3.25/11.11.4/11.11.15	Mid-dense <i>E. tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines, sparse <i>E.crebra</i> woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges and sparse <i>E.crebra</i> woodland on deformed and metamorphosed sediments and interbedded volcanics.
11.3.26	Mid-dense <i>E.moluccana</i> or <i>E.microcarpa</i> woodland to open forest on margins of alluvial plains.
11.4.8	Mid-dense <i>E.cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>Acacia argyrodendron</i> on Cainozoic clay plains.
11.4.9	Mid-dense <i>Acacia harpophylla</i> shrubby open forest to woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains.
11.5.2	Sparse <i>E.crebra</i> , <i>Corymbia</i> spp., with <i>E. moluccana</i> on lower slopes of Cainozoic sand plains/remnant surfaces.
11.5.2/11.9.1	Sparse <i>E.crebra</i> , <i>Corymbia</i> spp., with <i>E. moluccana</i> on lower slopes of Cainozoic sand plains/remnant surfaces and mid-dense <i>Acacia harpophylla</i> - <i>E.cambageana</i> open forest to woodland on fine-grained sedimentary rocks.
11.5.5	Sparse <i>E.melanophloia</i> , <i>Callitris glaucophylla</i> woodland on Cainozoic sand plains/remnant surfaces (deep red sands).
11.8.4	Sparse <i>E.melanophloia</i> woodland on Cainozoic igneous rocks (hillsides).
11.8.4/11.10.1	Sparse <i>E.melanophloia</i> woodland on Cainozoic igneous rocks (hillsides) and mid-dense <i>Corymbia citriodora</i> open forest on coarse-grained sedimentary

RE Code	RE Description
	rocks.
11.9.1/11.9.5	Mid-dense <i>Acacia harpophylla</i> - <i>E.cambageana</i> open forest to woodland on fine-grained sedimentary rocks and mid-dense <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on fine-grained sedimentary rocks.
11.9.5/11.10.1	Mid-dense <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on fine-grained sedimentary rocks and mid-dense <i>Corymbia citriodora</i> open forest on coarse-grained sedimentary rocks.
11.9.5	Mid-dense <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on fine-grained sedimentary rocks.
11.10.1	Mid-dense <i>Corymbia citriodora</i> open forest on coarse-grained sedimentary rocks.
11.10.1/11.10.13	Mid-dense <i>Corymbia citriodora</i> open forest on coarse-grained sedimentary rocks and mid-dense <i>Eucalyptus</i> spp. and/or <i>Corymbia</i> spp. open forest on scarps and sandstone tablelands.
11.10.13	Mid-dense <i>Eucalyptus</i> spp. and/or <i>Corymbia</i> spp. open forest on scarps and sandstone tablelands.
11.11.3/11.11.15/11.11.18	Mid-dense <i>Corymbia citriodora</i> , <i>E.crebra</i> , <i>E.acmenoides</i> open forest on old sedimentary rocks with varying degrees of metamorphism and folding (coastal ranges), sparse <i>E.crebra</i> woodland on deformed and metamorphosed sediments and interbedded volcanics and dense semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding.
11.11.4/11.11.15	Sparse <i>E.crebra</i> woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges and sparse <i>E.crebra</i> woodland on deformed and metamorphosed sediments and interbedded volcanics.
11.11.15/11.11.18	Sparse <i>E.crebra</i> woodland on deformed and metamorphosed sediments and interbedded volcanics and dense semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding.
11.12.1/11.12.6	Sparse <i>E.crebra</i> woodland on igneous rocks and mid-dense <i>Corymbia citriodora</i> open forest on igneous rocks (granite).
12.1.3	Dense mangrove shrubland to low closed forest on marine clay plains and estuaries.
12.3.3/12.3.7	Mid-dense <i>E.tereticornis</i> woodland to open forest on alluvial plains and mid-dense <i>E.tereticornis</i> , <i>Melaleuca viminalis</i> , <i>Casuarina cunninghamiana</i> fringing forest.
12.3.7/12.3.11	Mid-dense <i>E.tereticornis</i> , <i>Melaleuca viminalis</i> , <i>Casuarina cunninghamiana</i> fringing forest and mid-dense <i>E. tereticornis</i> , <i>E.siderophloia</i> , <i>Corymbia intermedia</i> open forest on alluvial plains near coast.
12.11.6	Mid-dense <i>Corymbia citriodora</i> , <i>E.crebra</i> open forest on metamorphics +/- interbedded volcanics.
12.11.6/12.11.14	Mid-dense <i>Corymbia citriodora</i> , <i>E.crebra</i> open forest on metamorphics +/- interbedded volcanics and sparse <i>E.crebra</i> , <i>E. tereticornis</i> woodland on metamorphics +/- interbedded volcanics.

Refer to the SSMP for detailed information on significant ecological communities present within the GTP ROW as well as mapping highlighting the location of each RE and its status within the GTP ROW.

4.2 Fauna

As part of the EIS process, fauna assessments of the mainland component of the GTP RoW were undertaken in 2008. During the survey periods, a total of 98 native and 8 introduced fauna species were identified from the GTP RoW. Additional surveys undertaken in 2010 detected an additional 220 native and 4 introduced fauna species within, and adjacent to, the GTP RoW.

The majority of the fauna species identified from the GTP RoW are listed as Least Concern under the provisions of the NC Act, and are not listed under the provisions of the EPBC Act. However, there are a number of EVNT fauna species known within the Project footprint, including the Powerful owl (*Ninox strenua*), Squatter pigeon

(*Geophaps scripta scripta*), Golden-tailed gecko (*Strophurus taenicauda*) and Brigalow scaly-foot (*Paradelma orientalis*).

Further detail regarding the EVNT species known or likely to occur within the GTP RoW is provided in the EIS, SEIS, SMP and SSMP.

4.3 Watercourse and wetlands

The project area encompasses the catchment areas of Dawson, Comet and Calliope Rivers, and extends into tidal creeks and wetlands of Port Curtis.

Within these three catchments, the proposed corridor traverses 183 watercourses. DERM has assigned each watercourse a Stream Order (SO) number from 1 to 8, based on its position within the catchment. The major watercourses intersected include the Dawson River (SO 8 and 5) and Calliope River (SO 5) and Hutton (SO 6), Clematis (SO 5), Callide (SO 5), Baffle (SO 4) and Larcom (SO 3 and 4) Creeks.

The GTP RoW also intersects the estuarine environs of Targinie and Humpy Creek and the intertidal wetlands (including seagrass, mangrove and saltmarsh communities) of Port Curtis (e.g. Kangaroo Island and Curtis Island).

4.3.1 Environmentally sensitive areas

To assist in minimising the impacts on the existing environmental values of the area, the Environmentally Sensitive Areas (ESAs) have been mapped. The ESAs within and adjacent to the GTP RoW include:

- TECs under the EPBC Act;
- Areas known to support EVNT species under the provisions of the EPBC Act and/or NC Act;
- Areas mapped as Endangered or Of concern REs under the provisions of the VM Act;
- Areas mapped as Essential Habitat under the provisions of the VM Act;
- Areas protected under the provisions of the NC Act and/or Forestry Act; and
- Riparian zones of watercourses with a Stream Order equal to or greater than 3.

Where possible, these areas will be avoided, or measures will be implemented, prior to and during construction, to minimise potential impacts (e.g. a maximum clearing footprint of 30 m).

Specific management measures for ESAs are outlined in the SSMP.

4.3.2 Agricultural Land Use

An assessment of the agricultural land capability of the area was conducted during the EIS (URS, 2009) to provide a benchmark of existing/potential agricultural land use. Land within the study area was identified in accordance with State Planning Policy 1/92: Development and the Conservation of Agricultural Land. The assessment was based on the four class system for defining Good Quality Agricultural Land (GQAL) as detailed in the Planning Guidelines - Department of Primary Industries (DPI) and the Department of Housing Local Government and Planning (DPI/DHLGP - 1993).

All Class A land is considered to be GQAL. In some areas, Class B land (where agricultural land is scarce) and better quality Class C land (C1) (where pastoral industries predominate), are also considered to be GQAL. For the Mainland GTP RoW, Classes A, B and C1 are considered to be GQAL.

The Mainland GTP RoW traverses GQAL land classes A through to D. Significant lengths of Class A and B land is traversed in the Arcadia Valley and East of the Dawson Highway to North of Burnett Highway. The majority of land intercepted by the Mainland GTP RoW is classified as Class C.

It has been calculated that approximately 7.4% of the GTP RoW will pass through Class A land; approximately 9.6% will pass through Class B land; and approximately 77.6% will pass through Class C land (with 34.9% of that being Class C1). The remaining mainland GTP RoW will pass through Class D non-agricultural land.

5. Impacts

The construction of the GTP ROW will create a linear disturbance across several landscape types. The GLNG EIS and SEIS identify the adverse and beneficial impacts associated with the construction and operation of the GTP ROW. Key examples of the short and long term impacts pertaining to landscaping and rehabilitation within and adjacent the GTP ROW are summarised in table 2 below.

Table 5.1 Impacts

Aspect	Impacts
Negative Impacts	
Vegetation clearing as a result of bulk earthworks (e.g. excavation, clearing quarrying etc.).	<ul style="list-style-type: none"> • Potential to alter the biodiversity, distribution and dynamics of the existing environment through: <ul style="list-style-type: none"> - Fragmentation of vegetation communities - Loss of habitat and microhabitats (flora and fauna) - Loss of local faunal and floral populations, including threatened and significant species - Loss of riparian vegetation - Establishment of pest and weed species in sensitive environs (increase in weed proliferation) - Loss of topsoil and increased erosion - Sedimentation into waterways resulting in a decrease in water quality - Subsequent salinity issues or a rise in the watertable - Increase in likelihood of disturbing acid sulphate soils - Reduction in buffering capacity particularly in or adjacent sensitive areas.
Topsoil removal and/or loss as a result of bulk earthworks (e.g. excavation, clearing etc.).	<ul style="list-style-type: none"> • Loss of soil seed bank. • Sedimentation into waterways resulting in a decrease in water quality. • Increase in likelihood of disturbing acid sulphate soils.
Chemical use	<ul style="list-style-type: none"> • An increase in chemical use (i.e. pesticides) may reduce food sources for some fauna species (i.e. moth/insects and other invertebrates). • Potential for bioaccumulation within the food chain. • Impact on local pollinators which are required to help maintain ecosystem function.
Positive Impacts	
Propagation of endemic species for rehabilitation activities (e.g. revegetation, seeding, weeding etc.)	<ul style="list-style-type: none"> • Potential to enhance the local biodiversity of the area through: <ul style="list-style-type: none"> - Strategic revegetation of and provision of artificial fauna furniture, such as glider poles, bat boxes and nests in potential corridors (to re-create linkages) - Recreating vegetation communities lost as a result of construction clearing - The enhancement of habitat and associated foraging resources for native fauna.
General landscape works (revegetation, seeding, weeding etc.)	<ul style="list-style-type: none"> • The use of locally native plant species to minimise the risk of introducing 'problem' species. <ul style="list-style-type: none"> - Enhance soil stability and structure - Enhance water retention in soils to encourage water table stability - Improve aesthetic/visual value to the area - Improve air quality.

6. Pipeline operational and decommissioning phase rehabilitation objectives

Australian Standard AS2885, Part 3: Vegetation on or near the pipeline states:

Unless approved, vegetation shall be restricted to allow free passage along the pipeline route. Vegetation, whose roots may damage the anti-corrosion coating of the pipeline, shall not be permitted in the vicinity of the pipeline.

The APIA Code of Environmental Practice – Onshore Pipelines states: *Vegetation management – Environmental management; Management Measures: Regrowth vegetation on the pipeline easement shall be maintained to ensure root systems do not create a safety risk to the pipeline. The width of vegetation removal (i.e. the distance cleared on either side of the pipeline centreline) should be the minimum extent reasonable necessary to ensure the safe operation of the pipeline.*

In line with the Australian Standard and APIA Code of Environmental Practice requirements stated above, rehabilitation following construction of the pipeline must allow for the protection of the pipeline integrity and ensure permanent access to the pipeline for monitoring and maintenance purposes whilst it is in operation. Subsequently rehabilitation objectives for the operational phase will restrict vegetation growth to allow for understorey species and mid-level species to return within 10m of the pipeline.

On decommissioning of the pipeline, rehabilitation to pre-clearance conditions will be undertaken within all previously restricted vegetation growth areas, in accordance with EPBC Act Approval Condition 3d.

7. Implementation and Management Strategy

A rehabilitation strategy has been developed and is detailed below. The strategy ensures that rehabilitation objectives are met for the range of land uses and disturbance levels for the lifespan of the pipeline.

7.1 Pre-clearance Survey

Prior to construction, a pre-clearance survey will be undertaken in accordance with EPBC Act Approval Condition 3(a). During the pre-clearance survey, information to document the condition and value of a site prior to disturbance, including habitat resources, species composition and level of disturbance will be collected.

7.2 Benchmark Guidelines

A range of benchmarks will be selected to guide rehabilitation for broad ecosystems, including pasture grasses, identified in the RoW. Benchmark guidelines provide a summary of the key condition indicators of a range of vegetation and grazing communities.

Benchmarks provide information on the best condition on offer for each broad ecosystem, and are considered to be the minimum target for rehabilitation. This information is designed to be supplemented by the pre-clearance survey, and provide a means to rehabilitate disturbance areas to better than pre-clearance condition.

The pre-clearance survey includes methods to select the appropriate benchmark guideline.

7.3 Operational Safety requirements

In accordance with Australian Standard AS25884, Part 3 and The APIA Code of Environmental Practice – Onshore Pipelines (Refer to Section 6) operation safety requirements must be considered when determining rehabilitation criteria. Trees with large root balls (such as *Ficus sp.*) pose a risk to the structural integrity of buried infrastructure. To ensure compliance with AS2885 (Part 3, Section 6.4.4), vegetation will be restricted to allow free passage along the pipeline route. Vegetation whose roots may damage the anti-corrosion coating of the pipeline shall not be permitted in the vicinity of the pipeline during the operational phase of the pipeline.

In order to ensure operational safety, vegetation species used to rehabilitate the RoW will be limited to species less than 10 to 12 m in height. In areas where RE communities are to be rehabilitated, understorey species and mid level species of pre-disturbance RE communities will be returned to the RoW.

To ensure compliance with EPBC Act Approval Condition 3d, pre-clearance conditions will be rehabilitated within these restricted areas on decommissioning of the pipeline.

7.4 Landholder Rehabilitation requirements

A Construction Line List (CLL) has been prepared detailing a number of commitments which GLNG has made to Landholders whose property is intersected by the GTP RoW (and/or ancillary sites). A number of the CLL commitments relate to specific site rehabilitation actions, which fall in to the following broad groups:

- Vegetation: Re-seeding (seed mix type); arrangements for relocation of cycads, grass trees and orchids, weed prevention;
- Disturbed soils: Restoration of land condition; prevention of soil erosion; soil compaction; soil inversion; soil subsidence; sink holes; surface disruption; provision of contour banks/whoo boys;
- Infrastructure: Fencing and gates; installation of Cathodic Protector posts; construction of water tank pad, relocation of dam) and
- Stockpiling of materials: Excess excavated materials and timber for reuse by landowner.

All CLL commitments must be actioned within the relevant land tenures prior to transferring decommissioned areas to Landholders. Where landholders have not specified additional rehabilitation requirements, land will be restored to its pre-disturbance land use.

7.5 Rehabilitation Schedules

Rehabilitation schedules will be developed based on benchmark guidelines for each disturbance type and broad land use (vegetation or agriculture), and include specific objectives and performance criteria to ensure disturbed sites are rehabilitated to a pre-disturbed condition.

The rehabilitation schedules will include performance measures and related monitoring actions to assess site rehabilitation, as well as provisions for reporting on the implementation of the LRMP including monitoring and performance to a standard which can be independently audited.

Rehabilitation schedules will include site remediation measures by stage of development (e.g. pre-construction, construction, post-construction, and decommissioning), as well as the inclusion of timeframes and standards for conducting rehabilitation activities.

The schedules will provide practical rehabilitation measures to support recovery of EVNT species habitat and recovery of TEC, in line with the SSMP, as well as recovery plans provided by SEWPaC and DERM.

7.5.1 Performance criteria

Performance criteria will be developed for each rehabilitation schedule in order to meet the overarching rehabilitation objectives of providing a safe, stable and non-polluting landform.

In order to comply with the EPBC Act Approval, CG Conditions and EA Conditions, standard performance criteria for vegetated sites (including TEC, RE and HVR vegetation) include the representativeness of species richness and diversity for the appropriate benchmark. Specific criteria to support the recovery of TEC, RE and significant species habitat will also be included within each rehabilitation schedule.

Standard performance criteria within agricultural sites across the Project area include:

- Plant survival, height, recruitment and richness;
- Stability of landform;
- No declared weeds occurring;
- Pasture species richness representative of pre-disturbed condition;

- The preservation of inherent GQAL agricultural land use classes; and
- Pasture diversity, quality and productivity rehabilitated to pre-disturbance benchmarks.

8. Management Requirements

While the rehabilitation schedules will determine the detailed management measures, the following general measures will be incorporated to the guidelines:

Table 7.1 Mitigation and Management Measures relevant to Landscape and Rehabilitation Works

Actions	Timing
• All landscaping and rehabilitation works will comply with relevant statutory conditions and guidelines (e.g. EPBC and NC Act approval).	At all times
• Where applicable, all landscaping and rehabilitation works will be consistent with measures outlined in the SSMP and SMP.	At all times
• Landscaping and rehabilitation personnel will be suitably qualified and experienced to undertake the works.	At all times
• Landscaping rehabilitation personnel will be educated on potential risks to native wildlife which may inhabit the area as per the SMP and SSMP.	Prior to and during works
• A pre-clearing survey of the GTP ROW will be undertaken to document the existing condition of the vegetation communities to be impacted as a result of clearing works. The survey will document (including photologging) all environments relevant to the landscape and rehabilitation works, including: <ul style="list-style-type: none"> - Topsoil and landforms - Drainage - Vegetation - Environmentally Sensitive Areas • The survey will also include undertaking cross sections to record existing surface level and contours.	Prior to works commencing
• Development of any Special Area plans will be undertaken in consultation with Councils, landowners, DERM, DTMR, DEEDI as necessary.	Prior to works commencing
• Consultation with the design civil engineers and landscape architects prior to finalising planting design will be undertaken where applicable.	Prior to works commencing
• Where applicable, compliance with the Road Landscaping Guidelines (DMR, 2004) will be undertaken within rehabilitation works within a road reserve.	At all times
• Where applicable, compliance with other stakeholder requirements including local government authorities (local government controlled roads), Energex and/or Powerlink and QR National (rail corridors) will be undertaken.	At all times
• The Principal shall organise for Type A flora pursuant to the NC Act to be translocated or salvaged. This may involve the relocation of specimens to an interim area (e.g. for orchids a bushhouse facility) until rehabilitation works are mature enough to accommodate translocated individuals.	Prior to works commencing
• The Principal Contractor will be responsible for organising the collection of any seeds and/or propagules from locally native flora (least concern) within the project area for use in the rehabilitation works. This includes flora associated with threatened ecological communities present within the GTP ROW. The Proponent will be responsible for the collection of any significant flora seeds and/or propagules for any translocation, offset and management works (those protected under the NC Act). Seed collection will be undertaken in accordance with seed collection guideline document: Model Code of Practice, Florabank Guideline 6: Native Seed Collection Methods.	Prior to works commencing
• All growing facilities must adhere to Australian phytosanitary standards and guidelines.	At all times
• Where enhancement plantings are required, a planting and/or seeding plan	Prior to works commencing

Uncontrolled if printed

Actions	Timing
will be developed based on the geology, soil description, pre-existing and existing floristic composition and vegetation characteristics and landholder preferences.	
<ul style="list-style-type: none"> Monitoring points will be strategically located and set up prior to rehabilitation works commencing. This will include but not be limited to the establishment of permanent photologging points for monitoring purposes. Monitoring and photologging stations will be set up at locations that include the locations where photos and data were collected prior to disturbance. 	Prior to works commencing
<ul style="list-style-type: none"> Clearing is a last resort. The retention of vegetation, selective clearing, trimming and fauna spotting is the first priority. 	Construction Phase
Stockpiling of topsoil for reuse during rehabilitation works is to be undertaken. Ensure that stockpiles are separated from subsoils and covered as appropriate, or that appropriate erosion and sediment controls are in place to avoid erosion and sediment runoff.	Construction Phase
<ul style="list-style-type: none"> Topsoil stockpiles shall preferably be no more than 2 m high and 50 m wide. Variation to this standard is subject to approval by the Environment Manager. 	Construction Phase
<ul style="list-style-type: none"> Topsoil that is stockpiled for greater than Six (6) months must be managed to minimise erosion. 	Construction Phase
<ul style="list-style-type: none"> Topsoil stockpiles shall be seeded if left for more than 12 months. 	Construction & Operational Phases
<ul style="list-style-type: none"> Relocate tree hollows and other microhabitats (e.g. rocky outcrops) to suitable sites outside the clearing footprint. This is to be determined in consultation with an ecologist and where necessary, landholders. 	Prior to and during works
<ul style="list-style-type: none"> Weather permitting, rehabilitation and reconsolidation of impacted watercourses shall commence immediately after the pipeline has been lowered in and backfilled. This will include early rehabilitation of riparian buffers will occur in order to restore natural stream functions and aquatic habitats 	Construction & Operational Phases
<ul style="list-style-type: none"> Where appropriate, rehabilitation of the bed and bank structure such that original dimensions and shape of the creek or spring are achieved. Bank re-contouring should include stabilisation methods (crib walls or soil wraps). 	Construction & Operational Phases
<ul style="list-style-type: none"> Where possible, promote a heterogeneous substrate in watercourse crossings, including : <ul style="list-style-type: none"> - Replace large woody debris to stabilise banks and also to provide in-stream complexity; and - Use a combination of rocks, gravel and/or cobbles, etc. in the stream bed. The use of large rocks and logs to moderate flows. 	Construction & Operational Phases
<ul style="list-style-type: none"> Salvaging of existing bed material prior to the construction and placing it back into the creek or spring at completion of construction. If the existing bed material is unable to be salvaged, a comparable sediment sized material is recommended to cover the bed and should be approximately 10 cm thick. If the sediment is fine (mud/silt), it is recommended that the bed material be replaced with sand to prevent future erosion. If the sediment is coarser (gravel, cobble, pebbles), new material must be washed prior to placing in the creek (as usually, new coarse substrate is covered in a fine dust, which will become suspended in the water). 	Construction & Operational Phases
<ul style="list-style-type: none"> Soils will be graded away from the watercourses, not towards it. Graded soil shall not be stockpiled where it has the potential to result in sedimentation or acidification of land or surface water (e.g. on slopes which drain immediately to a watercourse). 	Construction & Operational Phases
<ul style="list-style-type: none"> Weather permitting, rehabilitation of the GTP ROW shall commence within 3 months from the completion of the pipeline construction. Revegetation shall be consistent with the plant density, floristic composition and distribution of the adjacent remnant communities and where possible, should encourage the 	Construction & Operational Phases

Actions	Timing
natural re-establishment of significant species and ecological communities into the disturbed areas.	
<ul style="list-style-type: none"> The GTP ROW will be re-profiled to original or stable contours, including re-establishing watercourses, wetlands, overland flow paths and other topographic features, immediately after the pipeline has been lowered in and backfilled. 	Construction & Operational Phases
<ul style="list-style-type: none"> Erosion and sediment control measures will be implemented in accordance with the Erosion and Sediment Control Plan. 	At all times
<ul style="list-style-type: none"> Activities will be conducted in accordance with EHS04 (<i>Waste Management</i>) to ensure appropriate mitigation measures are implemented in the management of waste. 	At all times
<ul style="list-style-type: none"> Areas of the GTP ROW may be deep ripped prior to reapplying topsoil. 	Construction & Operational Phases
<ul style="list-style-type: none"> Subsoil will be respread over the GTP ROW and compacted over the trench, including contouring works, immediately after the pipeline has been lowered in and backfilled. 	Construction & Operational Phases
<ul style="list-style-type: none"> After subsoil resreading and compaction, topsoil will be respread over the GTP ROW and left with a slightly rough surface. 	Construction & Operational Phases
<ul style="list-style-type: none"> Cleared native vegetation will be respread over the GTP ROW to assist in seed stock distribution. This action will be undertaken in a manner which does not promote erosion or subsidence. 	Construction & Operational Phases
<ul style="list-style-type: none"> Native woody debris, which is not to be used in habitat rehabilitation works, will be mulched and respread across the GTP ROW. The mulch material will be used to filter out sediments and also in planting works. 	Construction & Operational Phases
<ul style="list-style-type: none"> Where necessary imported topsoil, which is of appropriate quality and weed and fire ant free, will only be used with landholder approval. 	Construction & Operational Phases
<ul style="list-style-type: none"> Where necessary, fertilisers and soil supplements will be only be used with approval from local landholders and authorities. 	Construction & Operational Phases
<ul style="list-style-type: none"> A maximum of 10 m will be maintained along the GTP ROW for access. No planting of deep-rooted trees within 3 m of the pipe will occur to maintain pipe integrity (Refer to Section 6 & 7). Within 10m of the pipeline, rehabilitation objectives for the operational phase will allow vegetation growth of understorey species and mid-level species to return. 	Operational Phase
<ul style="list-style-type: none"> Re-establish or enhance the habitat of a significant species known or likely to occur within the GTP ROW prior to clearing activities (especially where the construction clearing activities have affected such habitat (Refer SSMP)). 	Construction & Operational Phases
<ul style="list-style-type: none"> Preserve specific European and indigenous heritage that has been registered for the site (note that these values are managed under other legislation). 	Construction & Operational Phases
<ul style="list-style-type: none"> The natural regeneration of native species will be encouraged (in particular, groundcover and shrub species). However, seeding will be utilised in areas where rapid restoration is required (e.g. watercourse crossings and areas of high erosion potential). 	Construction & Operational Phases
<ul style="list-style-type: none"> Reseeding will be undertaken using native species only for areas of high value regrowth and regional ecosystems. Reseeding using non-native species may be used on pastoral grasslands and cropping land only and within these areas reseeded will be undertaken as per the landholder's requirements. 	Construction & Operational Phases
<ul style="list-style-type: none"> Where natural regeneration is not successful, establish vegetation communities to a condition at least equivalent to the ROW condition prior to commencement (especially where native vegetation is the proposed land use), taking into consideration the constraints. 	Construction & Operational Phases
<ul style="list-style-type: none"> Maintain a mosaic vegetation structure, including planting of different aged plants. 	Operational Phase

Actions	Timing
<ul style="list-style-type: none"> Any 'temporary'⁴ vegetation is to be locally native. If this is not achievable, other native plants from the bioregion are to be used. Any proposed species substitutes are to be approved by the Principal prior to planting. 	Construction & Operational Phases
<ul style="list-style-type: none"> Vegetated buffers are to be established at sufficient height and width to provide a wind break and visual screening along the boundaries between stockpiles and sensitive receptors. 	Construction & Operational Phases
<ul style="list-style-type: none"> Use foraging and habitat tree species in planting works for fauna such as koalas, gliders and Glossy-black cockatoos. 	Operational Phase
<ul style="list-style-type: none"> Place artificial nest and/or bat boxes in suitable sites outside the clearing footprint and within rehabilitated areas. 	Construction & Operational Phases
<ul style="list-style-type: none"> In consultation with an ecologist, erect glider poles and other measures (e.g. timber poles to allow semi-arboreal and arboreal species to escape predators) in the GTP ROW (especially in areas of remnant vegetation adjoining the Jemena Pipeline) to facilitate fauna movement (e.g. Expedition Range). 	Construction & Operational Phases
<ul style="list-style-type: none"> Re-establish large woody debris and rocky outcrops within rehabilitated areas to create stepping stones for fauna and also microhabitats. 	Construction & Operational Phases
<ul style="list-style-type: none"> Planting of frangible species, where required, to comply with safety requirements will be undertaken. 	At all times
<ul style="list-style-type: none"> Where applicable, maintain adjacent high tide banks with intertidal species. 	At all times
<ul style="list-style-type: none"> It is considered that the most appropriate method to regenerate large areas of intertidal wetlands is through natural regeneration. This should be achieved through regular weed control, maintaining existing tidal regimes, and mitigating issues with ASS. 	Construction & Operational Phases
<ul style="list-style-type: none"> If natural re-colonisation of intertidal communities does not occur within 12 months, manual planting may be required. This will be subject to consultation from DEEDI. 	Operational Phase
<ul style="list-style-type: none"> Watering of revegetated areas shall be carried out to maintain soil moisture content to no less than PAW⁵ during the establishment period. 	Construction & Operational Phases
<ul style="list-style-type: none"> Weed species will be managed as per the Weed and Pest Management Plan. However, as a general rule, weed management should occur prior to and during the rehabilitation planting to encourage rehabilitation success. 	At all times
<ul style="list-style-type: none"> All waste materials and equipment will be removed from the GTP ROW and associated laydown areas once construction is completed. This includes disused sediment fences. 	Construction & Operational Phases
<ul style="list-style-type: none"> Rehabilitated areas shall be clearly marked with appropriate signage, "Revegetation Area No Unauthorised Access". 	Construction & Operational Phases
<ul style="list-style-type: none"> Vehicles will be confined to designated maintenance access tracks within GTP ROW. 	At all times
<ul style="list-style-type: none"> Where appropriate, rehabilitation areas will be fenced to exclude cattle and other threatening processes. Fencing will only be undertaken with landholder approval. 	Construction & Operational Phases
<ul style="list-style-type: none"> Avoid the use of barb wire when erecting any Project related fencing. Where barb wire fencing is unavoidable the top strand will be high tensile steel (non-barbed wire) to avoid fauna getting caught and tangled in the barbs. 	At all times
<ul style="list-style-type: none"> Driving vehicles on freshly topsoiled sections of the GTP ROW will be prohibited. 	Construction & Operational Phases
<ul style="list-style-type: none"> Temporary access tracks have been selected to minimise or eliminate the need for any clearing, and are all based on the route of existing 	Operational Phase

⁴ 'Temporary' vegetation will be used to stabilise temporary banks/stockpiles and will be removed and re-established as native vegetation post construction.

⁵ Plant available water. The portion of water in a soil that can be readily absorbed by plant roots. That soil moisture held in the soil between field capacity and permanent wilting point (DMR 2008).

Actions	Timing
<p>tracks. Where a previously cleared alternative feasible route to a portion of an access track was identified as representing a lesser impact (e.g. around a patch of significant vegetation), this was selected in preference to the original route. The selection process for temporary access tracks has minimised any requirement for clearing of remnant vegetation in particular, by utilising alternative existing tracks where practicable, or by selecting routes which have previously been cleared. Where clearing is required, this is likely to be minimal, in the order of 0.5 m to 1.0 m width of clearing.</p> <p>Where clearing is required for the construction or maintenance of temporary access tracks, reinstatement and rehabilitation to pre-clearance conditions will be undertaken or, for cropping and pastoral land, as agreed with the landholder.</p> <p>Rehabilitation actions will consist of stabilisation of soils and reseeded, ensuring that the track is left in a stable condition. Where minor clearing of remnant or high value regrowth is necessary, any cleared areas will be revegetated with equivalent vegetation using locally collected seed.</p>	Operational Phase
<ul style="list-style-type: none"> Where non-public access routes are to be retained, the entrance will be disguised. 	Construction & Operational Phases
<ul style="list-style-type: none"> Monitoring the success of rehabilitation strategies will be undertaken as per the Principal Contractors LRMP with the findings reported to Principal. Monitoring and reporting should occur at the same time each month for the first 2 years. 	Construction & Operational Phases
<ul style="list-style-type: none"> Ongoing monitoring of the fauna measures implemented during construction to facilitate fauna movement and colonisation. This includes checking the nest and bat boxes, the success of gliders poles and the colonisation of fauna in rehabilitation areas. 	Operational Phase
<ul style="list-style-type: none"> Implement corrective actions where necessary if the performance objectives are not being achieved. This will include replanting of species which have not survived, installation of additional controls if erosion is occurring etc. 	Operational Phase
<ul style="list-style-type: none"> In accordance with EA condition E36, rehabilitation can be considered successful when the site can be managed for its designated land-use without any greater management input and there is evidence that the rehabilitation has been successful for at least 3 years. 	Operational Phase
<ul style="list-style-type: none"> A further review will be undertaken at the time of decommissioning to determine an appropriate rehabilitation policy in accordance with best practice at the time. 	Decommissioning Phase
<ul style="list-style-type: none"> On decommissioning, land will be rehabilitated to a level consistent with the pre-clearance condition. 	Decommissioning Phase
<ul style="list-style-type: none"> On decommissioning, the Pipeline will remain in situ and all above ground infrastructure will be removed by cutting at ground level. The decommissioned Pipeline will be inert and at atmospheric pressure, thus presenting negligible environmental impact and low environmental risk. 	Decommissioning Phase
<ul style="list-style-type: none"> During decommissioning phase rehabilitation, vegetation with large root balls (i.e. trees greater than 10 m) will be re-established within the RoW. This type of vegetation will be restricted during the operational phase to protect the structural integrity of the pipeline. Revegetation of these species may be undertaken through passive (i.e. allow for the natural encroachment of the species) or active (i.e. planting/seeding) methods depending on best practice at the time of rehabilitation. 	Decommissioning Phase
<ul style="list-style-type: none"> Risks and impacts during decommissioning of the pipeline will be limited to weed, vegetation and waste impacts. Impacts will be managed in accordance with the Project Pest and Weed Management Plan and Waste Management Plan. Should there be a requirement to clear vegetation to access the RoW to 	Decommissioning Phase

Actions	Timing
<p>remove above ground infrastructure, areas of impact will be rehabilitated to pre-clearance condition in accordance with the rehabilitation management plan.</p> <ul style="list-style-type: none"> Management plans will be reviewed and amended at the time of decommissioning to adopt current best practice. 	

It should be noted that failure to comply with the mitigation measures outlined in this plan will result in the Principal Contractor being responsible for any and all mitigation costs associated with that non-conformance.

9. Constraints

Rehabilitation of the GTP ROW will vary between areas depending on the level of clearing, the vegetation and habitat complexity and composition within each area, landholder requirements as well as the ongoing operation and maintenance requirements.

In addition, there are several constraints that will influence the rehabilitation works along the GTP ROW. These constraints are outlined in Table 8.1 below.

Table 8.1 Constraints and Actions

Constraint	Action
Weather	The success of the rehabilitation strategy will be dependent on weather conditions during and post construction (e.g. recent flooding in the last year along sections of GTP ROW and prior to this the extended drought conditions).
Land Owner Negotiations/ Requirements.	<p>Interference to landholder activities will vary according to the level of impact caused by the construction of the pipeline, type of activities being undertaken and the duration of the work on a landholder's property.</p> <p>Each landholder will be consulted prior to the works being undertaken to identify specific requirements and outcomes. Temporary provisions, such as fencing, driveways or stock access to water, will be discussed with each landholder.</p> <p>Reinstatement of cropping and pastoral grasslands will be as required by landowners. However rehabilitation of all Regional Ecosystems, high value regrowth areas and native vegetation not classified as either of these categories will be restored to its pre-disturbance condition during the decommissioning phase, in accordance with 3d of the EPBC Act conditions.</p> <p>Every effort will be made to minimise the impacts to landholders by limiting the area of works, using existing tracks which avoid homesteads and minimising the amount of time the trench is left open.</p>
Off-set Distances from Pipeline (operational phase)	<p>The Operator of the pipeline will need to ensure that the structural integrity of the pipeline is maintained (Refer to Section 6.3). In this regard, planting in close proximity to the pipeline must consider the root system of the chosen plant species. While trees and deep-rooted vegetation cannot be re-established directly across the pipeline (due to potential damage to the corrosion protection systems), grassland re-establishment and return of native understory/ mid level species will be undertaken.</p> <p>Habitat will be re-established as much as practicable through installation of glider poles, nest boxes, woody debris, logs, hollows etc.,</p>
Other infrastructure	The GTP ROW intersects other linear infrastructure, including power lines, roads and rail lines. Rehabilitation in these areas will need to be in accordance with the relevant stakeholders requirements for operations and maintenance.

Fencing/ Property Boundaries	Dependent on the outcomes of discussion with relevant landholders. However, preference will be to use wire (non-barbed) fencing with a plain wire strand on the top.
Weed Infestation Areas	Some areas along and adjacent the GTP ROW are heavily infested with weeds. The level of rehabilitation will be assessed in site-specific rehabilitation plans to ensure no spread of infestation.
Maintenance Tracks	An access track will be required along the pipeline route within the ROW for ongoing operations and maintenance. Some additional works may be required to access the ROW - these will be determined as construction works progress.

10. Rehabilitation completion criteria

Rehabilitation completion criteria will be dependent on the vegetation communities and land uses prior to clearing, pre-existing health and integrity of the landscape and landholder requirements. Therefore specific completion criteria for determining when a site has been completely rehabilitated will be specified within specific rehabilitation schedules.

However, the overall aim of the rehabilitation works is to rehabilitate impacted environs to as a minimum, their pre-existing condition. This is a particular prerequisite for all significant ecological communities, protected areas and other sensitive areas identified within the GTP ROW.

General guidelines on heights, canopy cover and potential complexity have been briefly discussed below to provide direction for desired outcomes.

Barrier plantings

The objective of the barrier plantings is to minimise weed infiltration into areas of considerable conservation value. The width of these plantings should be a minimum of 20m with a minimum density of 70% foliage cover.

Riparian zone

The vegetation within the riparian zone of a watercourse should achieve high densities, particularly in the lower stratum in order to keep weed infiltration to a minimum. The upper stratum in some instances may take on the structure of an open or closed forest community.

Samphire and mangrove communities

Optimum outcome for these communities is to be free of introduced weed species and to be further enhanced through natural regeneration. The structural formation of a closed samphire community would consist of approximately >80% foliage and surface cover (Attiwill and Wilson 2003).

Woodland

The structural formation of woodland generally consists of approximately 10-30% foliage cover and 20-50% foliage cover in the canopy (Confinas and Creighton 2001). The species complexity of woodland communities is highly variable due to factors such as aspect, rainfall and soil type. However as a guide, sclerophyllus woodlands containing an acacia understorey are likely to achieve the 30% foliage cover if fire and other disturbance factors are maintained.

Open forest

The structural formation of an open forest generally consists of approximately 30-70% foliage cover, 50-80% crown cover in the canopy and tree heights ranging between 10-30m (Confinas and Creighton 2001).

Closed forest

The structural formation of a closed forest generally consists of approximately 70-100% foliage cover, 80-100% crown cover in the canopy and heights of <30m (Confinas and Creighton 2001).

Landforms

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Pre-existing surface levels will be reinstated.

Open Areas and Agricultural Areas

The level of rehabilitation within these areas will be determined in consultation with the individual landholders. It is likely that rehabilitation will involve normal agricultural seeding, hydro-seeding or basic hydromulching techniques to return the pre-existing ground cover (or an appropriate or preferred replacement) to the site.

Habitat Rehabilitation

Habitat rehabilitation will be implemented along the GTP ROW to facilitate fauna movement and re-colonisation of the ROW. The following habitat features will be considered:

- Replacement of hollows, large woody debris in adjacent habitats and within the GTP ROW (subject to landholder permission);
- Placement of artificial structures, including bat and nest boxes and glider poles, at key locations to facilitate fauna movement and recolonisation;
- Bee hives for native bees dependent on the existing distribution and abundance; and
- Feeder and/or habitat trees for key species and migratory birds.

In determining whether the completion criterion is met, the following factors will be used:

- The similarity between the rehabilitated landforms and the natural landforms in adjacent areas;
- The stability of the landform and its resistance to erosion;
- Whether appropriate drainage patterns have been developed either naturally or through shaping activities during the rehabilitation programme;
- The degree to which the surface conditions are conducive to plant establishment;
- Whether the site conditions and existing habitat components provide resources, including for fauna movement, foraging habitat and/or shelter;
- Compliance with the relevant standards; and
- Public safety issues (e.g. signage, fencing etc.).

11. Training and awareness

11.1 Project Personnel induction

In accordance with Santos Management Standard EHSMS06, all personnel and visitors are required to undertake appropriate environmental training and induction programs.

As part of the training programme, all project personnel⁶ are required to complete site specific environmental awareness training which is to be conducted by the EO. As a minimum, the training will consist of a presentation and an assessment questionnaire. The site induction will address the following.

- Fauna and flora likely to be present within the corridor, including significant species (awareness training);
- Location of sensitive areas (e.g. wetlands and habitat trees);
- Landholder constraints;
- Vegetation protection areas and no go zones;
- Procedures and actions associated with encountering fauna;
- Threatened species habitat areas;
- Weed identification and control; and
- Responses and reporting of environmental issues.

This training will be developed with the assistance of the project ecologist and delivered by the Environmental Construction Manager / Environmental Officer(s). This will be undertaken within the initial induction process, ongoing toolbox meetings and relevant Construction Method Statements.

⁶ Project personnel include all staff, contractors and consultants that may undertake onsite works.

Where possible, personnel will also be shown photographs and given general information on significant species and ecological communities identified within and adjacent the GTP ROW, this will enable them to identify these species should they be encountered.

12. Monitoring and Maintenance

A rehabilitation monitoring and maintenance plan will be developed to complement each rehabilitation schedule. Monitoring of the rehabilitated GTP RoW is required every 20 days for the first 120 days, and annually for the first five (5) years following completion of rehabilitation, in accordance with the EA, Schedule J22-J24. The monitoring and maintenance plan is designed to be flexible to allow adaptations for natural disasters such as fire, drought and flood.

All monitoring will be undertaken by a suitably qualified person (EA Schedule H12).

Monitoring periods may require extension in the case of ineffective rehabilitation or natural disasters impeding rehabilitation efforts. Where monitoring extensions are required, it will be recorded and implemented by GLNG.

Specific monitoring criteria will be outlined within each rehabilitation schedule, reflective of the performance criteria. Generally, the following indicators will be monitored:

- Indicators of growth and survival of all plantings;
- Plant height;
- Native species richness;
- Evidence of recruitment;
- Native species cover;
- Weed control – extent of declared and environmental weeds and adequacy of treatment, as well as any secondary weed responses to treatments;
- Indicators of the presence of EVNT species and / or key habitat features (as per SSMP);
- Adequacy of site preparation, mulching, tree (and plant) protection and maintenance; and
- Landform stability – evidence of soil erosion as per the Soil MP and ESCM.

Monitoring will consist of vegetation surveys and photologging, monitoring locations established within representative areas of the GTP RoW and for each ancillary site. Monitoring locations are to be determined by the suitably qualified ecologist using BioCondition assessment methods (Nelder et al. 2011). This will include but not be limited to the establishment of permanent photologging points for monitoring purposes. Monitoring and photologging stations will be set up at locations that include the locations where photos and data were collected prior to disturbance. Where possible, monitoring plots will be established within the core of rehabilitation areas to avoid edge effects. Monitoring will take the impacts from seasonal variation into consideration.

Performance criteria to monitor the progress of each rehabilitation site will comprise of a combination of pre-clearing data and benchmark guidelines. It is noted that while three (3) years is insufficient time for rehabilitation to meet the benchmark guidelines, it is sufficient to ensure that rehabilitation is well established and regenerating, and an improvement in BioCondition scoring should be clearly evident. The progression and improvement of key rehabilitation indicators such as species composition and diversity, weed cover, and plant densities will be evident over a three (3) year period.

All monitoring results and records will be compiled and stored for a minimum of five (5) years and made available for inspection upon request, in accordance with CG Condition, Appendix 3, Part 4, Schedule J3.

13. Reporting and Record Keeping

A monitoring and evaluation report will include details on species survival, natural recruitment, percentage coverage of the rehabilitation area and percentage and species of weeds in the rehabilitated areas. In addition the following will also be recorded:

- Planning and impact assessment details;
- Activity site location and site access details;
- Commencement and completion dates;
- The area of native vegetation removed, and the amounts of material excavated and fill placed;
- The disposal location/s and quantity of spoil material removed;
- The disposal location/s and quantity of native vegetation removed;
- Impact management and rehabilitation details;
- Before, during and post activity photographs of the site;
- Any incidents of unanticipated failure of management methods and subsequent remedial action; and
- Any notable fauna activity will also be recorded.

In accordance with EA condition E36, rehabilitation can be considered successful when the site can be managed for its designated land-use without any greater management input and there is evidence that the rehabilitation has been successful for at least 3 years.

The Coordinator General Conditions, Appendix 3, Part 3, Condition 4g, state that:

For clearing impacts that result in permanent loss of least concern native plants (cannot be re-established within three (3) years of clearing or floristic modification), the permit holder must provide DERM with a written detailed report of permanent vegetation loss, including the area, species affected and mapping of affected areas, within twelve (12) months of completion of the pipeline construction (Note: this is in addition to the required Return of Operations).

In addition to complying with the above requirement, GLNG shall undertake a review of unsuccessful vegetation areas and provide management measures and revised timeframes to rectify issues and allow pre-clearance conditions to be achieved.

Species of Conservation Interest (SOCI) logbook

Species of conservation interest encountered during the landscape and rehabilitation works will be recorded in the Species of Conservation Interest (SOCI) logbook and mapped in the supporting ecological GIS database. The information collated in the SOCI will include:

- Location of the community or species;
- Person reporting the sighting;
- Habitat type the species was inhabiting or adjoining the area where;
- Total area cleared and time of the clearing works;
- Where necessary, where the species was relocated or translocated to;
- Incidents; and
- Remedial actions.

The records will also be made available to the DSEWPC and DERM upon request.

Annual Environmental Return

This information will support the Annual Environmental Return, which will be submitted to DSEWPac electronically, within 20 business days of each anniversary date from the date of Commonwealth approval. The Annual Environmental Return will document the following information:

- Addresses compliance with these conditions;
- Detail any rehabilitation work undertaken in connection with any unavoidable impact on MNES;
- Detail all non-compliances with these conditions; and
- Detail any amendments needed to plans to achieve compliance with these conditions.

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Any other landscape and rehabilitation related reporting will be conducted in accordance with the relevant approval conditions.

Incidents

Any incident that results in the injury or fatality of an animal will be recorded on Accident, Injury and Incident Reports. Details of the incident including time and date of incident, cause of injury/ mortality and the species (if known) will be recorded and reported to DSEWPaC and DERM within 24 hours of its occurrence.

Revision

All environmental management plans, including the LRMP will be reviewed and updated as required during the life of the Project. When the LRMP is updated, the reviewed plans will be submitted to SEWPaC for approval (EPBC Act Condition 31). Updates to the LRMP may be required due to:

- Changes in EVNT flora and fauna species;
- Changes in TECs;
- Updates to related plans, including the SSMP, SMP, and ESCM;
- Revisions to databases and datasets, including data provided by DERM such as REs, High Value Regrowth (HVR), and Wildlife Online records;
- Amendments to EAs;
- Amendments to legislation;
- At the request of the State or Commonwealth Governments; and
- Following periodic internal review of the LRMP.

Data collected as part of rehabilitation monitoring will be used to satisfy the reporting requirements of the EPBC Act, EA and CG approval requirements. The information collected as part of monitoring will be assessed and summarised to provide an overview of rehabilitation progress within the GTP. Additionally, assessment of collected data will be used to identify any amendments required to the LRMP.

Table 12.1 outlines a review and reporting program for the LRMP document. The program includes provision for periodic review and revision as required. A revision register has been included at the beginning of this document to ensure all amendments are documented. Reporting timeframes will be tracked by GLNG.

Table 13.1 LRMP Review and Reporting Program

Timing	Requirement	Responsibility
Review		
Annual	Revision of LRMP framework, benchmark guidelines and schedules to ensure: <ul style="list-style-type: none"> • additional requirements / amendments to conditions are updated • changes in ‘best practice’ methods are included • feedback from rehabilitation successes and failures are reflected in the LRMP to ensure effective methods are highlighted 	<ul style="list-style-type: none"> • GLNG • Suitably Qualified Restoration Ecologist
As requested by SEWPaC	<ul style="list-style-type: none"> • SEWPaC may request in writing for revisions to made to the LRMP 	<ul style="list-style-type: none"> • As per SEWPaC request
Reporting		
Annual Environmental Return (AER) as per EPBC Act Approval (2008/4096) (Condition 62)	<ul style="list-style-type: none"> • Address compliance with the conditions • Include record of any unavoidable adverse impacts on Matters of National Environmental Significance (MNES), mitigation measures applied to avoid adverse impacts on MNES, and any rehabilitation work undertaken in connection with unavoidable adverse impact on MNES • Identify all non-compliance with the conditions and provide details regarding complaints • Identify any amendments needed to plans to achieve compliance with the conditions 	<ul style="list-style-type: none"> • GLNG

Timing	Requirement	Responsibility
Annual Return for EA Conditions to DERM (Schedule J, Condition 8)	<ul style="list-style-type: none"> Summary of rehabilitation actions, including monitoring and maintenance completed 	<ul style="list-style-type: none"> GLNG Suitably Qualified Restoration Ecologist (or similar), that is either 'independent', or an 'other expert approved by SEWPaC
DERM Permanent Vegetation Loss report (CG Conditions: Appendix 3, Part 3, Condition 4(g))	<ul style="list-style-type: none"> Where pipeline construction will result in the permanent loss of vegetation, a detailed report must be provided to DERM within twelve (12) months of the completion of pipeline construction 	<ul style="list-style-type: none"> GLNG Suitably Qualified Restoration Ecologist (or similar), that is either 'independent', or an 'other expert approved by SEWPaC

14. Correction and Prevention

14.1 Preventative Actions

Preventative actions will be managed as follows.

- Environmental Incidents along with their corrective and preventative actions will be recorded in the Incident Management System. Corrective and preventative actions will be updated into the relevant EMP. Future audits will check for compliance with the EMP (s) and that the necessary preventative actions are in place;
- Reviews of environmental performance will be undertaken through consideration of key performance indicators, objectives and targets, and benchmark performance; and
- Where assessed by the relevant EO (as necessary), a preventative action will be raised and action undertaken as a Corrective Action. Preventative actions may include changes to specific procedures or training requirements, or other management areas.

14.2 Non-conformance

For clarity, environmental non-conformances will be referred to as environmental issues to differentiate them from Project non-conformances, which typically relate to quality defects in items of plant or materials. An environmental issue will be detected through verification processes such as monitoring, inspections, audits and receipt of complaints.

The process for managing environmental issues will be in accordance with GLNG's Internal and Project Policies and Procedures. When an environmental issue is detected, the following actions will occur.

- The incident will be recorded in the Incident Management System (IMS);
- The nature of the event will be investigated by the relevant EO;
- Advice may be sought from a specialist where the extent of the issue is beyond the expertise of the in-house resource;
- Monitoring will be undertaken where the issue is complaint driven and the impact may be outside the project parameters;
- The effectiveness or need for new/additional controls will be reviewed;
- An appropriate preventative and corrective action will be entered into the environmental IMS and implemented;
- Strategies will be identified to prevent reoccurrence;
- The IMS will be closed-out; and
- Environmental documentation (i.e. CEMP) will be reviewed and revised.

Where the issue impacts on a 3rd party (i.e. is outside the project area or in breach of regulatory conditions) the relevant EO will also issue an Incident Report. In addition to the above, where an issue of a more serious nature has been identified, the following will apply.

- Stop work;
- Implement an immediate action to rectify the incident and stop further damage;
- Report the incident;
- Identify corrective and preventative actions;

- If the incident impacts upon state or commonwealth interests, the incident report will also be forwarded to the relevant authority;
- The incident will be reported in monthly management reports; and
- Associated environmental issues and corrective actions will be tracked.

14.3 Contingency measures

The Proponent recognises that contingency measures and adjustments to the management strategies may need to be considered in the event that a detrimental impact is recorded, and/or performance measures or targets are not met. Where this occurs, DSEWPC, DERM and/or DEEDI will be consulted and contingency measures determined and implemented (where required).

14.4 Environmental incidents and Corrective Actions

All incidents in breach of state or commonwealth policy/regulations will be reported to the relevant regulatory authority within 5 business days.

Non-specific environmental incidents are discussed in detail in Section 9.5 of the relevant EMP. The incident reporting form will be located in the EMP.

Detailed below are actions that will be taken should an event relating to directly to flora and fauna occur.

14.4.1 Flora

If vegetation outside the approved GTP ROW is incorrectly cleared the following actions must occur:

- The EO must be notified immediately and a stop work must occur until the situation has been assessed and is given approval to proceed by the proponent;
- The Spotter catcher(s) will conduct a search for any injured or orphaned wildlife; and
- If native vegetation was impacted a report will be provided to DERM and management measures agreed.

14.4.2 Fauna

If a native animal is injured on site and where it is safe for staff and the animal, the animal will be bundled in a dry warm blanket or jacket and taken to a vet or approved wildlife carer (do not attempt to handle marine animals or platypus). If it is unsafe or not possible to bundle the animal then:

- The location of the injured animal will be identified/ marked so it can be found again. If the animal is moving, a note will be made of the direction in which it was headed;
- The species of animal will be identified if possible and its approximate size determined;
- The type of injury sustained will be identified if possible (without handling or causing the animal further stress); and
- The relevant EO will be contacted immediately to capture or organise the possible capture of the animal for transportation to a specialist veterinarian or wildlife carer.

The relevant EO shall immediately contact the following organisations listed in Table 7.1 and provide details of the last known location of the injured/dead animal.

Table 14.1 Contact Details in the Event of an Injury to or Death of Native Wildlife (incl. marine)

Organisation	Contact Details
The Proponent PEM	07 3838 3666
QPWS Gladstone Office or DERM	(07) 4971 6500 or 1300 130 372 (Option 3)

Following the capture/recovery of the animal, an investigation into the cause of the event will be undertaken within 72 hours including an assessment of the effectiveness of corrective and preventative actions currently in place.

Any corrective and preventative actions identified will be implemented. The risk register, relevant procedures and documentation (including this plan) will be reviewed and revised as is necessary.

In the event that a control measure appears to be ineffective, the measure will be adjusted in consultation with the DEWHA and/or DERM. This Plan will be updated if necessary to reflect any significant changes to control measures.

Prior to construction a list of suitably licensed and experienced wildlife carers, hospital and/or vets local to the project area will be developed and included within the SMP.

14.5 Emergency preparedness and response

An Incident Response Plan will be prepared for the project and will be outlined in the CEMP. This plan will document suitable incident procedures to ensure effective response in the event of an emergency (including environmental emergencies such as fire, flood and large fuel spills).

The emergency procedures shall be tested on a six-monthly basis. Records of all site emergencies will be maintained (incl. results of emergency practice drills). The Emergency Response Controller for the project will be defined within the Incident Response Plan. This will also include the use contingency measures to check open trenches during and after rainfall events.

An up-to-date list of emergency response personnel and organisations will be maintained at each site office and compound.

15. Compliance and Evaluation

The compliance component of this Plan will be developed in accordance with the CEMP and State and Commonwealth Approvals.

15.1 Monitoring (Landscape and Rehabilitation)

Upon completion of the Management (monitoring) Strategy by the Principal Contractor, compliance and evaluation measures will be developed and incorporated into this Plan.

15.1.1 Inspection and surveillance

The monitoring of the landscaping and rehabilitation works will be ongoing from the first planting. Visual inspections will be undertaken regularly during construction and operational phases of the Project.

Following construction monitoring will be undertaken on a quarterly basis over the first 2 years of the Project and the monitoring will focus on key performance criteria developed for project and where necessary specific areas, including but not limited to:

- The physical stability of the rehabilitated areas;
- The biological structure of the vegetation community in rehabilitated areas (including the establishment of weed species);
- Water drainage from the site;
- Any public safety aspects;
- Non-conformances; and
- Monitoring of the rehabilitated areas shall ensure that any areas requiring remedial work are identified.

The rehabilitation programme shall be modified, as required, to address any conditions of approval and/or depending upon the findings of the monitoring programme results, including remedial works to action any non-conformances.

15.2 Ecological performance auditing

All monitoring required under this Plan will be compliant with relevant section of the CEMP and will be conducted by suitably qualified person, as per the Coordinator-General's Report.

The Proponent will conduct internal compliance audits of the implementation of Project environmental management commitments during the construction and operational phases, including.

- On-site audits of compliance with this management plan;
- Audits of contractors environmental management; and
- Work area inspections and monitoring.

Non-conformances identified during inspections will be documented, addressed with appropriate corrective and preventive actions and rectified within an agreed time frame.

The regulatory agencies associated with environmental matters may also conduct regular works inspections. The relevant EO shall attend these inspections.

15.2.1 External audits

External audits will be undertaken on an annual basis by an independent auditor approved by the minister. The audits will be conducted in accordance with AZ/NZ ISO9011.2003 *Guidelines for Quality and/or Environmental Systems Auditing* and/or section 458 of the EPBC Act and may be used to verify compliance with the Commonwealth conditions.

The external auditors report must document the following:

- The components of the project being audited;
- The conditions that were activated during the period covered by the audit;
- A compliance/non-compliance table;
- A description of the evidence to support audit findings of compliance or noncompliance;
- Recommendations on any non-compliance or other matter to improve compliance;
- A response by the proponent to the recommendations in the report (or, if the proponent does not respond within 20 business days of a request to do so by the auditor, a statement by the auditor to that effect); and
- Certification by the independent auditor of the findings of the audit report.

Audits or summaries of audits carried out under these conditions, or under section 458 of the EPBC Act, may be posted on the Department's website. The results of such audits may also be publicised through the general media.

If during the auditing process, any non-compliance with the Commonwealth conditions are identified, DSEWPC will be provided with written advice within 20 business days of the audit report. The written advice will outline:

- Actions taken by the proponent to ensure compliance with these conditions; and
- Actions taken to prevent a recurrence of any non-compliance, or implement any other recommendation to improve compliance, identified in the audit report.

15.3 Non-compliance

Where non-compliance occurs with regard to the Commonwealth or any State conditions of approval, a report must be submitted to DSEWPC within 5 business days. The report will outline the type of non-compliance and the remedial actions taken to ensure that the matter is resolved within a reasonable time frame. The time frame will be specified in writing by DSEWPC.

Where non-compliance occurs with regard to the other relevant conditions of approval (e.g. NC Act), a report must be submitted to the relevant governing agency within the designated timeframe. The report will outline the type of non-compliance and the remedial actions taken to ensure that the matter is resolved within a reasonable time frame. The time frame will be specified in writing by the relevant agency.

15.4 Variations to the LRMP

Once the LRMP has been approved by the relevant state and commonwealth agencies, a revised plan will need to be submitted for approval, if the works are to be undertaken other than in accordance with the approved plans and governing conditions. This will include any changes to the LRMP requested by the Commonwealth and/or the State.

For any revision to the approved LRMP, ensure the relevant assessment agencies are provided at least 20 business days for review and consideration of the revised plan, unless otherwise agreed in writing between the proponent and the agencies.

- Until the revised LRMP is re-approved, works must continue in accordance with the original LRMP. Once the revised LRMP is approved, this plan will supersede the original LRMP.

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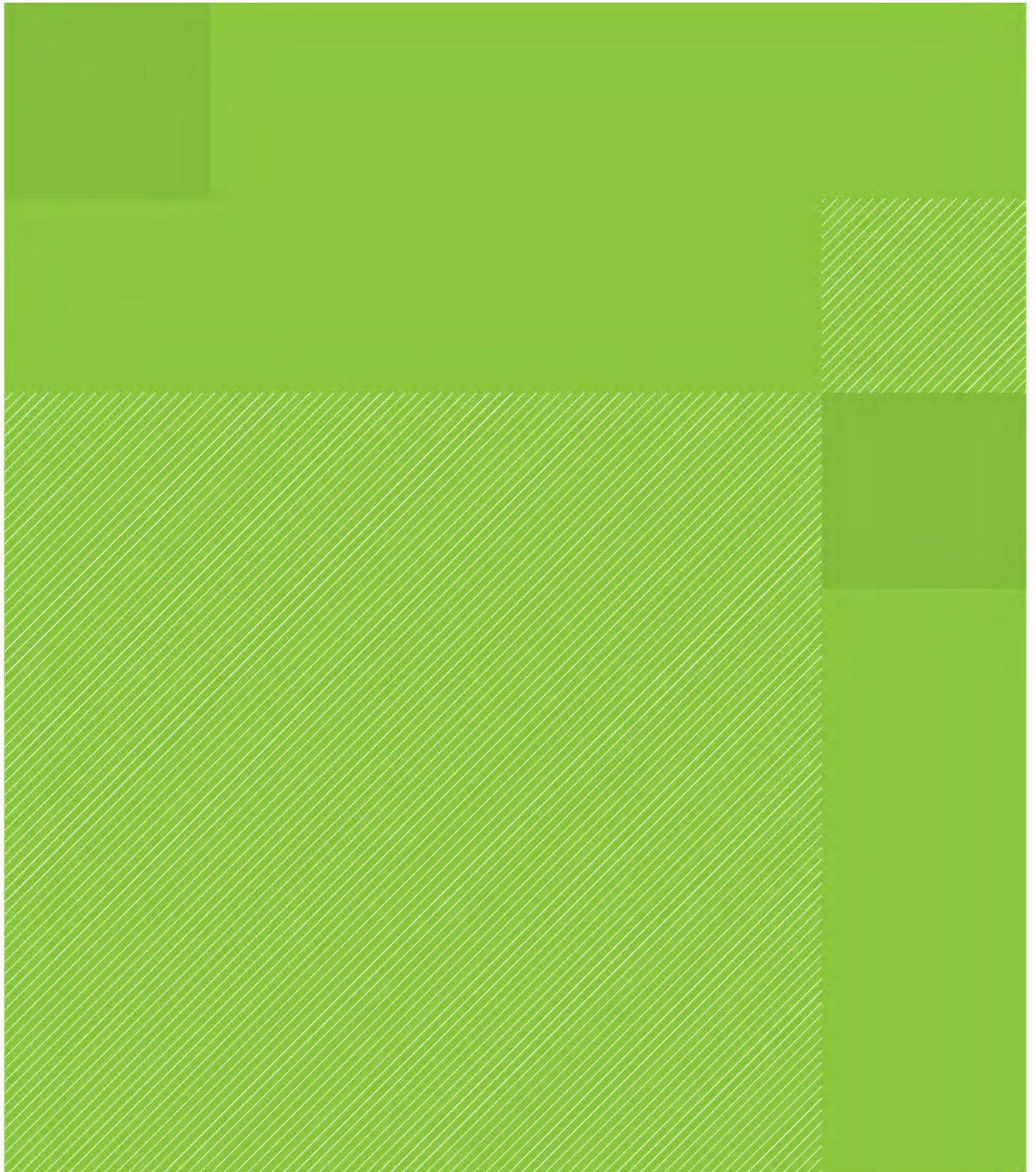
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Appendix F

Waste Management Plan (WMP)




**Waste Management Plan –
Santos GLNG Gas
Transmission Pipeline
(Mainland, Marine Crossing
(The Narrows) and Curtis
Island Sections)**

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8	6 February 2012	For SEWPaC Review	KH	KKF	GNC	AW
9	28 June 2012	Revised draft for Marine Crossing GTP EMP and change in construction methodology	KKF	KKF	BDP	

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Appendix A

Abbreviations

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Chemical inventory – Marine Crossing

Appendix D

Sandblasting Grit information

1. Introduction

1.1 Project overview

The Santos Gladstone Liquid Natural Gas (GLNG) Project has the following major components:

- Coal seam gas fields
- Gas transmission pipeline (GTP)
- LNG liquefaction and export facility (LNG facility)

1.2 Scope

This Waste Management Plan (WMP) addresses the waste management issues relating to construction, operation and decommissioning of the Santos GLNG GTP (the Project). It has been developed in accordance with the *Environmental Protection Act 1994* (EP Act) *Waste Reduction and Recycling Act 2011* (WRR Act) and other relevant State and Commonwealth legislative, guidelines, standards and covers the following key areas:

- The types and amounts of waste expected to be generated during construction and operation including chemical and hazardous materials, liquid wastes and hydrotest water. It also stipulates how wastes will be dealt with in accordance with the principles of the waste and resource management hierarchy (formerly the waste management hierarchy) as described in the Queensland Waste Reduction and Recycling Strategy (2010)
- Mitigation measures for dealing with accidents, spills and other incidents that may impact on the environment as a result of waste generation, handling and storage during construction and operational activities

This WMP also seeks to support the Project Environmental Management Plans (EMPs) and address the specific project approval conditions and items that have been raised as a result of the Coordinator General's (former Department of Infrastructure and Planning) comments in relation to the GLNG Environmental Impact Statement (EIS) (URS, 2009a) and Supplementary EIS (URS, 2009b), the *Report for Crossing of the Narrows – Review of the GLNG EMP* (DIP, 2011) and the former Department of Environment and Resource Management (DERM) request for additional information, dated 01/12/2011.

1.3 Objectives

The objectives of this WMP are:

- No contaminants or wastes discharged to land or water on the project site
- No unauthorised discharges of contaminants or waste to land or water offsite
- Minimise the quantity of wastes generated and disposed to a landfill during construction and operation
- Maximise the amount of material recovered for reuse or recycling during construction and operation
- All waste disposed of in accordance with State and Commonwealth legislation and guidelines
- No complaints relating to the management of waste during construction and operation

1.4 Project description

The Project includes the construction, operation and decommissioning of a 420 km GTP network to link the coal seam gas fields near Roma, Emerald, Injune and Taroom in Queensland to the proposed LNG Facility located on Curtis Island.

This WMP has been prepared to address all three sections of the Project, including the:

- Mainland GTP
- Marine Crossing GTP
- Curtis Island GTP

It is anticipated that the Project will have an operational lifespan of 42 years followed by a period associated with the decommissioning of the GTP and associated infrastructure.

1.4.1 Mainland GTP section

The Mainland GTP runs from the gas fields at Fairview to Port Curtis, traversing a distance of approximately 406 km.

1.4.2 Marine Crossing GTP section

The Marine Crossing GTP will connect the Mainland GTP to Curtis Island GTP (8.04 km) through a bored tunnel extending under The Narrows, between reference points C and D, utilising Earth Pressure Balance (EPB) Tunnel Boring Machine (TBM) construction methods. The Marine Crossing GTP Project will also encompass a section of open trenching on the Mainland, above the intertidal zone (reference points A to C), and on Curtis Island between the reference points D and E.

1.4.3 Curtis Island GTP section

The GTP on Curtis Island is 5 km long commencing at Point E at Laird Point and running through to the proposed LNG Facility. This section is a terrestrial section and will be constructed using open trench construction.

Further information on the project description has been provided in Section 4 and in the relevant EMP for each section of the Project.

1.5 Roles and responsibilities

GLNG Operation's personnel and contractors will be responsible for implementing this WMP in a manner that complies with relevant environmental standards, adheres to legislative requirements and ensures that environmental objectives associated with construction and operation for the Project are achieved.

Contract documents will include the necessary environmental specifications and commitments, and require compliance with the Environmental Authority (which this WMP supports), construction specifications, technical drawings and the general environmental duty.

All personnel are responsible for the environmental performance of their activities and for complying with the General Environmental Duty as outlined in the *Environmental Protection Act 1994 (EP Act)*. Section 319(1) of the *EP Act* states that 'a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all

reasonable and practicable measures to minimise the harm'. Specific environmental responsibilities are detailed in Table 1.1.

Table 1.1 Specific environmental responsibilities

Position	Overview
GLNG Operations Pipeline Project Manager	The GLNG Operations Pipeline Project Manager is ultimately responsible for the standard of management, including environmental management. To assist in fulfilling this responsibility, the GLNG Operations Pipeline Project Manager is supported by a series of specialised personnel
Construction Manager	The Construction Manager is responsible for all construction activities including planning, procedure approvals and execution of works. The Construction Manager is also responsible for ensuring that adequate provision is made for compliance activities
Engineering Manager	The Engineering Manager is responsible for generating the design drawings and specifications consistent with the EMP and AS2885
Pipeline Construction Superintendent	The Pipeline Construction Superintendent will direct work in a manner that complies with all relevant environmental procedures; adheres to all legislative requirements and ensures that all environmental objectives associated with the Project are achieved. The Construction Superintendent has "stop task" and "stop work" authority
Environmental Manager	The Environmental Manager will direct work in a manner that complies with all relevant environmental procedures, adheres to all legislative requirements and ensures that all environmental objectives associated with the Project are achieved. The Environmental Manager has "stop task" and "stop work" authority
Construction Contractor	The Construction Contractor is responsible for ensuring compliance with the EMP and the development and implementation of a specific Construction EMP (CEMP). This will include training of personnel (refer Section 7.9), provision and maintenance of equipment, facilities and associated services and consumables, and the monitoring of compliance with the EMP

Source GLNG Operations, 2011 EMP (Mainland)

1.6 Limitations of this WMP

This document provides guidance related to chemical and hazardous materials storage, spill management and clean up (containment and remediation), however it does not address health and safety aspects. Health and Safety aspects will be addressed in relevant GLNG Operations guidelines including the Environment, Health and Safety Management System (EHSMS) and inductions process.

This WMP should be viewed as a living document that will be progressively updated with additional information throughout the construction and operation phases.

2. Waste Management Legislation

2.1 General legislative structure

There are a number of Queensland and Commonwealth statutory environmental requirements, policies and guidelines that apply to the Project and have been taken into consideration during the preparation of this WMP. These statutory requirements are summarised in Table 2.1.

Table 2.1 Key legislation

Waste management legislation	Key requirement of legislation
<i>Environmental Protection Act 1994</i>	Includes licensing and approval of all Environmentally Relevant Activities (ERAs) Establishes a general environmental duty Process to prepare EMPs Provides for the making of environmental protection policies
<i>Environmental Protection Regulation 2008</i>	Defines regulated waste and waste disposal management Establishes regulated waste transport requirements
<i>Environmental Protection (Waste Management) Regulation 2000</i>	Establishes waste tracking requirements
<i>National Environmental Protection (Movement of Controlled Waste between States and Territories) Measure as Varied (2010)</i>	Controls the movement of Controlled Waste between States and Territories
Queensland's Waste Reduction and Recycling Strategy 2010-2020	Establishes waste and resource management hierarchy; sets targets to halve landfill volumes, double the recycling rate of municipal solid waste (MSW), and increase the recycling rates for commercial and industrial waste. Introduction of a levy on waste to landfill excluding MSW
<i>Waste Reduction and Recycling Act 2011</i>	Establishes waste disposal levy on industry waste sent to landfill (price signal); requirement for local government and Queensland Government agencies to prepare Waste Management Plans; introduction of product stewardship arrangements; litter and illegal dumping offences
<i>Waste Reduction and Recycling Regulation 2011</i>	Details provisions regarding the waste levy
<i>Dangerous Goods Safety Management Act 2001</i>	Controls storage and handling of dangerous goods and combustible liquids as well as the operation of major hazard facilities
<i>Dangerous Goods Safety Management Regulation 2001</i>	Prescription of dangerous goods location; major hazard facility or possible major hazard facility Safety obligations Flammable and combustible liquids licensing

Waste management legislation	Key requirement of legislation
<i>Transport Operations (Road Use Management – Dangerous Goods) Regulation 2008</i>	<p>Prescribes the obligations of persons involved in the transport of dangerous goods by road</p> <p>Aims to reduce as far as practicable the risks arising from the transport of dangerous goods by road</p> <p>Gives effect to the standards, requirements and procedures of the Australian Dangerous Goods (ADG) Code as far as they apply to the transport of dangerous goods by road</p> <p>Aim to promote consistency between the standards, requirements and procedures applying to the transport of dangerous goods by road and those applying to other modes of transport</p>

2.1.1 Queensland legislation

The relevant legislation which will impact on waste management related to the Project includes, but is not limited to:

Environmental Protection Act 1994

The (EP Act and its regulations and policies were developed to protect Queensland's environment, while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The EP Act is administered by the Department of Environment and Heritage Protection (DEHP) (formerly DERM).

The EP Act utilises a number of mechanisms to achieve its objective including:

- Environmental Protection Regulation, which includes licensing and approval of all ERAs
- Establishing a general environmental duty
- Process to prepare EMPs
- Issuing environmental protection policies

The EP Act establishes a duty of care for all persons to take reasonable and practicable measures to prevent and minimise environmental harm.

The EP Act allows for the establishment of Environmental Protection Policies (EPPs) which allow for the Queensland Government to declare and implement its aims and objectives for environmental protection. In regards to waste management; waste generators, transporters and receivers must comply with the following regulations:

- *Environmental Protection Regulation 2008* (EP Reg)

Environmental Protection (Waste Management) Regulation 2000 (EP(WM) Reg)

The EP Reg combined with the EP (WM) Reg aim to coordinate and clarify waste management practices in Queensland and provide a framework for improved environmental safeguards.

Environmental Protection Regulation 2008

The EP Reg replaces the Environmental Protection Regulation 1998, and supports the EIS process. It also identifies ERAs prescribed under the EP Act.

The EP Reg defines regulated waste and regulated waste disposal management. It also provides the statutory basis for implementing the National Environment Protection Measure for the National Pollutant Inventory.

Environmental Protection (Waste Management) Regulation 2000

The EP(WM) Reg sets specific requirements for the management of regulated waste, waste disposal facilities, waste management by local government, and litter control such as:

- Offences for littering, waste dumping and unlawful activities at waste facilities
- A waste tracking system within Queensland and interstate (National Environment Protection Measure (NEPM) for the Movement of Controlled Waste between States and Territories)
- Requirements for premises generating clinical and related waste
- A procedure for approval of wastes for beneficial reuse
- Approval processes for beneficial use of wastes
- Design rules for waste equipment

Waste Reduction and Recycling Act 2011

The WRR Act coordinates and clarifies waste and resource management practices in Queensland and promotes waste avoidance and reduction to encourage resource recovery and efficiency.

The WRR Act provides a tailored framework for waste management and resource recovery by the adoption of the waste and resource management hierarchy along with several management principles which include:

- “Polluter pays principle” – All costs associated with waste management should, where possible, be borne by the waste generator
- “User pay principle” – All costs associated with the use of a resource should, where possible, be included in the price of goods and services that result from the use
- “Proximity principle” – waste and recovered resources should be managed as close to the source of generation as possible
- “Product stewardship principle” – shared responsibility between all persons involved in the life cycle of a product and for managing the environmental, social and economic impact of the product

The above four principles form a hierarchy and provide a basis for waste management programs under ERAs. The waste and resource management hierarchy includes the following management principles (in order of priority) (DERM, 2010).

- Avoid
- Reduce
- Re-use
- Recycle
- Recover
- Treat
- Dispose

The WRR Act also lists matters that may be included in a waste reduction and recycling plan and introduces a levy on waste disposal.

Waste Reduction and Recycling Regulation 2011

This Regulation defines types of waste including commercial and industrial waste, construction and demolition waste and regulated waste, It describes the application of the waste levy including rates, zones and fees.

2.1.2 Commonwealth legislation

National Environmental Protection (Movement of Controlled Waste between States and Territories) Measure

The NEPM Movement of Controlled Waste between States and Territories aims to ensure that controlled wastes that are moved between States and Territories are properly identified, transported and handled in an environmentally sound manner, and that they reach licensed or approved facilities for treatment, recycling, storage and/or disposal. The NEPM provides a framework for developing and integrating systems for the movement of controlled waste between States and Territories which includes:

- Tracking systems, which provide information to assist agencies and emergency services and ensure that controlled wastes are directed to appropriate facilities
- Prior notification systems, which provide participating States and Territories with access to information to assess the appropriateness of proposed movements of controlled wastes in terms of transportation and facility selection
- Systems for licensing transporters and the regulating of generators and facilities so that tracking and notification functions are compatible between States and Territories
- Provision for mutual recognition by States and Territories of each other's transport licences (EP Reg)

2.1.3 Waste definitions

Under the EP Act "waste" is defined as anything that is:

- Left over, or an unwanted by-product, from an industrial, commercial, domestic or other activity
- Surplus to the industrial, commercial, domestic or other activity generating wastes

The EP Reg defines "general waste" as waste other than regulated waste. Regulated wastes are defined in the EP Reg as commercial or industrial waste that contains a constituent of a type mentioned in schedule 7 (Refer section 65 of the EP Reg). A list of all defined regulated wastes is outlined in Schedule 7 of the EP Reg. Appendix A provides a glossary of additional definitions relevant to this WMP.

2.1.4 Environmentally Relevant Activities – *Environmental Protection Act 1994*

The Project has the potential to trigger a number of ERA's during the construction and operation of the GTP.

The ERAs are prescribed under Schedule 2 of the EP Reg and the GTP construction work may include the following ERAs:

- ERA 8: Chemical storage

- ERA 17: Abrasive blasting
- ERA 21: Motor vehicle workshop operation
- ERA 38: Surface coating
- ERA 56: Regulated waste storage
- ERA 57: Regulated waste transport
- ERA 63: Sewage treatment
- ERA 64: Water treatment

If any GTP construction activity triggers an ERA then approval under the EP Act shall be sought by the Construction Contractor prior to construction and the activity commencing. Likewise for the Operational phase, GLNG Operations shall seek approval to conduct an ERA prior to the activity commencing.

2.1.5 Environmental Authority requirements

GTP Environmental Authority requirements regarding waste management are described within this WMP. All regulated wastes are to be disposed of to licensed waste disposal facilities or recycling facilities and transported by authorised companies or personnel. Designated personnel who will be required to collect, treat, transport or dispose of waste or recyclable materials will need to document their operational capacity in accordance with relevant State and Commonwealth legislation.

2.1.6 Records and data management

It is a legal requirement that records are kept in regards to regulated waste (defined under the EP Reg). The EP Reg requires all persons or business involved with the production or transportation of trackable wastes to record detailed information about the waste as defined in the EP (WM) Reg. These include the requirement to complete a Waste Transport Certificate for all deemed trackable waste. The EP(WM) Reg details the regulatory procedures.

2.2 Summary of standards, guidelines and codes of environmental compliance

Table 2.2 is a summary of Australian Standards, guidelines and codes which provide guidance on waste management and dangerous/hazardous goods storage and handling in relation to construction and operation of the GTP.

Table 2.2 Summary of standards, guidelines and codes of environmental compliance

Standard/guideline/code	Key requirements
AS1940	The storage and handling of flammable and combustible liquids
DNRMW On-Site Sewerage Code	Technical requirements for the management, site and soil evaluation, design, installation and operation of on-site sewerage facilities
DNRMW Guidelines for Vertical and Horizontal Separation Distance	Details acceptable vertical and horizontal separation distances from buildings, watercourses, bores etc
Standards Australia AS/NZS 1547 On-Site Domestic Wastewater Management	Australian Standard for on-site wastewater management
AS3833	Australian Standard for storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers
AS3780	Australian Standard for storage and handling of corrosive substances

Standard/guideline/code	Key requirements
AS2187 Explosives	Australian Standard for the storage and prescribed licenses and permits. (Specialist Contractor)
AS2885.3 & APIA Code of Environmental Practice – Onshore pipeline	Code of practice for onshore pipelines - gas and liquid petroleum - operation and maintenance
AS4452	Australian Standard for the storage and handling of toxic substances
Material Safety Data Sheets	Compliance with OH&S and legislative obligations related to the storage and handling of chemicals chemical registers (inventories)
Guide to the <i>Dangerous Goods Safety Management Act 2001</i>	This Queensland Department of Emergency Services document outlines the obligations, and provides definitions and information to help explain requirements under the <i>Dangerous Goods Safety Management Act 2001</i>
Code of environmental compliance ERA 17 – Abrasive blasting (mobile and temporary activity)	Sets out standard environmental conditions for abrasive blasting activity. Failure to comply with the code conditions is an offence under the EP Act and penalties apply
Code of environmental compliance ERA 57 – Regulated waste transport	Sets out standard environmental conditions for regulated waste transport by road. Failure to comply with the code conditions is an offence under the EP Act and penalties apply

2.3 Other regulatory conditions

In addition to the legislative requirements detailed in Section 2.1, this WMP has sought to address the relevant project approval conditions that have been raised as a result of the regulators' comments in relation to the GLNG EIS (URS, 2009a). These include:

- The conditions within the Coordinator General's Report (CG Report) related to waste management and the storage and handling of chemicals, flammable and combustible liquids. In particular the Part 4 Environmental Authority Conditions – Gas Pipeline, Schedule D – Waste Management and Condition D8 and D9
- The Department of Infrastructure and Planning comments related to waste management as documented in *Report for Crossing of the Narrows – Review of the GLNG EMP*
- The former DERM's (now DEHP) Guideline *Preparing an environmental management plan for coal seam gas activities* related to waste generated by the proposed petroleum activities

3. Waste Management Principles

3.1 Overview

The management of waste material generated as a result of GTP construction, operation and decommissioning will be dealt with in accordance with the principles of the waste and resource management hierarchy¹ (refer Figure 3.1) as described in the Queensland Waste Reduction and Recycling Strategy 2010 - 2020 (DERM 2010).



Source Queensland's Waste Reduction and Recycling Strategy 2010–2020 (DERM, 2010)

Figure 3.1 Waste and resource management hierarchy

The GTP waste and resource recovery hierarchy principles are outlined in Section 3.2.

3.2 Waste and resource management hierarchy principles

3.2.1 Waste avoidance

Waste avoidance will be targeted through adoption of alternative products and implementation of procurement processes which include the provision of contracts with companies which have documented sustainable waste management practices.

During delivery and transportation, the pipe sections will be protected with a coating applied during manufacture off-shore that reduces damage and subsequent wastage during the GTP construction process. All pipeline sections will be ordered and delivered to meet the detailed design requirements. This will reduce the quantities of some waste streams associated with the construction phase, including scrap steel.

¹ Prior to publishing of the Queensland Waste Reduction and Recycling Strategy 2010 – 2020, the Waste and resource management hierarchy was referred to in Queensland Legislation and other government documents as the Waste Management Hierarchy comprising waste avoidance, waste reuse, waste recycling, energy recovery and waste disposal

3.2.2 Waste reduction

Where possible, contracts will be established with companies that minimise waste through their production process, maximise recycling of waste produced and maximise recycling opportunities for the used end product and associated packaging waste. Procurement of pre-fabricated materials will be encouraged to reduce the quantity of waste generated onsite.

3.2.3 Waste re-use

The re-use of waste will be achieved through identifying at the earliest opportunity materials which can be re-used during the construction period. Items such as timber skids, sand bags, timber pallets and hydrotest water are examples of materials that will be targeted for reuse.

To maximise re-use opportunities, materials will be segregated within the designated waste storage areas along the GTP ROW. The environmental protection commitments, objectives and control strategies described in Section 8 provide recommendations on how re-use could be implemented for the Project.

3.2.4 Waste recycling

The collection of waste materials for recycling will be integral to the management of waste during construction of the GTP. A proportion of the materials created as a result of construction will be recycled. An example of some of the materials are:

- Dry recyclables like paper, cardboard, plastic and glass
- Ferrous and non-ferrous metals generated from the pipe welding and cutting process
- Oils generated from plant and equipment maintenance
- Timber generated from pallets, skids and off cuts (once reused)

Other potentially recyclable materials will be treated in accordance with the principles of the waste and resource management hierarchy where opportunities exist.

3.2.5 Other recovery and treatment of waste

This includes capturing the energy available in discarded products and treating the waste prior to disposal to reduce the hazardous characteristics of the waste.

Energy recovery facilities are generally not available in Central Queensland and are not likely to be an option for project waste. As such, some regulated waste from the Project may need to be sent to licensed treatment facilities to reduce the hazardous characteristics of the waste prior to disposal.

Opportunities for energy/resource recovery will be periodically reviewed through the auditing process and the Project waste and resource management hierarchy initiatives (refer Section 3.3). Potential opportunities will be assessed for suitability when they are identified.

3.2.6 Waste disposal

The construction and operation of the GTP will employ suitably licensed waste management and recycling contractors that will provide bins and collection/transportation services for specified waste/recyclables to be hauled to licensed waste management and resource recovery facilities.

Disposal options for wastes generated by the construction and operation of the GTP depends on the characteristics of the waste. The following section presents the waste disposal options that have been considered for the construction and operation of the GTP.

Landfill

Although most towns in Maranoa Regional Council, Central Highlands Regional Council and Banana Shire Council have a local waste disposal facility, many facilities only accept domestic waste (ie from residential premises) for disposal. The waste facilities that accept waste for disposal from commercial operators are listed in Table 3.1. No other waste disposal facilities may be used for disposal of Project waste without prior approval of GLNG Operations.

Table 3.1 Waste disposal facilities closest to GLNG GTP ROW

Licensed waste facility	Allowable annual capacity as per site environmental authority	Comments
Gracemere Landfill, Allen Road, Gracemere	20,000 t per annum for disposing of general waste or limited regulated waste	Construction and Operations Contractor/s to investigate if Rockhampton Regional Council will accept Project waste at the Gracemere Landfill from the Port Alma temporary pipe receiving area
Benaraby Landfill, Bruce Highway Benaraby (south of Gladstone)	50,000 t per annum	This will be the primary facility for disposal of Project waste. Construction and Operations Contractor/s to confirm waste acceptance criteria (ie types of waste permitted for disposal)
Trap Gully Landfill, Forestry Road, near Biloela	Less than 2,000 t per annum for disposing of general waste or limited regulated waste	Limited capacity to accept waste materials for disposal. Construction Contractor to investigate if Banana Shire Council will accept GTP construction waste at the Trap Gully Landfill from the Project
Rolleston Landfill, Rolleston	Unconfirmed	Construction Contractor to investigate if Council will accept GTP construction waste at the Rolleston Landfill from the Project
Roma Landfill, Short Street, Roma	Unconfirmed	Construction Contractor to investigate if Council will accept GTP construction waste at the Roma Landfill from the Project
Injune Landfill, Injune	Unconfirmed	Construction Contractor to investigate if Council will accept GTP construction waste at the Injune Rolleston Landfill from the Project

Sewage treatment plants

The Waste Management and Recycling Contractor (WMRC) is to contact the relevant local authority to determine the location of suitable Sewage Treatment Plants (STPs) for disposal of sewage from construction ablution facilities and to make arrangements to receive wastewater, effluent or sewage sludge from the construction camps.

3.3 Waste and resource management hierarchy initiatives

The Project will aim to achieve positive outcomes by targeting the source of the waste and adopting the waste and resource management hierarchy.

Table 3.2 outlines the potential Project opportunities for implementing the waste and resource management hierarchy within the Project.

Table 3.2 Waste and resource management hierarchy opportunities

Waste hierarchy	Opportunity	GTP initiative
Waste avoidance/ Waste reduction	Excavated material and topsoil	All excavated material and topsoil is to be used for backfill and respread along the ROW during restoration
	Hardstand material and rock	Clean hardstand material from areas to be restored to their original condition will be provided to local landowners for use on their properties (ie for roadways)
	Spoil from marine crossing tunnel construction	Beneficial reuse as fill for rehabilitation works for other sites in the Gladstone region
	Temporary fencing and gates	Temporary fencing and gates constructed along the boundary of the ROW are likely to remain after completion of restoration as many of the landowners have indicated that they would like to keep this fencing
	Pipe	Minimum length of pipe cut permitted is 2 m. These cut lengths are to be used within the pipeline
	Packaging materials in pipe and materials delivery	Where possible, packaging materials used to deliver pipe and materials will be reusable or recyclable
Waste re-use	Green waste (felled vegetation and plant matter)	Where possible, green waste will be reapplied during ROW restoration. Whole felled and mulched vegetation will be used in rehabilitation and soil stabilisation of ROW (refer Landscape Rehabilitation Management Plan (LRMP), document number 3380-GLNG-3-1.3-0037)
	Timber skids Wastewater effluent (treated wastewater) re-use	Timber skids used during pipe stringing will be collected and transferred along the ROW for reuse in pipe stringing further along the corridor Explore whether treated wastewater from construction camps is suitable for use for dust suppression or use in vehicle washdown facilities
	Hydrotest water re-use	Where possible hydrotest water will be reused for other pipeline segment hydrotesting
Waste recycling	Waste oil and hydrocarbons	A waste oil contractor would be engaged for recycling waste oil
	Steel and metal, cabling	Waste steel and other metals will be recycled by a steel and metal merchant
	Batteries	Batteries will be recycled with a battery recycler
	Tyres	A licensed contractor will be engaged to transport tyres to a tyre recycler
	Commingled recyclables (plastic, liquid paper board, aluminium and ferrous food/drink containers)	Investigate if recyclable materials can be sent to the CQ's Rockhampton Materials Recovery Facility (MRF) for recycling

Waste hierarchy	Opportunity	GTP initiative
	<p>Waste paper and cardboard</p> <p>Concrete</p>	<p>Banana Shire Council operates a small waste paper and cardboard bailing plant in Biloela. Construction Contractor to investigate the opportunity to recycle source separated waste paper and cardboard at Banana Shire Council's Calvale Road facility in Biloela</p> <p>Construction Contractor to investigate if opportunities for waste concrete recycling are available in the Gladstone/Banana region</p>
Energy recovery	<p>There are no energy recovery facilities in Central Queensland. There is a potential opportunity for some waste material to be used as a fuel for the cement kiln at Fisherman's Landing, Gladstone (eg tyres)</p>	<p>Construction Contractor to investigate if any waste materials have value and are suitable for use (ie meet the kiln's acceptance criteria) as a fuel/feed stock in the cement kiln at Fisherman's Landing, Gladstone</p>

4. Project Description

4.1 Project overview

An underground 420 km GTP will feed CSG from the CSG fields at Fairview through to the proposed LNG Facility on Curtis Island. The GTP route is shown on Figure 1 – GTP Waste and Recovered Material Haulage Route (refer Appendix B). The Project activities occur in 3 phases - construction, operation and decommissioning phases. Sections 4.2 to 4.4 provides an overview of the various activities that will be undertaken during each phase and a description of the Project components.

4.2 Construction

During the construction phase three distinct work areas are proposed, referred to as the Mainland GTP section, which is approximately 406 km in length, the Marine Crossing GTP section which is 8.04 km long and the Curtis Island GTP section which is 5 km in length. The construction activities provided in Section 4.2 summarise the details that are provided for each section in the relevant EMP for each Project section.

Pipeline materials will be imported via ship to the Port of Gladstone or Port Alma, transported via road and stored in temporary locations called 'temporary pipe storage sites' along the GTP ROW. A peak workforce of approximately 900 construction personnel are required for the pipeline construction, working 12 hours each day on a 28 days on, 9 days off roster.

4.2.1 Mainland GTP construction activities

Construction workforce and camps

Construction personnel will be accommodated in construction camps. Four construction camp locations have been identified (Arcadia Valley, Bauhinia, Banana and Calliope (refer Figure 1 – GTP Waste and Recovered Material Haulage Route). Temporary work site facilities such as vehicle refuelling facilities, waste storage areas, site offices, warehouse and laydown areas, maintenance workshop, prefabrication workshop, vehicle parking areas, vehicle washdown facilities and associated infrastructure such as water storage tanks, diesel generators and portable sewage treatment facilities will be located within the construction camps. These construction camps will use sectional trailers and modular structures joined together to provide the required buildings. The workshops and other facilities will be relocatable and will be moved to follow the Mainland GTP construction as it progresses along the ROW.

The construction camps will require potable and non-potable water for domestic use during construction. It is estimated that the overall usage of potable water during construction will be approximately 200 L/person/day.

A temporary equipment maintenance workshop, which is mostly containerised, will be mobilised at each construction camp for the purpose of undertaking maintenance and repairs of construction plant and equipment.

It is proposed that fuel trucks, lubrication trucks and small maintenance vehicles with roving mechanics will be on site daily to service and perform maintenance on plant and equipment. Plant and equipment requiring major repair will be brought to the construction camp's equipment workshop.

It is proposed that emergency vehicle maintenance will be provided for the following services:

- Towing of stalled vehicles to the workshop
- Tyre repair
- Changing fan belts, replacing hoses and other repairs requiring 3 hours or less

The prefabrication workshop will be provided for fabrication of mainline valves and end of loops piping.

General GTP construction activities

Pipe will be imported via ships, which will be unloaded to pipe receiving areas within each port area. Approximately 11 pipe shipments will be received at Port Alma and 5 pipe shipments at Gladstone Port Central. Prior to transport from the port to the temporary pipe receiving areas, the pipe will be inspected for compliance with the specification. Many of the construction vehicles, equipment and materials which are required for the pipeline construction will be sourced from the Construction Contractor's fleet and stores located outside Australia. The Construction Contractor's fleet, equipment and materials, which are imported into Australia, will arrive and be unloaded either at Gladstone Port Central or the Port of Brisbane and transported via road to the construction camp or ROW work area.

Pipe arriving at Port Alma will be transferred to the temporary pipe receiving area located at Lot 96 on DS186 on the Toonda Port Alma Road, Bajool. The pipe will be stored on at this location until scheduled for dispatch to the temporary pipe storage sites adjacent to the GTP ROW.

Similarly, pipe arriving at Gladstone Port Central will be transferred to the temporary pipe receiving area at the Gladstone Port Lot 300 or direct to the temporary pipe storage sites along the ROW. The pipe will be stored at Gladstone Port Lot 300 until scheduled for dispatch to the temporary pipe storage sites adjacent to the Mainland ROW or transported via barge to Curtis Island ROW. The Gladstone Port Lot 300 is to be established to support the pipeline construction activities near Gladstone and will be operational for the duration of the Project. Site offices, warehouse, small waste storage area laydown area and prefabrication workshop will also be located at Gladstone Port Lot 300.

Up to 11 temporary pipe storage sites (pipe laydown areas) are to be constructed at various locations adjacent to the Mainland ROW for temporary storage of pipe prior to transferring the pipe to the ROW during stringing works (Refer Figure 1 – GTP Waste and Recovered Material Haulage Route). Each temporary pipe storage site will typically be 8 ha in area to accommodate temporary storage of up to 60,000 pipes.

To prevent spread of weeds by construction vehicles, ROW access will be strictly controlled so that vehicles cannot travel from a weed infested area into a weed free area without passing through a vehicle washdown facility. It is proposed to install 12 ROW access points with vehicle washdown facilities along the Mainland ROW. Weed management and control associated with vehicle washdown and weed zones is addressed in the Pest and Weed Management Plan (PWMP) (document number 3380-GLNG-3-1.3-0006), which states that access routes shall be planned to achieve the following objectives:

- Vehicles operate in such a manner as to limit crossing of weed zone boundaries
- Vehicles start in clean areas and then move into the dirty areas
- Vehicles do not drive through or contact any seeding or flowering weeds

- Vehicles are subject to washdown and certification to move between zones

It is understood that the following pipeline construction activities are likely to generate waste:

- Early works
 - Weed control along the ROW
 - Construction of platforms for pipe storage at the temporary pipe storage sites
- Construction Contractor plant and equipment receipt in Gladstone and Brisbane ports
- Construction of port pipe laydown areas at Gladstone Port Lot 300 and Lot 96 on DS186 on the Toonda Port Alma Road, Bajool
- Pipe receipt at temporary pipe receiving areas at Port Alma and Gladstone Port Central
- Mobilisation
 - Construction of temporary facilities – Temporary receiving pipe areas (11) adjacent to the ROW
 - Transport and delivery of plant and equipment
 - Transport and delivery of pipe to temporary pipe storage sites
 - Progressive installation of construction camps - 4 mobile construction camps for worker accommodation, relevant to the work area of the construction workers
- Clearing and grading pipeline corridor and access tracks
- Erosion and sediment control maintenance
- Restoration and maintenance of existing roads, ROW access tracks and haul roads
- Trenching
- Drilling and blasting
- Pipe installation – welding and weld checking called holiday testing
- Pipe cleaning (pigging) and testing (hydrotesting and leak detection testing)
- Infield servicing of equipment and mobile plant
- Mobile refuelling of construction equipment
- Construction of inlet station and mainline valve stations
- ROW rehabilitation – backfilling and pipeline corridor restoration
- Decommissioning and relocation of construction camps

4.2.2 Marine Crossing section construction activities

The Marine Crossing GTP is an 8.04 km section of pipeline that includes a 4.3 km tunnel under the intertidal areas and The Narrows to reach Curtis Island. An EPB TBM will be used to excavate the tunnel, which entails boring a tunnel beneath The Narrows, between reference points C and D, and then constructing and installing the GTP and other utility components including a fibre optic cable through the tunnel. The intent of adopting this tunnelling technique is to leave the surface of the intertidal areas and The Narrows channel undisturbed. The other sections of the Marine Crossing GTP will be constructed by open trench. Details relating to the TBM construction process are included in the Marine Crossing EMP (document number 3380-GLNG-4-8.2-0021).

The TBM activity will generate 83,000 m³ of spoil..

The tunnel spoil will be beneficially used as soil for rehabilitation of other industrial residue sites in the Gladstone region. Tunnel spoil that potentially contains Acid Sulfate Soil (ASS) will be transported to an ASS treatment area for treatment in accordance with the Acid Sulfate Soil Management Plan (ASSMP). Treated material will then be transferred to the proposed reuse destination. Material that doesn't comply with the reuse destination's rehabilitation soil acceptance criteria will be disposed to landfill.

Upon completion of the Marine Crossing GTP section, the construction site pads, Access Road and associated pipe stringing and welding platforms will be removed and the area will be rehabilitated in accordance with the LRMP (document number 3380-GLNG-3-1.3-0037).

Waste and recyclable material from the construction site pad (Curtis Island) will be transported via barge to the Port of Gladstone and then via road transport to the WMRC's depot at Landing Road, Yarwun for aggregation and sorting prior to transport of the waste and recyclable material to a disposal or recycling facility. Figure 2 and 3 (refer Appendix B) show the waste and recovered material haulage routes and location of construction areas.

4.2.3 Curtis Island section construction activities

The Curtis Island GTP section that joins the Marine Crossing GTP section to the proposed LNG Facility will be constructed using open cut trenching (as described for the Mainland GTP section).

Waste and recyclable materials generated from the Curtis Island GTP will be transported via barge to the Port of Gladstone and then via road transport to the WMRC's depot at Landing Road, Yarwun for aggregation and sorting prior to transport of the waste and recyclable material to a disposal or recycling facility.

4.3 Operation

The operational phase involves activities associated with:

- Structural integrity monitoring
- Maintaining and repairing the GTP, valves and metering stations
- Cleaning the GTP
- Maintenance to operational access tracks such as weed control and vegetation management
- Monitoring the performance of the cathodic protection system and anti-corrosion initiatives
- Monitoring the gas transmission

Waste and recyclable materials likely to be generated from the operational phase are detailed in Section 5.2.

4.4 Decommissioning

Decommissioning will occur in accordance with regulatory requirements as set out in the EMPs for each GTP section.

Waste and recyclable materials likely to be generated from the decommissioning phase are detailed in Section 5.3.

5. Waste generation

Waste will be generated as a result of the Project construction activities. Three distinct construction work areas identified and outlined in Section 4 will generate waste; these are the Mainland GTP section, the Marine Crossing GTP section and the Curtis Island GTP section.

The estimated waste streams from the construction and operation of the GTP fall into one of the following broad categories:

- General waste
 - Recyclable waste such as paper, cardboard, plastics, glass, aluminium and timber
 - Putrescible waste
 - Medical and first aid waste
 - Scrap metals
- Liquid waste
 - Sanitary waste
 - Hydrotest water
 - Washdown facility wastewater and residue
 - Water treatment plant residue
- Construction and demolition waste
- Tunnelling and shaft spoil, excess or out of specification grout
- Fill material from roadway and construction site pads
- Workshop and electrical workshop waste
- Hazardous and regulated waste

The waste materials likely to be generated from construction, operation decommissioning phases of the Project have been described in Section 5.1 to Section 5.3. The quantities of waste are estimates only.

5.1 Construction waste

5.1.1 Mainland section

Table 5.1 to Table 5.3 list the expected wastes to be generated from the construction activities from the Mainland GTP section. The waste generation lists have been compiled relative to the key activity areas:

- Temporary pipe receiving area at the Port of Gladstone (ie Gladstone Port Lot 300) and Port Alma (Lot 96 on DS186 on the Toonda Port Alma Road, Bajool)
- Mainland ROW including temporary pipe storage sites and ROW access points
- Construction camps including plant and equipment workshops

Temporary pipe receiving areas

Table 5.1 Waste generated at temporary pipe receiving area at the Gladstone Port Lot 300 and Bajool (Lot 96 on DS186)

GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Delivery of plant and equipment to site (ie light vehicles and construction vehicles, dongas, portable toilets)	Packaging (ropes and strapping, cardboard), timber skids, fibre/nylon rope spacers, pallets, drums and scrap metals	Materials treated as per waste and resource management hierarchy with general waste disposed to local licensed landfill	Negligible
Delivery of pipe at port to temporary pipe receiving area	Pipes with irreparable defects or specification non-conformity or damage Pipe will arrive with PVC or polyethylene end caps and 3 pieces of nylon rope tied around each end and in the centre. These will remain on the pipe until stringing and welding is undertaken within the ROW	All dunnage and damaged pipe sections will remain on ship	Negligible
Site office	General waste, waste paper	General waste to local licensed landfill Recyclable material to recycling facility (where available)	General waste 240 L per week
Prefabrication workshop valve assemblies, pipe supports and light structures (not applicable to Port Alma)	Waste materials such as pipe spools, various off cuts and grindings, paint containers, welding waste	Recycle metals General waste to local licensed landfill	Pipe off cuts and waste steel 0.5 t per week (approximately one 12 m length of pipe per week) General industrial waste 0.5 t per week

Temporary pipe storage sites and ROW access points

Table 5.2 Waste generated from the Mainland ROW construction area and temporary pipe storage sites

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Mobilisation activities			
Translocation of plants	Plastic pots Wooden stakes Packaging material	All existing fencing removed from the ROW during the construction phase will be offered to local landowners for reuse. Any remaining items will be removed in accordance with the principles of the waste and resource management hierarchy Recyclable material to recycling facility (where available)	10 m ³ per week of general construction and recyclable waste during site establishment
Weed control	Surplus herbicides and empty chemical containers and other consumables		
Delivery of plant, equipment and portable structures to site (ie vehicles, dongas, portable toilets, vehicle weed washdown facilities at ROW access points)	Packaging (ropes and strapping, cardboard), timber skids, wooden crates, fibre/nylon rope spacers, pallets, drums and scrap metals		

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Installation of fencing and gates (temporary and permanent) and removal of existing fencing as per Landholder agreements	Damaged fencing, fencing wire off cuts, timber post off cuts Temporary fencing that can not be reused	General waste to local licensed landfill Unused herbicides will be retained by Weed Control subcontractor for use on other projects Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	
Construction			
Hardstand - import of hard standing materials for roadway or hardstand construction	Hardstand materials – gravel fill	Surplus clean material will be offered to local landowners for re-use, stored temporarily for use during the construction period, returned to the supplier or removed in accordance with the principles of the waste and resource management hierarchy	No waste materials are expected to be generated
Weed washdown facilities	Wastewater Sludge	Water is filtered and reused in washdown facility. Sludge disposed at local licensed landfill or Wastewater Treatment Plant (WWTP)	1 m ³ sludge per week per washdown facility
Clearing and grading of the ROW, temporary pipe laydown areas (temporary pipe storage sites) and access roads/tracks (clear and grade)	Green waste (felled vegetation and plant matter) Topsoil and excavated material (stockpiled for backfilling and application to ROW) Installation of temporary fencing and gates Construction of access tracks as required Steel post off cuts (from signage installation)	Stockpiled/windrowed vegetation will be reapplied during restoration/rehabilitation of ROW All topsoil and excavated material reused for backfilling in ROW Any surplus fencing material will be either removed for reuse by the fencing contractor or offered to local landowners for re-use or removed in accordance with the principles of the waste and resource management hierarchy	Included in general waste in mobilisation activities

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Construction of temporary pipe storage sites – grading and levelling, hardstand, berm construction, and fencing where required	Hardstand materials	Surplus clean material will be offered to local landowners for reuse or removed in accordance with the principles of the waste and resource management hierarchy	Included in general waste in pipe construction works
Erosion and sediment control installation and maintenance	Packaging material – cardboard, plastic wrapping, wooden pickets and geofabric sediment fencing Geofabrics "Bidim" A34 grade polyester filter off cuts	Sediment collected in devices stored in the ROW for respreading during rehabilitation works General waste to local licensed landfill	Quantities of waste dependent on climatic, site and topography conditions Included in general waste in mobilisation activities
Drilling and blasting	Packaging – cardboard, plastic wrapping	Specialist contractors will manage all waste associated with the handling and storage of explosives in accordance with relevant legislation and standards AS2187	No waste materials are expected be generated
Delivery of pipe construction materials and consumables to temporary pipe storage sites	Neoprene plastic wrapping Nylon rope Rubber matting Packaging – timber dunnage, pallets and crates, plastic wrapping, metal and plastic strapping around consumables Ropes and strapping, cardboard, timber skids, fibre/nylon rope spacers, pallets, drums and scrap metals	Materials will be recycled where possible General waste to local licensed landfill	Included in general waste in pipe construction works
Pipeline construction works <ul style="list-style-type: none"> • Pipe stringing and bending • Pipe cutting and trimming • Pipe welding (up to 1000 m pipe strings) • Weld sandblasting 	PVC or polyethylene pipe end caps (68,000 pipe end caps for pipeline) 42" mild steel pipe off cuts and defective pipe; metal filings (less than 100 m of pipe for pipeline) Timber skids and sand bags (reuse on each 30 km section)	PVC or polyethylene pipe end caps recycled Metal recycled Timber skids and sand bags reused General waste to local licensed landfill Licensed contractor to transport regulated waste to an	17.5 t per week of pipe end caps (10 kg per pipe end) 0.6 t per week of steel pipe off cuts and defective pipe 1.7 t per week of metal filings 8 t per week of general waste 100 L per week of regulated waste (spent chemicals and chemical container)

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
<ul style="list-style-type: none"> • Tie-ins (above ground or in-the-trench) • Coating of field joints - application of rust proofing agent required to be applied when pipe is cut and a coating of epoxy-urethane over weld • Holiday detection survey and weld testing • Ducting for fibre optic cable • River/waterway crossings 	<p>Off cuts – duct for future installation of fibre optic cable</p> <p>Marker tape</p> <p>Chemical containers (ie paint/epoxy coating cans, empty containers of rust proofing agents)</p> <p>Sandblasting grit (GMA Garnet) – spent grit will contain some metal fragments and paint/surface coatings (refer Appendix D)</p> <p>Welding residue – welding rod scraps and electrode butts</p> <p>Polypropylene bags</p> <p>Waste cement and concrete</p> <p>Nylon rope</p>	<p>appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill</p> <p>“Spent” Sandblasting grit disposed in accordance with Code of Environment Compliance (DERM, 2009)</p> <p>Spent abrasive (ie spent sandblasting grit) will be tested (eg Toxicity Characteristics Leaching Procedures test) to check whether it requires treatment in an approved hazardous waste treatment facility</p>	
<p>Trenching</p> <p>Foam trench breakers and foam pillows installation</p>	<p>Excavated material</p> <p>Excess rigid polyurethane foam (Aptane P220 / Isocyanate B900) and hose washings</p> <p>Spent absorbent material</p> <p>Drums/plastic bags (polypropylene)</p> <p>PPE - Protective gloves and disposable overalls</p> <p>PVC conduit offcuts</p>	<p>All excavated material reused for backfilling in ROW or offered to local landowners for reuse</p> <p>All materials will be managed as per the waste and resource management hierarchy with general waste disposed to the local licensed landfill</p>	<p>Included in general waste in pipe construction works</p>
<p>Pipe cleaning and gauging</p> <p>Pipe testing – Hydrotesting</p> <p>48 hour leak test</p>	<p>Pipe cleaning waste (pigging grit - scale, rust, or other foreign material)</p> <p>Hydrotest water not treated with biocides, corrosion inhibitor and oxygen scavengers (estimated 25 km tested at a time (approximately 90 m³ water required), used 4 times before discharge)</p>	<p>Pigging grit - licensed contractor to transport regulated waste to a licensed regulated waste landfill</p> <p>Hydrotest water released to land (refer Mainland EMP – document number 3380-GLNG-3-8.2-0024) No chemical treatment of water is required as source is potable water (refer Dewatering, Hydrotest Water and Land Release Management Plan (DHWLRMP))</p>	<p>200 m³ pigging grit total (assume 0.5 m³ per km)</p> <p>360 m³ water</p>

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
<p>Infield servicing and maintenance of construction plant and equipment</p> <p>Fuel trucks, lubrication trucks and minor maintenance pick-ups provide onsite daily service and perform regular checks on equipment</p> <p>Daily field servicing, safety checks and refuelling in the field to be undertaken in the ROW</p>	<p>Oily rags, spent absorbent material infield servicing and maintenance (minor servicing only)</p> <p>Waste oil and greases (eg lube oil, hydraulic oil and engine oil)</p> <p>Spent spill kit materials</p> <p>Packaging from replacement parts</p> <p>End of life vehicle parts (eg fan belts, hoses, other machinery parts)</p> <p>Tyres</p> <p>Batteries</p> <p>Used chemicals – chemicals, used tins from solvents, degreasing agents, lubricants</p> <p>Waste associated with diesel generator operation and maintenance</p>	<p>Licensed contractor to transport regulated waste to a licensed recycling facility</p> <p>Residual material dealt with in accordance with the principles of the waste and resource management hierarchy</p>	<p>All waste generated from infield servicing will be returned to the waste storage area at the construction camps</p> <p>250 kg regulated waste per week</p> <p>1 m³ of waste oil per month</p>
<p>Site offices, crib room/s, site amenities (servicing of construction site amenities)</p>	<p>Office waste – paper, cardboard packaging</p> <p>Kitchen waste</p> <p>Rubbish bin waste in facilities (ie paper towels)</p> <p>First aid waste</p> <p>Wastewater</p>	<p>Recyclable material to recycling facility (where available)</p> <p>General waste to local licensed landfill</p> <p>Wastewater hauled via vacuum truck and disposed at construction camp's WWTP</p>	<p>Recycling and general waste quantities included in the construction camp quantities per person per week</p> <p>Wastewater volumes included in construction camp quantities per person per day</p>
<p>Spill clean up</p>	<p>Hydrocarbon contaminated soil (small quantities)</p> <p>Contaminated absorbent material from ROW</p>	<p>Licensed contractor to transport regulated waste to a licensed recycling facility and residual material disposal at a licensed regulated waste landfill</p>	<p>Up to 160 L per week of regulated waste across Mainland GTP activities</p>
ROW rehabilitation			
<p>Clean up and restoration: reinstatement of the ROW, removal of foreign material (construction material and waste), surface contouring, compaction, respreading topsoil, respreading felled vegetation (whole or mulched) and reseeding</p>	<p>Any recyclable or general waste items listed above</p> <p>Useable surplus pipe will be delivered to a location designated by GLNG Operations</p>	<p>Clean hardstand material will be offered to local landowners or local council for reuse or removed for treatment or disposal in accordance with the principles of the waste and resource management hierarchy</p>	<p>100 t timber skids</p> <p>50 t sand bags (assume timber skids and sand bags are reused approximately 15 times over the length of the pipeline (ie assume reuse on each 30 km section)</p>

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Removing any surplus materials, restoring services to their original condition, disposing of refuse, smoothing disturbed earth, removing temporary fills, culverts and bridges, and performing such work as may be necessary to restore ROW to original condition		Useable surplus pipe and other reusable materials stored at location designated by GLNG Operations General waste to local licensed landfill	
Reinstatement of temporary pipe storage sites/pipe storage yards and other non ROW areas such as haul roads, spoil storage and other such areas requiring restoration	Polyethylene sheeting from pipe storage area	Reused or recycled where possible. Will be offered to local landowners for re-use General waste to local licensed landfill	80 t of polyethylene sheeting from temporary pipe storage sites
Establishment of vegetation	Plastic pots Wooden stakes Packaging material Surplus herbicides and empty containers	Residual material dealt with in accordance with the principles of the waste and resource management hierarchy Items will be recycled where possible if no option available then waste will be disposed of to a local licensed landfill General waste to local licensed landfill Unused herbicides will be retained by Weed Control subcontractor for use on other projects Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	50 kg per week during vegetation establishment activities in the ROW Quantity dependent upon whether herbicides for weed control are required during establishment of vegetation

Construction camps

Table 5.3 Waste generated from construction camps

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Mobilisation, construction and commissioning of construction camps	Site clearance green waste, topsoil and excavated material (stockpiled for backfilling and application to construction camps)	Stockpiled/windrowed vegetation will be reapplied during restoration/rehabilitation of ROW All topsoil and excavated material stockpiled along ROW for backfilling and spreading during site restoration	Nil
	Construction materials, concrete, scrap metal, timber, plastics, plumbing, electrical wiring	The construction methodology will aim to limit the amount of waste produced on the construction site and ensure that wherever possible, waste materials are re-used or recycled General waste to local licensed landfill	20 m ³ per week general and recyclable waste per construction camp during construction camp set up activities
Operation of construction camps – cleaning, catering, site offices, accommodation areas, ROW, temporary pipe storage sites, construction areas, temporary storage, and residential blocks within construction camps	General waste (including putrescible and non-hazardous waste) Recyclables (dry recyclables, cardboard, packaging materials and offices wastes)	Recyclable material to recycling facility (where available) General waste to local licensed landfill	6 kg per person per week recyclable material 13 kg per person per week general waste
	Metals - aerosol, aluminium cans, steel chemical containers, copper and aluminium (other than cans), steel drums (damaged), steel drums (good condition), scrap steel, steel chemical containers, bulk food containers		
	Food waste - Putrescible waste, metal, plastic, plastic and other associated food packaging		
	Chemicals - Cleaning and maintenance of camp buildings chemicals		
	Cardboard – Bulk food packaging and plant and equipment maintenance storage		

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
	Cooking oils – Food production activities	Waste cooking oil will be securely stored by the catering contractor and removed by the supplier for recycling where practicable	Recycling and general waste quantities included in the per person quantities per week
	Wood (pallets) bulk deliveries of food	All pallets will be collected by suppliers and returned for reuse	
	Clinical, medical, sanitary waste, first aid station waste, medical waste	Waste material dealt with in accordance with the principles of the waste and resource management hierarchy	Minimal quantities expected to be produced and have been included in the per person general waste quantities
	Wastewater treatment plant effluent	Discharge to mobile sewage treatment plants – irrigation beds/absorption beds	200 L per person per day - effluent
	Sludge from wastewater treatment plant	Licensed landfill or wastewater treatment plant	5 L sludge per person per week at 2% solids
Site mowing and vegetation maintenance	Green organic waste (woody garden waste, grass)	Stockpiled/windrowed vegetation will be reapplied during restoration / rehabilitation of construction camp	No waste expected to be generated
Office waste, construction materials and equipment store	Spent toner and printer cartridges, electronic and electrical equipment, white goods, computers, office equipment, mobile phones, batteries (dry cell)	Equipment will be reused by returning items to Brisbane	Minimal – each office will only be operational 6 to 9 months Recycling and general waste quantities included in the kg per person per week
	Spent lamps and fluorescent tubes	Recyclable material to recycling facility (where available)	
	Paper – Office paper, other sources of packaging	General waste to local licensed landfill	
	General non-recyclable - synthetic material waste Fibre insulation filters (activated carbon) filters (air, dust, paper)		
	Wood (pallets) construction materials and other equipment	Pallets will be collected by suppliers during subsequent deliveries	

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Plant and equipment maintenance service areas / workshops			
Vehicle wash down	Wastewater and sludge	Water will be reused at the vehicle wash facilities Sludge disposed at local licensed landfill or WWTP	0.5 m ³ sludge per week per construction camp wash down facility
Delivery of bulk equipment and supplies	Packaging (ropes and strapping, cardboard), timber pallets, fibre/nylon rope, drums and scrap metals	All packaging materials such as pallets will be collected by suppliers and returned for reuse or dealt with on site as per the principles of the waste and resource management hierarchy General waste to local licensed landfill	0.5 t per week of packaging material
	Explosives	Specialist contractors will manage all waste associated with the handling and storage of explosives in accordance with relevant legislation and standards AS2187	No waste materials are expected to be generated Included in Mainland – ROW (Table 5.2)
Refuelling – diesel generators	Absorbent material	All waste will be stored in accordance with Australian Standard AS 1940 in bunded areas	No waste expected to be generated (absorbent material listed below)
Diesel refuelling area for construction vehicles - fuel storage up to three 30 kL tanks at construction camps for refuelling construction vehicles	Absorbent material	All waste will be stored in accordance with Australian Standard AS 1940 in bunded areas	
Plant and equipment maintenance workshop	Filters (oil) filters (air, dust, paper)	Collected and transported by a licensed contractor for recycling where possible	100 kg per week oil and air filters
	Batteries (wet lead acid)	Collected and transported by a licensed contractor for recycling where possible	Up to 50 batteries are expected for the duration of the Project
	Oils and oil contaminated waters - waste oil, oily absorbents, oily rags, oily sludges, sump oils, grease traps	Collected and transported by a licensed contractor for recycling or disposal to regulated waste landfill	Up to 3,000 L per week of waste oil 160 L per week of oily rags and absorbent material
	Rubber – tyres	Collected and transported by a licensed contractor for recycling	Up to 20 tyres per week

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Prefabrication workshop valve assemblies, pipe supports and light structures	Waste materials such as pipe spools, various off cuts and grindings, paint containers, welding waste	Recyclable material to recycling facility (where available) General waste to local licensed landfill	Pipe off cuts and waste steel 0.5 t per week General industrial waste 0.5 t per week
Restoration and rehabilitation (decommissioning of construction camps)	Construction materials, concrete, scrap metal, timber, plastics, plumbing, electrical wiring	On decommissioning any remaining material will be offered to local landowners for reuse or removed for treatment or disposal in accordance with the principles of the waste and resource management hierarchy	Reusable accommodation facilities and relocatable buildings will be retained by Construction Camp subcontractor for use on other projects Waste produced during decommissioning of the construction camps will be re-used or recycled wherever possible

5.1.2 Marine Crossing section

Table 5.4 lists the expected waste types and estimated quantities for the Marine Crossing GTP Project. Each construction worker will be responsible for transporting their recyclable materials and waste to the designated waste storage area located within the construction site pads. The workers will be required to separate their waste into the correct bin as per the bin label.

All waste and recyclable material from the Marine Crossing GTP Project waste storage area located within the construction site pad (mainland) will be collected and transferred by road to the WMRC's depot for further sorting or consolidation with other recyclable material and dispatch to markets or transported direct to the recycling or disposal destination.

All waste and recyclable material from the construction site pad (Curtis Island) will be collected and transferred by barge and then road to the WMRC's depot for further sorting or consolidation with other recyclable material and dispatch to markets or transported direct to the recycling or disposal destination (refer Table 3.1).

All waste and recyclable material from the construction site pad (Curtis Island) will be collected and transferred by barge to Gladstone Port Central and then by road to the WMRC's depot for further sorting or consolidation with other recyclable material and dispatch to markets or transported direct to the licensed recycling or disposal destination. Where logistically more efficient (ie when waste quantities equate to a full hook lift or front lift collection vehicle), general waste may be hauled directly from the Marine Crossing Project waste storage area at construction site pad (mainland) via road to Benaraby Landfill for sorting and appropriate disposal. Recyclable material may be collected and hauled from the Marine Crossing GTP Project waste storage area directly to the recycling service provider's yard for aggregation and dispatch to recycling markets.

Figures 2 and 3 (refer Appendix B) show the location of the Project, the WMRC's depot, construction site pads, proposed waste haulage routes and local waste and sewage disposal facilities. Post construction, the construction site pads and Access Road will be removed and managed as per the control measures listed Table 8.4.

Table 5.4 Waste generated from construction activity – Marine Crossing GTP ROW

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Mobilisation activities			
Delivery of plant and equipment	Packaging (ropes and strapping, cardboard), timber skids, fibre/nylon rope spacers, pallets, metal and plastic drums	General waste to local licensed landfill	Negligible
Weed control	Surplus herbicides and empty chemical containers and other consumables	Recyclable material to recycling facility (where available)	20 m ³ per month of general construction waste during site establishment
Site establishment - Delivery of plant, equipment and portable structures to site (ie vehicles, dongas, portable toilets, vehicle weed washdown facilities at ROW access points, sheet piling retaining walls)	Packaging (ropes and strapping, cardboard), timber skids, wooden crates, fibre/nylon rope spacers, pallets, drums and scrap metals	General waste to local licensed landfill Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	4.5 m ³ per month of metal (recycled)
Construction			
Construction site pads – import of hard standing materials for roadway and hardstand construction	Hard standing materials – gravel fill	Surplus imported clean material will be offered to local landowner for reuse, stored temporarily for use during the construction period, returned to the supplier or removed in accordance with the principles of the waste and resource management hierarchy	No waste materials are expected to be generated
Vehicle weed and mud washdown facilities	Wastewater Sludge	Water is filtered and reused in washdown facility Sludge disposed at local licensed landfill or WWTP	1 m ³ sludge per week per washdown facility

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Clearing and grubbing of the ROW, construction site pads, pipe laydown areas (temporary pipe storage sites) and Access Road (clear and grade)	Green waste (felled vegetation and plant matter) Topsoil and excavated material (stockpiled for backfilling and application to ROW) Installation of temporary fencing and gates (around Site Pads) Construction of access tracks as required Steel post offcuts (from signage installation)	Stockpiled/windrowed vegetation will be reapplied during restoration/rehabilitation of ROW (refer LRMP – document number 3380-GLNG-3-1.3-0037) All topsoil and excavated material reused for backfilling in ROW Any surplus fencing material will be either removed for reuse by the fencing contractor, offered to local landowners for reuse or removed in accordance with the principles of the waste and resource management hierarchy	Included in general waste in mobilisation activities
ROW, access / service roads and string area preparation	Hardstand materials	Surplus materials will be returned to supplier or offered to local landowners for reuse or removed in accordance with the principles of the waste and resource management hierarchy	Nil
TBM shaft construction	Surplus concrete Formwork (for concrete slabs) Damaged sheet piles Excavated material	Surplus concrete, damaged formwork and sheet piles to be treated as per the waste and resource management hierarchy with general waste to local licensed landfill Formwork and sheet piles to be removed from site by the contractor for reuse on other projects Excavated material from the shaft will be stored in the site pad stockpile area for backfilling shaft at completion	No waste materials are expected to be generated
Tunnel boring by TBM	Tunnel and TBM shaft spoil	Tunnel spoil transported by road transport for disposal at proposed location as described in Chapter 2 Project Description of the Marine Crossing EMP. Spoil will need to meet the specific acceptance criteria	83,000 m ³

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
	Oily rags, spent absorbent material from TBM	Licensed contractor to transport regulated waste to a licensed recycling facility and residual material for disposal at a licensed regulated waste landfill	240 L per week
Lining tunnel with concrete segments, grouting and backfilling annulus	Damaged concrete segments Timber strips (packaging between concrete tunnel lining segments for transport) Out of specification grout or stabilised sand Glue/adhesive and empty containers	Concrete to be treated as per the waste and resource management hierarchy with general waste to local licensed landfill Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	12 m ³ per month of general construction waste 4.5 m ³ per month of metal (recycled) 100 m ³ in total of out of specification grout and stabilised sand
Dewatering	Shaft dewatering and tunnel water ingress	Refer to Chapter 15 of the Marine Crossing EMP	Refer to Marine Crossing GTP EMP – document number 3380-GLNG-4-8.2-0021)
Construct pipe laydown areas (temporary pipe storage sites) – grading and levelled, hardstand, berm construction, and fencing where required	Polyethylene sheeting offcuts Cardboard or plastic tubes Plastic wrapping	Surplus clean material will be offered to local landowners for reuse or removed in accordance with the principles of the waste and resource management hierarchy	Included in general waste in pipe construction works
Erosion and sediment control installation and maintenance	Packaging material – cardboard, plastic wrapping, wooden pickets and geofabric sediment fencing Geofabrics "Bidim" A34 grade polyester filter off cuts	Sediment collected in devices stored in the ROW for respreading during rehabilitation works General waste to local licensed landfill	Quantities of waste dependent on climatic, site and topography conditions Included in general waste in mobilisation activities
Trenching and bulk earthworks Foam trench breakers and foam pillows installation	Excavated material Excess Rigid Polyurethane foam (Aptane P220/Isocyanate B900) Spent absorbent material Drums/plastic bags Polypropylene PPE - Protective gloves and disposable overalls PVC conduit off cuts	All non ASS excavated material reused for backfilling in ROW or offered to local landowners for reuse ASS material will be treated and disposed of as per the ASSMP All materials will be treated as per the waste and resource management hierarchy with general waste to local licensed landfill	Included in general waste in pipe construction works

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Delivery of pipe construction materials and consumables to Marine Crossing GTP Project	Neoprene plastic wrapping Nylon rope Rubber matting Packaging – timber dunnage, pallets and crates, plastic wrapping, metal and plastic strapping around consumables Ropes and strapping, cardboard, timber skids, fibre/nylon rope spacers, pallets, drums and scrap metals	Materials to be treated as per the waste and resource management hierarchy with general waste to local licensed landfill	Included in general waste in pipe construction works
<p>Pipeline construction works</p> <ul style="list-style-type: none"> • Pipe stringing and bending • Pipe cutting and trimming • Pipe welding (up to 800 pipes) • Weld sandblasting • Tie-ins (above ground or in-the-trench) • Coating of field joints - application of rust proofing agent required to be applied when pipe is cut and a coating of epoxy-urethane over weld • Holiday detection survey and weld testing • Ducting for fibre optic cable • River/waterway crossings 	PVC or polyethylene pipe end caps (1,500 pipe end caps for pipeline) 42" mild steel pipe off cuts and defective pipe; metal filings (less than 5 metres of pipe for pipeline) Timber skids and sand bags Offcuts – duct for future installation of fibre optic cable Marker tape Chemical containers (ie paint/epoxy coating cans, empty containers of rust proofing agents) Sandblasting grit (GMA Garnet) - Spent grit will contain some metal fragments and paint/ surface coatings (refer Appendix D) Welding residue – welding rod scraps and electrode butts Polypropylene bags Waste cement and concrete Nylon rope	PVC or polyethylene pipe end caps recycled Metal recycled Timber skids and sand bags reused General waste to local licensed landfill Licensed contractor to transport regulated waste to a licensed recycling facility and residual material disposal at a licensed regulated waste landfill "Spent" Sandblasting grit disposed in accordance with Code of environmental compliance (DERM 2009) Spent abrasive (ie spent sandblasting grit) will be tested (eg Toxicity Characteristics Leaching Procedures test) to check whether it requires treatment in an approved hazardous waste treatment facility	15 t in total of pipe end caps 1 t in total steel pipe off cuts and defective pipe 1.5 t in total of metal filings 0.5 t per week of general waste 10 L per week of regulated waste (spent chemicals and chemical container)
Pipe cleaning and gauging Pipe testing – Hydrotesting 48 hour leak test	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material) Hydrostatic test water not treated with biocides, corrosion inhibitor and oxygen scavengers (assuming whole 8.04 km tested - approximately 15,000 m ³ of water required)	Pigging grit - Licensed contractor to transport regulated waste to an licensed regulated waste landfill Hydrotest water released to land (refer Marine Crossing GTP EMP – document number 3380-GLNG-4-8.2-0021)	Up to 4 m ³ pigging grit in total over construction period (assume 0.5 m ³ / km) 15,000 m ³ hydrotest water

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
<p>Infield servicing and maintenance of construction vehicles and equipment</p> <p>Fuel trucks, lubrication trucks and minor maintenance pick-ups provide on-site daily service and perform regular maintenance on plant and equipment</p> <p>Daily field servicing, safety checks and refuelling in the field to be undertaken in the ROW</p>	<p>Oily rags, spent absorbent material infield servicing and maintenance (minor servicing only, no service workshop)</p> <p>Waste oil and greases (eg lube oil, hydraulic oil and engine oil)</p> <p>Spent spill kit materials</p> <p>Packaging from replacement parts</p> <p>End of life vehicle parts (eg fan belts, hoses, other machinery parts)</p> <p>Tyres</p> <p>Batteries</p> <p>Used chemicals – chemicals, used tins from solvents, degreasing agents, lubricants</p> <p>Waste associated with diesel generator operation and maintenance</p>	<p>Licensed contractor to transport regulated waste to a licensed recycling facility</p> <p>Residual material for disposal at a licensed landfill</p>	<p>All wastes generated from infield servicing will be returned to the waste storage area</p> <p>250 kg regulated waste per week</p> <p>1 m³ of waste oil per month</p>
<p>Site offices, crib room/s, site amenities (servicing of construction site amenities)</p>	<p>Office waste – paper, cardboard packaging etc</p> <p>Kitchen waste</p> <p>Rubbish bin waste in facilities (ie paper towels)</p> <p>First aid waste</p> <p>Kitchen and amenity wastewater</p>	<p>Recyclable material to recycling facility (where available)</p> <p>General waste to local licensed landfill</p> <p>Wastewater from crib rooms and amenities will be hauled via vacuum truck and disposed at a local WWTP in Gladstone</p>	<p>Recyclable material 50 kg per week</p> <p>200 kg per week of general waste (approximately one 6 m³ skip bin per week)</p> <p>0.25 m³ of waste paper and cardboard per month</p> <p>20 L wastewater per person per day</p>
<p>Spill clean up</p>	<p>Contaminated soil and absorbent material</p>	<p>Licensed contractor to transport regulated waste to an a licensed recycling facility and residual material for disposal at a licensed regulated waste landfill</p>	<p>10 L per week of regulated waste across Marine Crossing GTP activities</p>
<p>WTP residue</p>	<p>Alum based sludges/filter cake</p>	<p>Residue to local licensed landfill</p> <p>Treated water from WTP is used in grout batching and for other construction activities such as dust suppression (further information will be provided in the WTP Operation Manual)</p>	<p>1 m³ per week</p>

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
ROW rehabilitation			
Construction site pad removal	Gravel, hardstand, concrete foundations, clay material for pond lining	Clean hardstand, gravel and clay material will be offered to local landowners or GRC for reuse or removed for treatment or disposal in accordance with the principles of the waste and resource management hierarchy Surplus concrete to be treated as per the waste and resource management hierarchy if no reuse can be found then will be disposed to local licensed landfill	Approximate 10,000 m ³ from construction site pad (mainland) and 5,000 m ³ from construction site pad (Curtis Island)
<p>Clean up and restoration: reinstatement of the ROW, removal of foreign material (construction material and waste), surface contouring, compaction, respreading topsoil, respreading felled vegetation (whole or mulched) and reseeding</p> <p>Removing any surplus materials, restoring services to their original condition, disposing of refuse, smoothing disturbed earth, removing temporary fills, culverts and bridges, and performing such work as may be necessary to restore ROW to original condition</p> <p>Reinstatement of storage areas and other off ROW areas such as haul roads, spoil storage and other such areas requiring restoration</p>	<p>Recyclable or general waste items listed above</p> <p>Useable surplus pipe will be delivered to a location designated by GLNG Operations</p>	<p>Clean hardstand material will be offered to local landowners or GRC for reuse or removed for treatment or disposal in accordance with the principles of the waste and resource management hierarchy</p> <p>Useable surplus pipe and other reusable materials stored at location designated by GLNG Operations</p> <p>Fencing may be removed from site by the contractor for reuse on other projects</p> <p>Residual material dealt with in accordance with the principles of the waste and resource management hierarchy</p>	<p>20 t timber skids</p> <p>10 t sand bags</p>

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Demobilisation	General construction waste - timber, construction fines (incidental soil), plastic, cardboard, chemical drums, metal	<p>Residual material dealt with in accordance with the principles of the waste and resource management hierarchy</p> <p>General waste to local licensed landfill</p> <p>Licensed contractor to transport regulated waste to an appropriately licensed recycling facility (if available locally) and residual material disposal at appropriately licensed regulated waste landfill</p>	<p>55 m³ per month of general construction waste</p> <p>25 m³ per month of metal (recycled)</p>
Shaft removal	<p>Concrete slabs</p> <p>Sheet piles</p>	<p>Concrete to be treated as per the waste and resource management hierarchy with general waste to local licensed landfill</p> <p>Sheet piles will be removed for reuse by the contractor on other projects</p>	5,000 m ³ concrete
Establishment of vegetation	Plastic pots, wooden stakes, packaging material, surplus herbicides and empty containers	<p>Residual material dealt with in accordance with the principles of the waste and resource management hierarchy</p> <p>General waste to local licensed landfill</p> <p>Unused herbicides will be retained by Weed Control subcontractor for use on other projects</p> <p>Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill</p>	<p>10 kg per week during vegetation establishment activities in the ROW</p> <p>Quantity dependent upon whether herbicides for weed control are required during establishment of vegetation</p>

5.1.3 Curtis Island section

Table 5.5 Waste generated from the Curtis Island section

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Mobilisation activities			
Translocation of plants	Plastic pots Wooden stakes Packaging material	Recyclable material to recycling facility (where available)	Less than 1 m ³ per week of general and recyclable waste during mobilisation activities
Weed control	Surplus herbicides and empty chemical containers and other consumables	General waste to local licensed landfill Unused herbicides will be retained by Weed Control subcontractor for use on other projects	
Delivery of plant, equipment and portable structures to site (ie vehicles, dongas, portable toilets, vehicle weed washdown facilities at ROW access points)	Packaging (ropes and strapping, cardboard), timber skids, wooden crates, fibre/nylon rope spacers, pallets, drums and scrap metals	Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	
Installation of fencing and gates and removal of existing fencing	Damaged fencing, fencing wire off cuts, timber post off cuts Temporary fencing that cannot be reused	Recyclable material to recycling facility (where available) General waste to local licensed landfill	No fences or gates to be installed or removed from the Curtis Island ROW
Construction			
Hard standing - import of hard standing materials for roadway or hardstand construction	Hardstand materials	Surplus clean material will be offered to local landowners for reuse or removed in accordance with the principles of the waste and resource management hierarchy	No waste materials are expected to be generated
Vehicle weed and mud washdown facility	Wastewater Sludge	Water is filtered and reused in washdown facility Sludge disposed at local licensed landfill or WWTP	1 m ³ sludge per week per washdown facility
Clearing and grubbing of ROW, temporary pipe storage sites and access tracks (clear and grade)	Green waste (felled vegetation and plant matter) Topsoil and excavated material (stockpiled for backfilling and application to ROW) Installation of temporary fencing and gates	Stockpiled/windrowed vegetation will be reapplied during restoration/rehabilitation of ROW All topsoil and excavated material reused for backfilling in ROW	Included in general waste in mobilisation activities

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
	Construction of access tracks as required Steel post off cuts (from signage installation)	Any surplus fencing material will be either removed for reuse by the fencing contractor, offered to local landowners for reuse or removed in accordance with the principles of the waste and resource management hierarchy	
Construct of temporary pipe storage sites – grading and levelling, hardstand, berm construction, and fencing where required	Polyethylene sheeting off cuts Cardboard or plastic tubes Plastic wrapping	Minimise surplus clean material in accordance with the principles of the waste and resource management hierarchy	Included in general waste in pipe construction works
Erosion and sediment control installation and maintenance	Packaging material – cardboard, plastic wrapping, wooden pickets and geofabric sediment fencing Geofabrics "Bidim" A34 grade polyester filter off cuts	Sediment collected in devices stored in the ROW for respreading during rehabilitation works General waste to local licensed landfill	Quantities of waste dependent on climatic, site and topography conditions Included in general waste in mobilisation activities
Delivery of pipe construction materials and consumables to the Curtis Island GTP Project	Neoprene plastic wrapping Nylon rope Rubber matting Packaging – timber dunnage, pallets and crates, plastic wrapping, metal and plastic strapping around consumables Ropes and strapping, cardboard, timber skids, fibre /nylon rope spacers, pallets, drums and scrap metals	Materials to be treated as per the waste and resource management hierarchy with general waste to local licensed landfill	Included in general waste in pipe construction works
Pipe construction works <ul style="list-style-type: none"> • Pipe stringing and bending • Pipe cutting and trimming • Pipe welding (up to 1000 m pipe strings) • Weld sandblasting • Tie-ins (above ground or in-the-trench) • Coating of field joints - application of rust proofing agent required to be applied when 	PVC or polyethylene pipe end caps (1,000 pipe end caps for Curtis Island GTP) 42" mild steel pipe off cuts and defective pipe; metal filings(less than 5 m of pipe for Curtis Island GTP) Timber skids and sand bags Off cuts – duct for future installation of fibre optic cable Marker tape Chemical containers (ie paint/epoxy coating cans, empty containers of rust	PVC or polyethylene pipe end caps recycled Metal recycled Timber skids and sand bags reused General waste to local licensed landfill Licensed contractor to transport regulated waste to a licensed recycling facility and residual material disposal at a licensed regulated waste landfill	9.2 t in total of pipe end caps (10 kg per pipe end) 1 t in total of steel pipe off cuts and defective pipe 1 t in total of metal filings General waste 0.5 t per week 10 L per week of regulated waste (spent chemicals and chemical container)

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
<ul style="list-style-type: none"> pipe is cut and a coating of epoxy-urethane over weld Holiday detection survey and weld testing Ducting for fibre optic cable River/waterway crossings 	proofing agents) Sandblasting grit (GMA Garnet) - Spent grit may contain some metal fragments and paint/surface coatings (refer Appendix D) Welding residue – welding rod scraps and electrode butts Polypropylene bags Waste cement and concrete Nylon rope	“Spent” Sandblasting grit disposed in accordance with Code of Environment Compliance (DERM, 2009) Spent abrasive (ie spent sandblasting grit) will be tested (eg Toxicity Characteristics Leaching Procedures test) to check whether it requires treatment in an approved hazardous waste treatment facility	
Trenching and bulk earthworks Foam trench breakers and foam pillows installation	Excavated material Excess Rigid Polyurethane foam (Aptane P220/ Isocyanate B900) and hose washings Spent absorbent material Drums/plastic bags (polypropylene) PPE - protective gloves and disposable overalls PVC conduit off cuts	All excavated material reused for backfilling in ROW to be spread across ROW All materials will be treated as per the waste and resource management hierarchy with general waste disposed to local licensed landfill	Included in general waste in pipe construction works
Pipe cleaning and gauging Pipe testing – hydrotesting 48 hour leak test	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material) Hydrostatic test water not treated with biocides, corrosion inhibitor and oxygen scavengers (assuming 5 km tested at a time (20 kL water required))	Pigging grit - licensed contractor to transport regulated waste to a licensed regulated waste landfill Hydrotest water released to land (refer to Curtis Island GTP EMP – document number 3380-GLNG-3-8.2-0026) (assume no chemical treatment of water is required as source is potable water) (refer DHWLRMP)	2 m ³ pigging grit in total (assume 0.5 m ³ per km) 20 kL water
Infield servicing and maintenance of construction vehicles and equipment Fuel trucks, lubrication trucks and minor maintenance pick-ups provide on-site daily service and perform regular checks on	Oily rags, spent absorbent material infield servicing and maintenance Waste oil and greases eg lube oil, hydraulic oil and engine oil Spent spill kit materials Packaging from replacement parts	Licensed contractor to transport regulated waste to an a licensed recycling facility. Residual material dealt with in accordance with the principles of the waste and resource management hierarchy	All waste generated from infield servicing will be returned to the waste storage area 250 kg regulated waste per week 1 m ³ of waste oil per month

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
equipment Daily field servicing, safety checks and refuelling in the field to be undertaken in the Curtis Island GTP ROW	End of life vehicle parts (eg fan belts, hoses, other machinery parts) Tyres Batteries Used chemicals – chemicals, used tins from solvents, degreasing agents, lubricants Waste associated with diesel generator operation and maintenance		
Site offices, crib room/s, site amenities (servicing of construction site amenities)	Office waste – paper, cardboard packaging Kitchen waste Rubbish bin waste in facilities (ie paper towels) First aid waste Kitchen and amenity wastewater	Recyclable material to recycling facility (where available) General waste to local licensed landfill Wastewater hauled via vacuum truck and disposed at a local WWTP in Gladstone (Calliope River STP)	Recyclable material 50 kg per week 200 kg per week of general waste 20 L wastewater per person per day
Spill clean up	Hydrocarbon contaminated soil (small quantities) Contaminated absorbent material from ROW	Licensed contractor to transport regulated waste to a licensed recycling facility and residual material disposal at a licensed regulated waste landfill	10 L per week of regulated waste across the Curtis Island GTP activities
ROW rehabilitation			
Clean up and restoration: reinstatement of the ROW, removal of foreign material (construction material and waste), surface contouring, compaction, respreading topsoil, respreading felled vegetation (whole or mulched) and reseeding Removing any surplus materials, restoring services to their original condition, disposing of refuse, smoothing disturbed earth, removing temporary fills, culverts and bridges, and performing such work as may be necessary to restore ROW to original condition	Useable surplus pipe will be delivered to a location designated by GLNG Operations	Clean hardstand material will be offered to Gladstone Regional Council for reuse or removed for treatment or disposal in accordance with the principles of the waste and resource management hierarchy Useable surplus line pipe and other reusable materials stored at location designated by GLNG Operations Residual material dealt with in accordance with the principles of the waste and resource management hierarchy	20 t timber skids 10 t sand bags

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Demobilisation	General construction waste - timber, construction fines (incidental soil), plastic, cardboard, chemical drums, metal	Residual material dealt with in accordance with the principles of the waste and resource management hierarchy General waste to local licensed landfill Licensed contractor to transport regulated waste to an appropriately licensed recycling facility (if available locally) and residual material disposal at appropriately licensed regulated waste landfill	55 m ³ per month of general construction waste during demobilisation 25 m ³ per month of metal (recycled)
Establishment of vegetation	Plastic pots Wooden stakes Packaging material Herbicides	Residual material dealt with in accordance with the principles of the waste and resource management hierarchy General waste to local licensed landfill Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	10 kg per week during vegetation establishment activities in the ROW Quantity dependent upon whether herbicides for weed control are required during establishment of vegetation

5.2 Operational waste

A list of the waste types and an estimate of the waste quantities generated from operational activities is detailed in Table 5.6, Table 5.7 and Table 5.8.

Table 5.6 Waste generated from Mainland GTP operations

Mainland GTP operation activity	Waste generated	General management principle	Estimate of waste quantity/rate
Vegetation maintenance of the ROW	Green waste – felled/ trimmed vegetation and plant matter to maintain designated maximum vegetation heights	Green waste is to be chipped/mulched and reapplied to ROW for weed suppression	Nil as reapplied to ROW (quantity dependent upon soil type and weather conditions)
Maintenance of Mainland GTP ROW pipeline valves, delivery and metering stations	Filters (non-oily, oily and gas)	Collected and transported by a licensed contractor for recycling or disposal to regulated waste landfill	Less than 350 kg per year (approximately 0.8 kg/km/year based upon 30 kg per month for entire pipeline)
	Waste oils and greases	Collected and transported by a licensed contractor for recycling where possible	5 m ³ per year (estimate 10 L per km)
	Packaging	General waste for disposal at a licensed landfill	1,500 kg per year (approximately 3.6 kg/km/year based upon 30 kg per week for entire pipeline)
Cleaning of pipeline - pigging (if undertaken in the future)	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material)	Pigging grit - licensed contractor to transport regulated waste to a licensed regulated waste landfill	8 m ³ pigging grit per year (approximately 20 L per km)
Spills of hydrocarbon based material	Potential hydrocarbon contaminated soil from spills oils and greases	Remediation in situ for small quantities. Advice sought from DEHP regarding treatment options for larger spills (eg >200 L). Removal of soil under disposal permit for remediation or disposal at suitably licensed facility	No waste materials are expected be generated
Offices, crib room/s, site amenities along pipeline	Office waste – paper, cardboard packaging Kitchen waste Rubbish bin waste in facilities (ie paper towels) First aid waste Kitchen and amenity wastewater	Recyclable material to recycling facility (where available) Residual material local licensed landfill Wastewater from crib rooms and amenities will be hauled via vacuum truck and disposed at a local WWTP	Recyclable material and general waste very small quantities – less than 30 kg per week Very small quantities of wastewater are expected. Amenities to be serviced weekly when in use

Table 5.7 Waste generated from Marine Crossing GTP operations

Marine Crossing GTP operation activity	Waste generated	General management principle	Estimate of waste quantity/rate²
Vegetation maintenance of the ROW	Green waste – felled/ trimmed vegetation and plant matter to maintain designated maximum vegetation heights	Green waste is to be chipped/mulched and reapplied to ROW for weed suppression	Nil as reapplied to ROW (quantity dependent upon soil type and weather conditions)
Maintenance of Marine Crossing GTP ROW pipeline valves, delivery and metering stations	Filters (non-oily, oily and gas)	Collected and transported by a licensed contractor for recycling or disposal to regulated waste landfill	Less than 10 kg per year (approximately 0.8 kg/km/year based upon 30 kg per month for the GTP)
	Waste oils and greases	Collected and transported by a licensed contractor for recycling where possible	100 L per year (estimate 10 L per km)
	Packaging	General waste for disposal at a licensed landfill	30 kg per year (approximately 3.6 kg/km/year based upon 30 kg per week for entire pipeline)
Cleaning of pipeline - pigging (if undertaken in the future)	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material)	Pigging grit - licensed contractor to transport regulated waste to a licensed regulated waste landfill	200 L of pigging grit per year (approximately 20 L / km)
Spills of hydrocarbon based material	Potential hydrocarbon contaminated soil from spills oils and greases	Remediation in situ for small quantities. Advice sought from DEHP regarding treatment options for larger spills (eg >200 L) Removal of soil under disposal permit for remediation or disposal at suitably licensed facility	No waste materials are expected be generated
Offices, crib room/s, site amenities along pipeline	Office waste – paper, cardboard packaging Kitchen waste Rubbish bin waste in facilities (ie paper towels) First aid waste Kitchen and amenity wastewater	Recyclable material to recycling facility (where available) Residual material local licensed landfill Wastewater from crib rooms and amenities will be hauled via vacuum truck and disposed at a local WWTP	30 kg per year recyclable material and general waste (approximately 3.6 kg/km/year based upon 30 kg per week for entire pipeline) Small quantities of wastewater are expected. Portable amenities to be serviced weekly when in use

² Estimated operational waste quantities are based on proportions

Table 5.8 Waste generated from Curtis Island GTP operations

Curtis Island GTP operation activity	Waste generated	General management principle	Estimate of waste quantity/rate
Vegetation maintenance of the ROW	Green waste – felled/ trimmed vegetation and plant matter to maintain designated maximum vegetation heights	Green waste is to be chipped/mulched and reapplied to ROW for weed suppression	Nil as reapplied to ROW (quantity dependent upon soil type and weather conditions)
Maintenance of Curtis Island GTP ROW pipeline valves, delivery and metering stations	Filters (non-oily, oily and gas)	Collected and transported by a licensed contractor for recycling or disposal to regulated waste landfill	Less than 5 kg per year (approximately 0.8 kg/km/year based upon 30 kg per month for the GTP)
	Waste oils and greases	Collected and transported by a licensed contractor for recycling where possible	50 L per year (estimate 10 L per km)
	Packaging	General waste for disposal at a licensed landfill	20 kg per year (approximately 3.6 kg/km/year based upon 30 kg per week for entire pipeline)
Cleaning of pipeline - pigging (if undertaken in the future)	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material)	Pigging grit - licensed contractor to transport regulated waste to a licensed regulated waste landfill	100 L of pigging grit per year (approximately 20 L / km)
Spills of hydrocarbon based material	Potential hydrocarbon contaminated soil from spills oils and greases	Remediation in situ for small quantities. Advice sought from DEHP regarding treatment options for larger spills (eg >200 L) Removal of soil under disposal permit for remediation or disposal at suitably licensed facility	No waste materials are expected be generated
Offices, crib room/s, site amenities along pipeline	Office waste – paper, cardboard packaging etc Kitchen waste Rubbish bin waste in facilities (ie paper towels etc) First aid waste Kitchen and amenity wastewater	Recyclable material to recycling facility (where available) Residual material local licensed landfill Wastewater from crib rooms and amenities will be hauled via vacuum truck and disposed at a local WWTP	20 kg per year recyclable material and general waste (approximately 3.6 kg/km/year based upon 30 kg per week for entire pipeline) Small quantities of wastewater are expected. Portable amenities to be serviced weekly when in use

5.3 Decommissioning waste

The rehabilitation of the Project disturbance footprint is not expected to generate large volumes of waste. The GTP is expected to be operational for a period of 42 years.

Prior to final decommissioning or abandonment of any facilities associated with the GTP, GLNG Operations will investigate potential environmental issues and impacts associated with decommissioning or abandonment. Infrastructure that is no longer required for the operation of the GTP will be decommissioned or abandoned in accordance with the regulatory requirements and accepted management environmental practice of the day.

Prior to the decommissioning of the GTP, a detailed assessment of the types and quantities of waste materials that could be expected will be conducted.

It is likely that above ground materials such as signs and some fencing would be disposed of in accordance with the principles of the waste and resource management hierarchy.

6. Environmental Values and Potential Impacts

6.1 Environmental values

Existing environmental values that may be impacted by the generation of waste as a result of the Project include:

- Life, health and wellbeing of people and the community
- Diversity of ecology and associated ecosystems
- Land use capability, having regard to economic considerations
- Management of finite resources

The Project will create liquid, solid and gaseous wastes as a result of the construction, operation and decommissioning phases of the GTP ROW. Typical wastes that will be generated include regulated, general, recyclable and inert waste.

The management of waste in accordance with the waste and resource management hierarchy and the relevant State and Commonwealth legislation and standards, will reduce the risk of harm to staff, community and the environment. The potential impacts include the following:

- Water (surface water, marine environment and groundwater) contamination from unsuitable storage, handling, spills and disposal of solid and liquid wastes
- Land contamination from spills during handling and transportation of liquids and solid waste
- Increased occurrences of vermin due to unsuitable storage and handling of putrescible wastes
- Wasteful use of finite resources
- Adverse effects to flora and fauna

6.2 Potential adverse or beneficial impacts associated with waste management

Table 6.1 details the potential impacts of the waste management activities associated with the Mainland GTP, the Marine Crossing GTP and the Curtis Island GTP ROW and associated construction activities. Further details of the existing environmental values of the Project that have the potential to be affected by waste are provided in this WMP (refer Table 6.1).

Table 6.1 Summary of impacts on the environmental values associated with the Project

Aspect/source/activity	Potential impacts
Inappropriate waste management and disposal	Soil, groundwater, surface water contamination, ambient air quality impact, marine environment degradation
Construction camp wastewater disposal	Habitat degradation to wetlands or waterways. Soil, groundwater and surface water contamination; health and safety risks
Disposal of treated wastewater effluent, wastewater and other liquid wastes from project-related sources (eg construction camps, equipment washdown stations)	Reduced water quality (particularly suspended solids/ turbidity, nutrients and microbiological contaminants) with potential reduction in: <ul style="list-style-type: none"> • Suitability of water for drinking • Potential contamination of surface water and/or groundwater
Spillage of oil/fuel/chemical during transport, storage, handling or refuelling	Loss of oil/fuel/other hazardous material to air, surface water, marine environment, groundwater, soil and/or sediment with consequent adverse impacts on associated quality and beneficial values

Aspect/source/activity	Potential impacts
Spillage of hazardous materials during transport, storage, handling and use	Loss of hazardous material to air, surface water, marine environment, groundwater, soil and/or sediment with consequent adverse impacts on associated quality and beneficial values
Tunnel spoil and grout from TBM	Soil, groundwater, marine environment and surface water contamination; health and safety risks
Spill during transfer of liquid and solid waste on/off barge	Release of hazardous material to terrestrial and marine environment resulting in adverse environmental and health effects
Hydrotest water discharge	Accidental release of hydrotest water may impact on, surface water, drinking water, terrestrial and marine aquatic habitat quality, temporary loss of land use for economic use, due to excessive erosion

7. Activity Specific Waste Management Requirements

7.1 Temporary pipe receiving areas

A waste management area will be allocated at the Port Alma temporary pipe receiving area for storage of waste and recyclable material. On an as needs basis, recyclable material and waste will be collected by the WMRC for dispatch to Rockhampton's MRF for recycling and landfill disposal in Rockhampton, respectively.

A waste management area will be allocated at the Gladstone Port Lot 300 temporary pipe receiving area for storage of waste and recyclable material. On an as needs basis, recyclable material and waste will be collected by the WMRC for dispatch to recycling markets and landfill disposal respectively.

7.2 Temporary pipe storage sites

The temporary pipe storage sites will be primarily used for pipe and some equipment storage. Waste materials generated at these locations will be collected and transported daily by the Construction Contractor's personnel for sorting and segregation into the appropriate storage containers or bins at the construction camp waste storage area.

Portable site amenities at these sites will be provided and these will be serviced on a regular basis. Wastewater from the portable amenities will either be hauled to the nearest construction camp wastewater treatment plant for treatment or to a local Council operated WWTP if accepted for disposal by the relevant local authority.

7.3 ROW

All personnel will be responsible for collecting and transporting all solid waste from the ROW daily to the waste and recyclables storage area at the construction camps. A WMRC will be responsible for collecting solid waste and recycling materials from waste and recyclables storage area at the construction camps on a regular basis and transporting the waste materials to the recycling or disposal destination.

Green waste and excavated material will be reused within the ROW during rehabilitation. Steel pipe off cuts, packaging and general waste will be collected by the Construction Contractor's personnel and transported to the construction camp waste storage area at the end of the working day. The Construction Contractor's personnel will sort the ROW waste materials into bins (or containers) for recyclable materials such as metals, cardboard and plastics, regulated waste or general waste. On a regular basis the waste and recyclables from the waste management areas will be transported offsite by the WMRC either for transfer to the WMRC's depot for aggregation with other waste or recyclable materials, or transported to a disposal facility in accordance with the principles of the waste and resource management hierarchy.

7.4 Vehicle wash down facilities

It is anticipated that there will be 11 access points from public roads provided to the GTP ROW. The ROW access points will be located to optimise vehicle movements and to meet the requirements of the PWMP (document number 3380-GLNG-3-1.3-0006).

A vehicle washdown facility will be located at each of these access points for the purpose of removing mud and weed seeds as part of weed management control measures. It is anticipated that on average 1 m³ of mud and silt material will be accumulated in each sump per week.

A licensed WMRC will remove the washdown facility sludge and dispose to an appropriately licensed facility.

7.5 Hydrotesting

The water from hydrotesting will be reused along the length of the GTP to reduce the amount of water to be managed. Given that raw water will be used, it is considered unlikely that any additional chemicals (eg oxygen scavengers or biocides) will be added. If chemicals are used, they will be biodegradable. Chemicals that are unsuitable for release to land will not be used. Hydrotest water will be transferred from one test section to another via a break tank.

The preferred method to dispose of the hydrotest water is to release it directly to land, away from watercourses. All hydrotest water released to land will be tested and will comply with discharge limits as per the Environmental Authority Conditions for the Gas Pipeline – Schedule C, Table 1. Hydrotest water will be tested and managed as described in Section 8 and as per the DHWLRMP. The hydrotest water management procedures will aim to maximise the efficiency of testing, taking into consideration the timing of construction and commissioning, and will follow good environmental practice. Release of hydrotest water to land will only occur where an assessment of water quality meets relevant criteria and relevant approvals have been obtained.

Hydrotest water will be released to land at locations in accordance with the relevant environmental authority conditions. Written consent of the administering authority must be obtained if hydrotest water containing chemical additives is proposed to be released to land.

7.6 Construction camps

The construction camps will generate general putrescible wastes along with recyclables, sewage, grey water and other wastes.

An area at each of the construction camps will be set aside for storage of waste materials which are to be recycled or reused. The waste storage area will receive waste and recyclable material from the:

- Accommodation and kitchen facilities
- Offices
- Vehicle workshop
- Prefabrication workshop
- Warehouse
- ROW and temporary pipe storage sites

All bins will be serviced by the WMRC. Separate bins will be provided for general waste, waste metal, oily waste (rags and absorbent material), batteries, tyres, regulated waste and items for recycling. Likewise an area will be set aside for a bunded waste oil tank.

7.6.1 Wastewater treatment plants in construction camps

Each construction camp will have a wastewater treatment system installed capable of treating the maximum amount of effluent generated from the construction camp and associated workshops and offices.

Emphasis will be placed on the reduction and re-use of effluent onsite. Each construction camp will adopt the principles of the waste and resource management hierarchy to minimise the wastewater quantities generated (where possible) through education and adoption of water efficient equipment and machinery.

Wastewater collection systems will segregate the wastes. Sanitary waste from various sources will be directed to a wastewater treatment plant. Once the wastewater has been treated to the relevant effluent standard, it will be used for irrigation or disposed of to a licensed facility. If the effluent is to be irrigated to land a disposal system will consist of a fenced (sediment fencing and bund), vegetated area, where treated effluent will be irrigated above-ground. Sludge from wastewater treatment facilities will be removed as required to a licensed facility.

7.7 Tunnel boring

Tunnel boring waste includes tunnel spoil and out of specification grout and TBM waste includes oily wastes. A waste storage area at the construction site pad (mainland) and construction site pad (Curtis Island) will be provided for storage of general waste and any regulated waste.

Tunnel spoil will be temporarily stored in an area located in the construction site pad and periodically transported by road for re-use on another site as rehabilitation material in accordance with the relevant site's acceptance criteria as per their environmental approval. Prior to transfer to the reuse site, samples of tunnel spoil will be collected and submitted for laboratory analysis to confirm whether the tunnel spoil complies with the site's approval conditions.

7.8 Transport of project related waste

Traffic movements associated with the WMRC's vehicles have been addressed in the Road Use Management Plan (RUMP).

Waste and recyclable materials will be moved on a daily basis from all construction accommodation camps during the construction phase.. Waste materials will be transported by Saipem personnel from the point of generation on the ROW and transported to the closest waste storage areas located within the construction camps.

During operation waste and recyclable materials will be removed on a daily basis by GLNG Operations personnel and transported to the relevant waste storage area within GLNG's depot and holding yard.

From there the waste material will be consolidated prior to collection for recycling or disposal. The existing network of state and regional council controlled roads, as well as the ROW will be used by waste collection vehicles to collect and transport the waste and recyclables.

The WMRC will identify and confirm the proposed haulage routes (refer Figures 1, 2 and 3) and potential issues associated the collection and haulage of waste and recyclable materials. Haulage route and site access procedures will be prepared and implemented by the

Construction Contractor in order to minimise impacts, the procedures will be developed with regard to the Project's RUMP. This plan will also detail the proposed destinations for the waste and recyclable materials. All waste vehicles travelling to and from the Project sites will follow dedicated heavy vehicle routes to avoid built-up areas. The WMRC, where practicable, will limit vehicle movements to daytime working hours.

Waste deemed as regulated or dangerous will be transported along preferred routes in accordance with the *Australian Code for the Transport of Dangerous Goods by Road and Rail*, and in accordance with the *Queensland Transport Operations (Road Use Management – Dangerous Goods) Regulation 1998* and the *Transport Infrastructure Act 1994* and the EP Reg.

7.8.1 Waste tracking

Regulated waste which is transported by road and barge is required to be accompanied by a Waste Transport Certificate stating the nature of the waste and any associated hazard in accordance with the EP (WM) Reg. A licensed WMRC will collect and transport the Project waste. The following requirements will be implemented for the Project waste-tracking system:

- Provide tracking of wastes of environmental concern from production to disposal, with the aim of ensuring that Project waste is disposed in an environmentally appropriate manner
- Ensure that only those licensed facilities that have adequate treatment and disposal methods receive wastes
- Promote responsibility to reduce the risk of illegal dumping and establish a system of accountability

The types of trackable wastes and instructions for completing the Waste Transport Certificate are outlined in the EP (WM) Reg.

7.8.2 Non-trackable waste

Non-trackable waste associated with GTP Project will be identified and basic waste shipment information will be recorded for the purpose of recording project waste quantities and monitoring compliance with this WMP.

This information will be stored by the WMRC for the purposes of recording Project waste quantities and monitoring compliance with this WMP. Table 7.1 provides an example of a waste shipment record for non-regulated/non-trackable waste shipments.

Table 7.1 Example of waste shipment record

Information to be recorded on each waste shipment	
Type of waste	
Date waste collected	
Quantity of waste (L, kg, number of bags, size of container)	
Waste transportation certificate number (only if trackable waste)	
Waste collection contractor name	
Vehicle driver name	
Vehicle transporting waste from project site	
Destination of waste	

Information to be recorded on each waste shipment

Recipient names (company or site)	
Other details or comments	
Transporters signature	

7.9 Waste inductions and training

All construction personnel associated with the Project will be required to complete an induction. The induction training should incorporate relevant aspects of this WMP and cover an individual's personal obligations with regard to the management procedures for all waste items and materials. This training will outline the importance of managing waste materials in accordance the principles of the waste and resource management hierarchy. A list of employees and dates that training was provided will be recorded for the purpose of demonstrating Project training compliance with this WMP.

7.10 Waste chemical and hazardous materials management

The Project will require the use of chemicals and hazardous materials and will therefore generate waste chemicals and hazardous waste.

Chemical and hazardous wastes associated with the Project will be handled and stored in accordance with the State and Commonwealth legislation (refer Table 2.1) and Australian standards and guidelines (refer Table 2.2). This will include the separate storage of waste chemicals in containers at designated storage areas within construction camps, construction site pads and GLNG Operation's depot . Table 7.2 provides a list of likely chemicals and hazardous materials to be used during the Project construction phase including relevant activity and likely storage location.

Table 7.2 Likely chemical and hazardous materials during construction

Chemical/hazardous material	Activity	Likely storage location
Diesel	Fuel for construction vehicles and machinery and diesel generators at construction camps and offices	Storage tanks located at construction camps Up to a total storage capacity 90,000 L at each construction camp (3 x T30 fuel tanks (30,000 L each))
	Fuel for tunnel boring machine generator and associated equipment	Construction site pad (mainland) and construction site pad (Curtis Island)
Fuel dispenser pump and storage (gasoline) Fuel dispenser pump and storage (diesel)	Fuelling facilities for vehicles at the Marine Crossing GTP section and the Curtis Island GTP section	Diesel and petrol fuel storage on the construction site pad (mainland) and construction site pad (Curtis Island)
Fertiliser	Translocation of plants and restoration of the ROW	Construction camps storage area and Gladstone
Herbicides (chemicals registered for the specific weed to be controlled)	Chemical spraying of weeds	Brought to site by Weed Control Contractor only during weed control activities
Rigid Polyurethane foam (Aptane P220/Isocyanate B900)	Foam trench breakers and foam pillow installation – to hold the pipe off the trench invert (alternative material - sand bags)	Specialist subcontractors will be engaged to mobilise foam components to site in storage

Chemical/hazardous material	Activity	Likely storage location
		containers on vehicles. Subcontractors will provide the Construction Contractor and the WMRC with documentation regarding storage, handling and disposal arrangements prior to bringing to site
Oils and greases	In field vehicle servicing and maintenance of construction vehicles and equipment Major Note: major repair and maintenance of construction equipment will occur at the Preventative Vehicle Maintenance workshop at the temporary maintenance workshop at each of the construction camps. HDD	Construction camp and Gladstone Logistic Base Designated storage area in suitably sized tanks within appropriately bunded compounds as per AS1940 at the construction camps and Marine Crossing GTP Project construction site pads (mainland and Curtis Island) HDD drilling pad
Waste oil	Minor repairs and maintenance of construction equipment during infield servicing and maintenance – minor servicing only at the ROW. Other servicing at the Preventative Vehicle Maintenance workshop within the construction camps and Gladstone Logistic Base	All waste oils will be collected and stored within appropriately sized bunded storage containers within construction camps, construction site pad (mainland) and construction site pad (Curtis Island)
Emulite (bottom charge)	Blasting	Specialist subcontractors will be engaged to mobilise blasting materials to site. Handling, storage requirements and disposal methods to be documented by the blasting contractor ie AS 2187
Prillite (column charge)	Blasting	Specialist subcontractors will be engaged to mobilise blasting materials to site. Handling, storage requirements and disposal methods to be documented by the blasting contractor ie AS 2187
Nonel U175 or U500 detonators, Nonel UB,42 UB17, UB25	Painting welds and pipe coating defects	Specialist subcontractors will be engaged to mobilise blasting materials to site. Handling, storage requirements and disposal methods to be documented by the blasting contractor ie AS 2187
Paint		Hazardous materials storage area at the construction camps, construction site pad (mainland) and construction site pad (Curtis Island)/Gladstone Logistic Base Storage area at construction camps/Gladstone Logistic Base Storage area at construction camps/Gladstone Logistic Base

Chemical/hazardous material	Activity	Likely storage location
		<p>Storage area at construction camps/Gladstone Logistic Base</p> <p>Storage area at construction camps/Gladstone Logistic Base</p> <p>Contained in pipe crawler machine. Pipe crawler located (ROW) or parked in equipment storage area at the construction camp/Gladstone Logistic Base</p> <p>Specialist subcontractor will maintain documentation and certificates to transport these materials to site and be responsible for handling, storage requirements and identification of disposal methods</p> <p>Darkroom, containing the necessary film processing equipment, will be located at the construction camps/Gladstone Logistic Base</p> <p>Specialist subcontractor will maintain documentation and certificates to transport these materials to site and be responsible for handling, storage requirements and identification of disposal methods</p>
Fusion bond epoxy powder	Coating for welded field joints	Hazardous materials storage area at the construction camps, construction site pad (mainland) and construction site pad (Curtis Island)
Polyurethane-tar coating compound	Field joint coating	
Oxygen scavenger	Chemical dosing during Hydrotesting	Construction site pads in secure containers as per Australian Standards
Biocide Radioactive isotope/ material/ element within weld inspection device (pipe crawler)	Hydrotesting Weld inspection activities Non-destructive testing (NDT) X-ray films development for weld quality assurance	
Drilling additives - polymers	Tunnel spoil	
Water treatment chemicals – aluminium sulphate, sulphuric acid	WTP	Hazardous materials storage at the construction site pad (mainland)
Lime	ASS treatment	Hazardous materials storage at the construction site pad (mainland)

Table 7.3 provides a list of likely chemicals and hazardous materials to be stored and used during the operation of the GTP, along with the relevant activity and proposed storage location.

Table 7.3 Likely chemical and hazardous materials during operation

Chemical/hazardous material	Activity	Likely storage location
Lubricants	Maintenance of mainline valve stations	GLNG Operations headquarters in Gladstone
Solvents	Cleaning pigging equipment and sumps	
Oils and greases	Maintenance of equipment for pipeline maintenance	

8. Proposed environmental protection commitments, objectives and control strategies

Waste material generated as a result of the Project construction and operation activities will be managed in accordance with the principles of the waste and resource management hierarchy as described in Section 3.2 and in accordance with the Queensland Waste Reduction and Recycling Strategy 2010 – 2020 (DERM, 2010).

The following environmental protection commitments, objectives and control measures for each aspect of the Project have been described for the following areas:

- Waste management
- Hydrotest water
- Chemicals and hazardous materials

8.1 Waste management – Mainland GTP and Curtis Island GTP

Table 8.1 details the environmental protection objectives, control strategies and performance indicators for the waste management objectives detailed in Section 6 above.

8.1.1 Waste management

Table 8.1 Environmental protection commitments, objectives and control strategies for general waste

Item	Detail
Environmental protection objective	<ul style="list-style-type: none"> • The GTP construction adheres to the waste management hierarchy of avoid, reuse, re-use and recycle. Where this is not possible, waste is disposed of in the most appropriate manner
Specific objectives	<ul style="list-style-type: none"> • No inappropriate disposal or management of waste • No contamination of soil, air or water as a result of waste handling • Petroleum activities do not result in the release or likely release of contaminants to the environment from the storage, conditioning, treatment and disposal of regulated waste materials
Control strategies	<p>General</p> <ul style="list-style-type: none"> • Prior to commencement of works, the appropriate methods for disposal of waste will be determined by consultation with the relevant administrating authorities and DEHP • A waste management plan in accordance with the WRR Act will be implemented including: <ul style="list-style-type: none"> – The types and amounts of waste generated – How the waste will be dealt with, including a description of the types and amounts of waste that will be dealt with under each of the waste management practices mentioned in the waste management hierarchy (Section 9 of the WRR Act) – Procedures for dealing with accidents, spills and other incidents that may impact on waste management – How often the performance of the waste management practices will be assessed (ie at least annually) – The indicators or other criteria on which the performance of the waste management practices will be assessed • On completion of each section of pipeline, all waste material will be removed from the workplace. No wastes will be buried or disposed of on-site without local government and/or DEHP approval • The Construction Contractor will advise designated disposal areas for each section of the ROW

Item	Detail																																								
	<ul style="list-style-type: none"> • All welding waste will be managed appropriately and removed from the GTP Project area on a daily basis • General waste will be collected and transported generally to local council approved disposal sites • Food wastes will be collected, where practicable, considering health and hygiene issues, for disposal off-site • All waste/rubbish will be correctly disposed of and will not pose a risk to marine fauna. Plastic bags will be banned from all site offices and project areas within the coastal zone (intertidal and marine zones) • Refuse containers will be located at each worksite • Where practical, wastes will be segregated and reused / recycled (eg scrap metal) • All personnel will be instructed in project waste management practices and procedures as a component of the environmental induction process • Suppliers will be requested to minimise packaging where practicable • Emphasis will be placed on housekeeping and all work areas will be maintained in a neat and orderly manner • All equipment and facilities will be maintained in a clean and safe condition <p>Liquid waste</p> <ul style="list-style-type: none"> • Wastewater from construction, cleaning and testing operations will be treated and managed in accordance with the relevant environmental authorities • Sewage or grey water will either be collected for treatment and disposal off-site or treated via an on-site treatment system and disposed of to effluent absorption beds or irrigation fields, with treated sewage effluent generally to be disposed of by irrigation • The treatment method will be selected in consultation with a relevant local authority and DEHP and the relevant environmental authority obtained • Prior to commencement of works, the Construction Contractor must determine from all relevant local governments, any additional upgrades of sewerage or waste disposal facilities required as a result of this project's requirements for workers' accommodation and meet any costs associated with these upgrades • Prior to discharge of wastewater to land, the Contractor must submit a copy of the Wastewater Irrigation Management Plan (WIMP) to GLNG Operations within a sufficient timeframe to obtain approval from the administering authority allowing for review and comment and having due regard to that comment in the finalisation of the plan • The release of contaminants from the sewage treatment plant to land must comply, at the sampling and in situ monitoring point(s) with each of the limits specified in Table 1 for each quality characteristic <p>Table 1 Release quality characteristics for discharge to land</p> <table border="1"> <thead> <tr> <th>Quality characteristics</th> <th>Release limit</th> <th>Limit type</th> <th>Monitoring frequency</th> </tr> </thead> <tbody> <tr> <td>Total-N</td> <td>3 mg/l</td> <td>50 percentile Compliance</td> <td>Weekly</td> </tr> <tr> <td>Total-N</td> <td>10 mg/l</td> <td>Maximum</td> <td>Weekly</td> </tr> <tr> <td>Total-P</td> <td>0.1 mg/l</td> <td>50 percentile Compliance</td> <td>Weekly</td> </tr> <tr> <td>Total-P</td> <td>1 mg/l</td> <td>Maximum</td> <td>Weekly</td> </tr> <tr> <td>Ammonia-N</td> <td>1 mg/l</td> <td>50 percentile Compliance</td> <td>Weekly</td> </tr> <tr> <td>5-day Biochemical Oxygen Demand</td> <td><5 mg/l</td> <td>80 percentile Compliance</td> <td>Weekly</td> </tr> <tr> <td>Suspended Solids</td> <td><5 mg/l</td> <td>80 percentile Compliance</td> <td>Weekly</td> </tr> <tr> <td>pH</td> <td>6.5 – 8.0</td> <td>Range</td> <td>Daily</td> </tr> <tr> <td>Faecal Coliforms</td> <td>5 colonies per 100 ml sample</td> <td>Geometric Mean</td> <td>Weekly</td> </tr> </tbody> </table>	Quality characteristics	Release limit	Limit type	Monitoring frequency	Total-N	3 mg/l	50 percentile Compliance	Weekly	Total-N	10 mg/l	Maximum	Weekly	Total-P	0.1 mg/l	50 percentile Compliance	Weekly	Total-P	1 mg/l	Maximum	Weekly	Ammonia-N	1 mg/l	50 percentile Compliance	Weekly	5-day Biochemical Oxygen Demand	<5 mg/l	80 percentile Compliance	Weekly	Suspended Solids	<5 mg/l	80 percentile Compliance	Weekly	pH	6.5 – 8.0	Range	Daily	Faecal Coliforms	5 colonies per 100 ml sample	Geometric Mean	Weekly
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Faecal Coliforms	5 colonies per 100 ml sample	Geometric Mean	Weekly																																						

Item	Detail
	<ul style="list-style-type: none"> • The effluent released must not have any properties nor contain any organisms or contaminants in concentrations which are capable of causing environmental harm or an environmental nuisance • Signage must be placed around the land irrigation area and irrigation equipment warning the public that the area and equipment has been set aside for irrigation by treated effluent, which is not to be used for drinking purposes. The signs must be maintained in a visible and legible condition • Any treated effluent irrigation area must not be used for: <ul style="list-style-type: none"> – Recreational activities or as a traffic thoroughfare during irrigation – Any activity which may involve members of the public or employees without appropriate personal protective equipment coming in contact with treated wastewater during irrigation periods and for at least four hours after irrigation has ceased or until irrigated vegetation has dried • Sufficient wet weather storage should be provided for a 3 month period • When weather conditions or soil conditions preclude the irrigation of treated effluent, the treated effluent must only be discharged at nomination locations as per environmental authority • Treated sewage effluent must not be irrigated when weather or soil conditions would cause run-off or ponding of any irrigated wastewater • The amount of treated sewage effluent irrigated must be matched to the water requirements of the vegetation irrigated, without exceeding a reasonable estimation of the field capacity of the soil, in the root zone, in the irrigation area • The rate of application of treated sewage effluent to the release area must not exceed the capacity of the soil in the contaminant release area to absorb it • The irrigation of treated effluent must be carried out with a sufficient buffer distance to comply with all environmental conditions and requirements (eg contaminants release, Air quality) • Treated effluent will not be released to other parties for irrigation without written permission from GLNG Operations. The quality of the treated effluent released to other parties for the purpose of irrigation must comply, at the sampling point specified, with each of the release limits specified in Table 2 • Copies of agreements to supply treated sewage effluent from the Sewage Treatment Plant for the purpose of irrigation must be forwarded to GLNG Operations in a sufficient timeframe to be approved by administering authority • The Contractor must prepare a Wastewater Irrigation Management Plan (WIMP) as part of the EMP. The WIMP is to be developed in accordance with the “Interim Guidelines for the Reuse of Reclaimed Wastewater in Queensland, 1996” produced by the Department of Natural Resources or the “Draft National Guidelines for Sewerage Systems: Reclaimed Water” endorsed by National Health and Medical Research Council (NHMRC) in 2000. The WIMP should address at least, but not be limited to, the following matters: <ul style="list-style-type: none"> – The measurement of the quantity and quality of treated effluent produced by the activity – An assessment of the suitability of the area of land available for wastewater irrigation – The definition and clear identification of areas to be used for wastewater irrigation – Carrying out daily time step modelling (using MEDLI or similar) to estimate at least wastewater irrigation application rates, the wastewater irrigation area required and the volume of wet weather storage required, taking into account at local tropical climatic conditions, soils in the wastewater irrigation area and the vegetation grown in the wastewater irrigation area – An assessment of surface waters, including stormwater, that may be affected – An assessment of the characteristics of the soils in the wastewater irrigation area including assessment of nutrient and salt levels of the soils in the disposal area and how soils will be managed – An assessment of the potential impacts of odour resulting from wastewater irrigation – Management of human and fauna health issues associated with the irrigation of

Item	Detail
	<p>wastewater</p> <ul style="list-style-type: none"> • Sewage treatment plants associated with temporary workers' accommodation must be located above Q50 flood levels • The plant and equipment used for sewage treatment or disposal will be installed, maintained and operated in a proper and efficient manner by a suitably qualified and experienced person • Sewage effluent absorption beds and/or irrigation fields will be selected and designed to ensure that: <ul style="list-style-type: none"> – Sensitive areas are avoided – Soil erosion and soil structure damage is avoided to the extent possible – There is no ponding or runoff of effluent – The receiving environment has the capacity to assimilate the contaminants – There will be no discharge of treated effluent from wet weather storage to any waters • Flammable and combustible liquids (including petroleum products and associated piping and infrastructure), must be stored, handled and maintained in accordance with the latest edition of Australian Standard 1940 - the Storage and Handling of Flammable and Combustible Liquids • Any liquids stored on site that have the potential to cause environmental harm must be stored in or serviced by an effective containment system that is impervious to the materials stored and managed to prevent the release of liquids to waters or land. Where no relevant Australian Standard is available, the following must be applied: <ul style="list-style-type: none"> – Storage tanks must be bunded so that the capacity and construction of the bund is sufficient to contain at least 110 % of a single storage tank or 100 % of the largest storage tank plus 10 % of the second largest storage tank in multiple storage areas – Drum storages must be bunded so that the capacity and construction of the bund is sufficient to contain at least 25 % of the maximum design storage volume within the bund <p>Hazardous waste</p> <ul style="list-style-type: none"> • Chemical wastes will be collected in 200 L drums (or similar sealed container) and appropriately labelled for safe transport to an approved chemical waste depot or collection by a liquid waste treatment service • Storage, transport and handling of all chemicals will be conducted in accordance with all legislative requirements • Containment bunds and/or sumps will be drained periodically to prevent overflow and subsequent pollution of the surrounding land and/or water body • All hazardous wastes will be appropriately stored in bunded areas away from watercourses and in accordance with legislative requirements • Where no Australian Standard is available, any liquid with potential to harm the environment will be: <ul style="list-style-type: none"> – Stored in impervious bunded tanks with bunded capacity at least 110% of a single storage tank or 100% of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas – Impervious drum storage must have a bunded capacity to contain at least 25% of the maximum design storage volume within the bund • Hazardous wastes, such as solvents, rust proofing agents and primers will be managed in accordance with the requirements of relevant legislation and industry standards • A hazardous materials inventory will be prepared • Material Safety Data Sheets (MSDS) for hazardous materials will be available at all work sites • Hydrocarbon wastes, including lube oils, will be collected for safe transport off-site for reuse, recycling, treatment or disposal at approved locations

Item	Detail
	<ul style="list-style-type: none"> • As soon as practicable remove and dispose of all regulated waste to a licensed waste disposal facility or recycling facility • All regulated waste removed from the site must be removed by a person who holds a current authority to transport such waste under the provisions of the EP Act and sent to a facility licensed to accept such waste • When regulated waste is removed from within the boundary of the petroleum tenure and transported by the holder of this authority, a record must be kept of the following: <ul style="list-style-type: none"> – Date of waste transport – Quantity of waste removed and transported – Type of waste removed and transported – Route selected for transport of waste – Quantity of waste delivered – Any incidents (eg spillage) that may have occurred on route • If a person removes regulated waste associated with activities within the operational land and disposes of such waste in a manner which is not authorised or is improper or unlawful then, as soon as practicable, the administering authority will be notified of all relevant facts, matters and circumstances known concerning the disposal • If a hazardous contaminant is released to waters or land the following steps must be taken: <ul style="list-style-type: none"> – Take immediate action to stop any further release and make sure that the area is safe – Take immediate action to contain the hazardous contaminant to the affected area, taking particular care to protect environmentally sensitive areas – Restore or rehabilitate the environment to its condition before the release occurred; and take necessary action to prevent a recurrence of the release – Ensure that all health risks associated with the disposal and reuse of treated sewerage is mitigated through appropriate primary and secondary treatment
Performance indicators	<ul style="list-style-type: none"> • No inappropriate disposal or management of waste • No contamination of soil, air or water as a result of waste handling

8.1.2 Hydrotest water

Table 8.2 details the environmental protection objectives, control strategies, monitoring and reporting requirements for the management of hydrotest water.

Table 8.2 Environmental protection commitments, objectives and control strategies for hydrotesting

Item	Detail
Environmental protection objective	<ul style="list-style-type: none"> The quality of local land and water resources during pipeline hydrotesting is protected
Specific objectives	<ul style="list-style-type: none"> Appropriate permits obtained prior to drawing water No existing water sources unsustainably depleted to provide hydrotesting water No adverse impacts on soil or surface water as the result of discharging hydrotesting water
Control strategies	<ul style="list-style-type: none"> Relevant permits to draw water obtained Hydrotest water will be re-used on multiple and adjacent pipeline sections as much as possible to reduce actual volumes used Pipe sections crossing water bodies will be tested prior to installation Inspection of all pipeline section welds, or hydrotesting of pipeline sections before installation under water bodies, will be performed in accordance with construction specifications/procedures Biocides, where required, will be biodegradable Where biocides are added, discharge water will be aerated <ul style="list-style-type: none"> The Contractor will prepare a (DHWLRMP prior to commencement of construction works for the Project. The HWMP will include: <ul style="list-style-type: none"> A detailed assessment of impacts from hydrostatic test water along the pipeline route including source water quality data and characteristics of additives, particularly biocides Proposed storage, treatment and disposal methods of hydrotest water Site specific mitigation measures for management of hydrotest water including monitoring and reporting Determination of whether testing of the hydrotest water is necessary and submit a plan for review to GLNG Operations. Where the water source and water quality is known, and no chemicals have been added, water quality testing may not be required Hydrostatic test water, including a detailed assessment of impacts from hydrostatic test water along the pipeline route, will be provided. Source water quality data and characteristics of additives, (particularly biocides) will be provided along with the proposed storage, treatment and disposal methods. The information will be used to determine the site specific mitigation measures including monitoring and reporting Hydrotest water will be treated as necessary and then disposed of such that it does not enter into any watercourses or run in an uncontrolled manner onto open land. Where water cannot be discharged to ground, other options will be considered to ensure compliance with all regulations Hydrotest water will be released at least 100 m from any watercourse such that vegetation and soil structure are not damaged or eroded and the quality of groundwater is not adversely impacted Discharge of hydrotesting water will comply with all regulatory and landholder requirements Where hydrostatic test water is proposed to be released to land, it will not exceed the water quality limits specified in Table 1: Water Quality Limits. Hydrostatic test water containing chemical additives must not be released to land without written consent from GLNG Operations and the administering authority

Item	Detail	
	Table 1 Water quality limits	
	Parameter	Maximum value
	pH	6.5-8.5 (Range)
	Arsenic (mg/L)	2.0
	Cadmium (mg/L)	0.05
	Chromium (mg/L)	1
	Copper (mg/L)	5
	Iron (mg/L)	10
	Lead (mg/L)	5
	Manganese	10
	Zinc (mg/L)	5
	Nitrogen (mg/L)	35
	Phosphorus (mg/L)	10
Electrical Conductivity (uS/cm)	2000	
Performance indicators	<ul style="list-style-type: none"> • Appropriate permits are obtained prior to drawing water • No existing water sources unsustainably depleted to provide hydrotesting water • No adverse impacts on soil or surface water as the result of discharging hydrotesting water 	

8.1.3 Chemical and hazardous materials

Table 8.3 Environmental protection commitments, objectives and control strategies for chemical and hazardous materials management

Item	Detail
Operational policy or management objective	<ul style="list-style-type: none"> • Storage and handling of chemicals and dangerous goods does not cause environmental harm or harm to persons
Performance criteria	<ul style="list-style-type: none"> • Petroleum activities do not result in the release or likely release of a hazardous contaminant to the environment • Storage and handling procedures correct and appropriate • Chemicals stored in secure areas • All containment systems must be designed to minimise rainfall collection within the system
Control strategies	<ul style="list-style-type: none"> • Spill control procedures will be prepared and personnel trained • Dangerous goods will be stored and handled as per the requirements of relevant Australian Standards • Areas where contaminants or wastes are stored or handled will be minimised or roofed • Dangerous goods will, where appropriate (eg outside locations), be stored in bunded areas away from watercourses • Stormwater will be diverted around disturbed areas and areas where contaminants or wastes are stored or handled • All explosives, hazardous chemicals, corrosive substances, toxic substances, gases and dangerous goods must be stored and handled in accordance with the relevant Australian Standard • Explosives will be stored in magazines constructed and located as prescribed in AS 2187

Item	Detail
	<ul style="list-style-type: none"> • Where no Australian Standard is available, any liquid with potential to harm the environment will be <ul style="list-style-type: none"> – Stored in impervious bunded tanks with bunded capacity at least 110% of a single storage tank or 100% of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas – Impervious drum storage must have a bunded capacity to contain at least 25% of the maximum design storage volume within the bund • Stormwater runoff and rainfall events will be collected, treated, reused or released in accordance with environmental and legal requirements • Material safety data sheets for chemicals and dangerous goods will be available on-site • Waste dangerous goods, which cannot be recycled, will be transported to a designated disposal site as approved by the local authority • Any spillage of hazardous waste or other contaminants that may cause environmental harm, will be effectively contained and cleaned up as quickly as practicable. Such spillage must not be cleaned up by hosing, or otherwise thereby releasing such waste or contaminants to any land or waters • Spillages must be cleaned up using dry methods that minimise the release of wastes, contaminants or materials to any stormwater drainage system, roadside gutter or waters • Spills of dangerous goods will be rendered harmless and collected for treatment and disposal at a designated site, including cleaning materials, absorbents and contaminated soils • Hydrocarbon spillage from storage areas, diesel and chemical spills from construction equipment, and industrial waste spill will be contained, reported, and treated/remediated in accordance with appropriate legislative and regulatory agency requirements. Drainage will be reinstated • Absorbent and containment material (eg absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use • Protective clothing, appropriate to the materials in use, will be provided • Relevant permits will be held and conditions of permits met • Servicing of equipment/machinery will not be permitted on the ROW without prior authorisation from GLNG Operations. All planned services for all equipment is to occur in an approved workshop
Performance indicators	<ul style="list-style-type: none"> • No hazardous goods contamination of the environment • Storage and handling procedures are correct and appropriate • Chemicals are stored in secure areas • All containment systems are designed to minimise rainfall collection within the system

8.2 Waste management control strategies – Marine Crossing GTP

Table 8.4 details the environmental protection objectives, strategies, monitoring and reporting requirements for the management of construction waste.

8.2.1 Waste management

Table 8.4 Environmental protection commitments, objectives and control strategies for general waste

Item	Outcomes
Environmental protection objective	<ul style="list-style-type: none"> • The Marine Crossing GTP construction adheres to the waste management hierarchy of avoid, reuse, re-use and recycle. Where this is not possible, waste is disposed of in the most appropriate manner
Specific objectives	<ul style="list-style-type: none"> • No inappropriate disposal or management of waste • No contamination of soil, air or water as a result of waste handling • Petroleum activities do not result in the release or likely release of contaminants to the environment from the storage, conditioning, treatment and disposal of regulated waste materials
Control strategies	<p>General</p> <ul style="list-style-type: none"> • Prior to commencement of works, the appropriate methods for disposal of waste will be determined by consultation with the relevant administering authorities and DEHP • A WMP (this plan) has been developed in accordance with the WRR Act and will be implemented. The WMP includes: <ul style="list-style-type: none"> ○ The types and amounts of waste generated ○ How the waste will be dealt with, including a description of the types and amounts of waste that will be dealt with under each of the waste management practices mentioned in the waste and resource management hierarchy (Section 9 of the WRR Act) ○ Procedures for dealing with accidents, spills and other incidents that may impact on waste management ○ How often the performance of the waste management practices will be assessed (ie at least annually) ○ The indicators or other criteria on which the performance of the waste management practices will be assessed • On completion of each section of pipeline, all waste material will be removed from the workplace. No wastes will be buried or disposed of onsite • The Construction Contractor will advise designated disposal areas for each section of the ROW • All welding waste will be managed appropriately and removed from the Marine Crossing GTP Project area on an as required basis • General waste will be collected and transported to local council approved disposal sites • Food wastes will be collected, where practicable, considering health and hygiene issues, for disposal off-site • Refuse containers will be located at each worksite • Where practical, wastes will be segregated and reused / recycled (eg scrap metal) • All personnel will be instructed in project waste management practices and procedures

Item	Outcomes
	<p>as a component of the environmental induction process</p> <ul style="list-style-type: none"> • Suppliers will be requested to minimise packaging where practicable • Emphasis will be placed on housekeeping and all work areas will be maintained in a neat and orderly manner • All equipment and facilities will be maintained in a clean and safe condition • All waste/rubbish will be correctly disposed of and will not pose a risk to marine fauna • Plastic bags will be banned from all site offices and project areas within the coastal zone (intertidal and marine zones) <p>Liquid Waste</p> <ul style="list-style-type: none"> • Wastewater from construction, cleaning and testing operations will be treated and managed in accordance with the relevant environmental authorities • The treatment method will be selected in consultation with a relevant local authority and DEHP and the relevant environmental authority obtained • Flammable and combustible liquids (including petroleum products and associated piping and infrastructure), must be stored, handled and maintained in accordance with AS1940 • Any liquids stored on site that have the potential to cause environmental harm will be stored in or serviced by an effective containment system that is impervious to the materials stored and managed to prevent the release of liquids to waters or land. Where no relevant Australian Standard is available, the following will be applied:
	<ul style="list-style-type: none"> • Storage tanks will be bunded so that the capacity and construction of the bund is sufficient to contain at least 110 % of a single storage tank or 100 % of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas; and • Drum storages will be bunded so that the capacity and construction of the bund is sufficient to contain at least 25 % of the maximum design storage volume within the bund • Hazardous Waste • Chemical wastes will be collected in 200 L drums (or similar sealed container) and appropriately labelled for safe transport to an approved chemical waste depot or collection by a liquid waste treatment service • Storage, transport and handling of all chemicals will be conducted in accordance with all legislative requirements • Containment bunds and/or sumps will be drained periodically to prevent overflow and subsequent pollution of the surrounding land and/or water body • All hazardous wastes will be appropriately stored in bunded areas away from watercourses and in accordance with legislative requirements • Where no Australian Standard is available, any liquid with potential to harm the environment will be: <ul style="list-style-type: none"> ○ Stored in impervious bunded tanks with bunded capacity at least 110% of a single storage tank or 100% of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas ○ Impervious drum storage will have a bunded capacity to contain at least 25% of the maximum design storage volume within the bund • Hazardous wastes, such as solvents, rust proofing agents and primers will be managed in accordance with the requirements of relevant legislation and industry standards • A hazardous materials inventory will be prepared

Item	Outcomes
Performance indicators	<ul style="list-style-type: none"> • Material Safety Data Sheets (MSDS) for hazardous materials will be available at all work sites • Hydrocarbon wastes, including lube oils, will be collected for safe transport off-site for reuse, recycling, treatment or disposal at approved locations • As soon as practicable, all regulated waste will be removed and disposed of to a licensed waste disposal facility or recycling facility • All regulated waste removed from the site will be removed by a person who holds a current authority to transport such waste under the provisions of the EP Act and sent to a facility licensed to accept such waste • When regulated waste is removed from within the boundary of the petroleum tenure and transported by the holder of this authority, a record will be kept of the following: <ul style="list-style-type: none"> - Date of waste transport - Quantity of waste removed and transported - Type of waste removed and transported - Route selected for transport of waste - Quantity of waste delivered - Any incidents (eg spillage) that may have occurred on route • If a person removes regulated waste associated with activities within the operational land and disposes of such waste in a manner which is not authorised or is improper or unlawful then, as soon as practicable, the administering authority will be notified of all relevant facts, matters and circumstances known concerning the disposal • Hydrotest water will be disposed of in accordance with the DHWLRMP (refer Appendix D) • If a hazardous contaminant is released to waters or land the following steps will be taken: <ul style="list-style-type: none"> - Immediate action to stop any further release and make sure that the area is safe - Immediate action to contain the hazardous contaminant to the affected area, taking particular care to protect environmentally sensitive areas - Restore or rehabilitate the environment to its condition before the release occurred; and take necessary action to prevent a recurrence of the release • Waste handling is conducted in a way that minimises contamination of soil, air or water

8.3 Chemical and hazardous materials

Table 8.5 details the environmental protection objectives, relevant control strategies, monitoring and reporting requirements for the management of chemical and hazardous materials.

Table 8.5 Environmental protection commitments, objectives and control strategies for chemical and hazardous materials management

Item	Detail
Environmental protection objective	<ul style="list-style-type: none"> • Storage and handling of chemicals and dangerous goods does not cause environmental harm or harm to persons
Specific objectives	<ul style="list-style-type: none"> • Petroleum activities do not result in the release or likely release of a hazardous contaminant to the environment • Storage and handling procedures as per the WMP • Chemicals stored as per the WMP • All containment systems must be designed to minimise rainfall collection within the system

Item	Detail
Control strategies	<ul style="list-style-type: none"> • Spill control procedures (refer Marine Crossing GTP EMP – document number 3380-GLNG-4-8.2-0021 will be prepared and personnel trained • Dangerous goods will be stored and handled as per the requirements of relevant Australian Standards • Areas where contaminants or wastes are stored or handled will be minimised or roofed • Dangerous goods will, where appropriate (eg outside locations), be stored in bunded areas away from watercourses • Stormwater will be diverted around disturbed areas and areas where contaminants or wastes are stored or handled • All explosives, hazardous chemicals, corrosive substances, toxic substances, gases and dangerous goods will be stored and handled in accordance with the relevant Australian Standard • Where no Australian Standard is available, any liquid with potential to harm the environment will be: <ul style="list-style-type: none"> – Stored in impervious bunded tanks with bunded capacity at least 110% of a single storage tank or 100% of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas – Impervious drum storage will have a bunded capacity to contain at least 25% of the maximum design storage volume within the bund – If the bunded area is not covered, stormwater runoff from rainfall events will collect within bunded areas, and will be treated, reused or released in accordance with environmental and legal requirements, DHWLRMP and SMESCP • MSDS for chemicals and dangerous goods will be available on-site • Waste dangerous goods, which cannot be recycled, will be transported to a designated disposal site as approved by the local authority • Any spillage of hazardous waste or other contaminants that may cause environmental harm, will be effectively contained and cleaned up as quickly as practicable (refer Marine Crossing GTP EMP – document number 3380-GLNG-4-8.2-0021. Such spillage must not be cleaned up by hosing, or otherwise thereby releasing such waste or contaminants to any land or waters • Spillages will be cleaned up using dry methods that minimise the release of wastes, contaminants or materials to any stormwater drainage system, roadside gutter or waters • Spills of dangerous goods will be rendered harmless and collected for treatment and disposal at a designated site, including cleaning materials, absorbents and contaminated soils • Hydrocarbon spillage from storage areas, diesel and chemical spills from construction equipment, and industrial waste spill will be contained, reported, and treated/remediated in accordance with appropriate legislative and regulatory agency requirements. Drainage will be reinstated • Absorbent and containment material (eg absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use • Protective clothing, appropriate to the materials in use, will be provided • Relevant permits will be held and conditions of permits met • Servicing of equipment/machinery will not be permitted on the Marine Crossing GTP ROW. All planned services for all equipment is to occur in an approved workshop
Performance indicators	<ul style="list-style-type: none"> • The environment is not being contaminated by hazardous materials • Storage and handling procedures as per the WMP and relevant Australian Standards • Chemicals are stored in secure areas

8.4 Waste management record keeping, auditing and monitoring

This section addresses the recording and monitoring requirements which will be undertaken as part of this WMP. Waste streams, quantities and management practices (including chemical and hazardous materials) will be monitored during the construction and operational phases to ensure compliance with State and Commonwealth legislation, approval conditions and Australian Standards.

The key objectives of auditing the waste management and chemical management activities are to:

- Monitor and review wastes and chemical handling, usage, storage and disposal
- Monitor and review transportation records
- Monitor and review compliance with legislation, approval conditions and standards
- Assess the wastes quantities and streams compared to the predicted levels
- Recommend and implement actions to improve waste management practices
- Monitoring performance against the key performance indicators

8.4.1 Record keeping

Information generated from auditing and monitoring will be stored by the WMRC to enable corrective actions identified during the inspection / auditing process to be recorded, tracked and finalised. The information will be made available to the relevant regulatory authorities as required. The WMRC will keep the following key records:

- Regulated waste records
- Waste register including hazardous and dangerous materials
- Other records prescribed by DEHP or government agencies through the licensing and permitting of these activities
- Copies of relevant waste management licences
- Environmental training and induction
- Complaints and incidents
- Inspection and audit details including findings
- Corrective actions

8.4.2 Auditing

The WMRC will be required to comply with the following auditing requirements:

- During construction the WMRC will be required to report on environmental compliance on a weekly and monthly basis
- During construction undertake internal audits to verify that all work is proceeding in accordance with this WMP
- GLNG Operations will conduct a post-construction audit of the ROW and other related infrastructure annually for two years following construction to ensure all waste materials have been removed from the ROW
- The audit report will identify the segment of the Project being audited, the conditions that were activated during the period, and a compliance/non-compliance table. A description of the evidence to support the compliance table will be provided. The audit report shall also contain recommendations on any non-compliance or other matter to improve compliance. The third party auditor must certify the findings of the audit report

- The WMRC will immediately act upon any recommendations arising from the audit report and investigate any non-compliance issues identified
- As soon as practicable, implement measures or take necessary action to ensure compliance
- When first becoming aware of a non-compliance, the WMRC will:
 - Undertake action to bring the matter into compliance within an effective time frame
 - Report the non-compliance and remedial action to GLNG Operations within the specified timeframe

8.4.3 Monitoring

Table 8.5 to Table 8.9 outline the recommended auditing requirements along with the monitoring activities and inspection frequencies.

Table 8.5 WMP auditing and monitoring activities – general waste

Inspection and monitoring activity*	Frequency
Inspect waste handling activities and storage areas to check processes effectively handle, store and securely contain wastes as per the project WM Plan ie lids are closed, no spillages or leaks from liquid or solid waste tanks or containers that could cause nuisance or harm to water or the environment	Weekly
Review waste disposal records/transport receipts to confirm use of licensed waste management facilities and transport contractors to ensure wastes are appropriately collected, transported and disposed of	Weekly
Check all WMRC vehicles brought to the GTP construction sites have correct and up to date licenses and permits as required to conduct the waste transport and disposal activity	Weekly / monthly/ annually
Check MSDS and a dangerous goods register is available and easily accessible and contains MSDS for each stored chemical	Weekly
Check that spill containment and remediation process equipment is in place and unused Check construction personnel effectively implement the required procedures for spill response and the storage, handling and disposal of hazardous waste	Weekly
Check the training and induction/awareness program records to check all personnel have undertaken awareness training in their responsibilities with regard to waste management	Weekly
Any findings where a breach of license conditions has been identified, are to be reported to GLNG Operations or relevant external stakeholders (ie DEHP)	Monthly / annually
Review waste handling, storage and sorting practices to ensure all materials are being dealt with in accordance with the Waste and Resource Management Hierarchy	Weekly / monthly/ annually
Conduct a post-construction audit of the construction camp and ROW and other related infrastructure to check all waste materials have been removed from the ROW	Annually for two years following construction

*Note These suggested monitoring actions and frequencies are not comprehensive, detailed monitoring and auditing schedules should be developed by the WMRC

Table 8.6 WMP auditing and monitoring activities – liquid waste

Inspection and monitoring activity*	Frequency
Record the quantity of effluent treated on a daily basis as required in the approval conditions	Daily
Conduct treated effluent quality monitoring as required in the approval conditions	Weekly
Check that any environmental incidents or accidents that have occurred are reported in accordance with EHSMS	As required
Inspect the construction camp wastewater storage/s and irrigation area in accordance with Wastewater Irrigation Management Plan (WIMP)	Weekly
Inspect the hydrotest water discharge areas in accordance with DHWLRMP	Weekly / monthly/ annually
Inspect waste handling activities and storage areas to check processes effectively handle, store and securely contain wastes as per the project Waste MP and relevant Australian Standards ie lids are closed, no spillages or leaks from liquid or solid waste tanks or containers that could cause nuisance or harm to water or the environment	As required
Check MSDS and a dangerous goods register is available and easily accessible and contains MSDS for each stored chemical	As required
Review liquid waste disposal records/transport receipts to confirm use of licensed waste management facilities and transport contractors to ensure liquid wastes are correctly collected, transported and disposed of	Weekly
Review the waste auditing and monitoring process to ensure the process is effectively achieving objectives	As required
Check that spill containment and remediation process equipment is in place and unused	As required
Check project workers effectively implement the required procedures for spill response and associated storage, handling and disposal of hazardous waste	As required
Check the training and induction/awareness program records to check all personnel have undertaken awareness training in their responsibilities with regard to waste management	As required
Check copies of agreements (if any) to supply treated sewage effluent from the wastewater treatment plant for the purpose of irrigation have been forwarded to administering authority	Monthly/ annually
Review waste handling, storage and sorting practices to ensure all materials are being dealt with in accordance with the Waste and Resource Management Hierarchy	Weekly / monthly/ annually
Check WIMP against its objectives such as discharge quality, rates or application area and erosion	Monthly
Conduct a post-construction audit of the construction camp and ROW and other related infrastructure to check all waste materials have been removed from the ROW	Annually for two years following construction

*Note These suggested monitoring actions and frequencies are not comprehensive, detailed monitoring and auditing schedules should be developed by the Construction Contractor

Table 8.7 WMP auditing and monitoring activities – vehicles and machinery

Inspection and monitoring activity*	Frequency
Check vehicles, plant and equipment are maintained as per maintenance schedules to ensure no leaks or damage which could result in spills or leaks	Daily
Inspect waste handling and storage processes to check waste is effectively handled, stored and securely contained as per this WMP and Australian Standards (ie no spillages, leaks from liquid or solid waste tanks or containers that could cause damage to water or the environment)	As required
Check the training and induction/awareness program records to check all personnel have undertaken awareness training in their responsibilities with regard to waste management	As required
Check all WMRC vehicles brought to the Project construction sites have appropriate and up to date licenses and permits as required to conduct the waste transport and disposal activity	Weekly / monthly/ annually
Review waste handling, storage and sorting practices to check all materials are being dealt with in accordance with the Waste and Resource Management Hierarchy	Weekly / monthly/ annually

*Note These suggested monitoring actions and frequencies are not comprehensive, detailed monitoring and auditing schedules should be developed by the Construction Contractor

Table 8.8 WMP auditing and monitoring activities – hazardous waste and chemical storages monitoring

Inspection and monitoring activity*	Frequency
Inspect hazardous wastes handling activities and storage areas to check hazardous waste is stored in sealed containers, banded areas, correctly labelled as per the WMP and Australian Standards and Legislation	As required
Inspect containment bunds and/or sumps to check integrity of bund and to maintain storage capacity to reduce risk of overflow and subsequent pollution of the surrounding land and/or water body (ie captured sump liquid to be extracted periodically when required – noting that extracted liquid will need to be handled and disposed correctly)	As required
Review waste disposal records/transport receipts to confirm use of licensed waste management facilities and transport contractors to ensure wastes are correctly collected, transported and disposed of	Weekly
Check regulated waste tracking paperwork to ensure the process accurately records all necessary details with regard to waste	Weekly / monthly/ annually
Check all WMRC vehicles brought to the GTP construction sites have correct and up to date licenses and permits as required to conduct the waste transport and disposal activity	Weekly / monthly/ annually
Review hazardous materials inventory with stored items to check all items are recorded, stored and treated correctly	Weekly / monthly/ annually
Check MSDS and a dangerous goods register is available and easily accessible and contains MSDS for each stored chemical	Weekly
Check that spill containment and remediation process equipment is in place and unused Check project workers effectively implement the required procedures for spill response and associated storage, handling and disposal of hazardous waste	Weekly
Check the training and induction/awareness program records to check all personnel have undertaken awareness training in their responsibilities with regard to waste management	As required
Review waste handling, storage and sorting practices to ensure all materials are being dealt with in accordance with the Waste and Resource Management Hierarchy (Review waste and recyclable quantities and check dispatched to correct destination)	Weekly / monthly/ annually
Any findings of auditing and monitoring where a breach of license conditions has been identified, are to be reported to GLNG Operations or relevant external stakeholders (ie DEHP)	As required

*Note These suggested monitoring actions and frequencies are not comprehensive, detailed monitoring and auditing schedules should be developed by the Construction Contractor

Table 8.9 WMP auditing and monitoring activities – TBM

Inspection and monitoring activity*	Frequency
Review spoil material laboratory results to check that the tunnel spoil complies with the proposed beneficial reuse area's acceptance criteria	
Review waste disposal records/transport receipts to confirm use of licensed waste management facilities and licensed waste transport contractors to check wastes are correctly collected, transported and disposed of	As required
Check TBM equipment is maintained as per maintenance schedules to check for leaks or damage which could result in spills or leaks	Daily
Inspect waste handling and storage processes to check appropriate and effective handling, storage and secure containment of tunnel spoil and associated TBM wastes as per project WMP and Australian Standards ie no spillages, leaks from liquid or solid waste tanks or containments (ie spoil storage areas) that could cause nuisance or harm to water or the environment	Daily
Check MSDS and a dangerous goods register is available and easily accessible and contains MSDS for each stored chemical	As required
Check the training and induction/awareness program records to check all personnel have undertaken awareness training in their responsibilities with regard to waste management	As required
Check all WMRC vehicles brought to the Marine Crossing construction site pads have appropriate and up to date licenses and permits as required to conduct the waste transport and disposal activity	As required
Review waste handling, storage and sorting practices to check all materials are being dealt with in accordance with the Waste and Resource Management Hierarchy	As required
Conduct a post-construction audit of the Marine Crossing ROW and other related infrastructure to ensure all waste materials have been removed from the ROW	Annually for two years following construction

*Note These suggested monitoring actions and frequencies are not comprehensive, detailed monitoring and auditing schedules should be developed by the Construction Contractor

8.4.4 Continuous improvement

GLNG Operations will work closely with the Construction Contractor to rectify any issues identified as a result of WMP monitoring and auditing activities.

GLNG Operations will continue to investigate and implement actions to reduce impacts and deliver positive outcomes through the operation of the GTP ROW in relation to waste management.

The results of inspections, audits and incident reports will be used to drive continuous improvement along with other associated internal environmental performance reviews conducted by the Mainland, Marine Crossing and Curtis Island sections of GLNG Operations.

Following any significant changes to the GTP design or operational processes the WMP will be reviewed and mitigation measures updated to reflect the changes.

Following any environmental incidents resulting in environmental harm, this WMP will be reviewed and mitigation measures updated and improved to reduce the risk of incidents.

This WMP will be subject to annual review by GLNG Operations and its effectiveness in managing the waste streams associated with the Mainland, Marine Crossing and Curtis Island sections of GLNG Operations reported internally and to any relevant stakeholder.

8.4.5 Complaints response

Complaints which are received from internal or external stakeholders should be recorded and investigated in accordance with the Complaints Response Procedures.

Refer to the proposed management objectives and strategies as detailed in Section 8 for more details on the complaints procedure.

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9. Emergency Response Management

Emergency response management for spills and incident involving waste and hazardous materials will be undertaken in accordance with the requirements stipulated in the Project EMPs.

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10. References

Australian Standard 2885.3-2001: Pipelines – Gas and liquid petroleum Part 3: Operation and Maintenance

GLNG Operations (2011) GLNG Gas Transmission Pipeline Environmental Management Plan in Support of an Environmental Authority for Mainland

GLNG Operations (2012) GLNG Gas Transmission Pipeline Environmental Management Plan in Support of an Environmental Authority for Marine Crossing

GLNG Operation (2011)a GLNG Gas Transmission Pipeline Environmental Management Plan in Support of an Environmental Authority for Curtis Island

Department of Infrastructure and Planning (2010) Report for Crossing of The Narrows, Review of GLNG Environmental Management Plan

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Department of Environment and Resource Management (2010) Queensland's Waste Reduction and Recycling Strategy 2010-2020
Department of Environment and Resource Management (2011) Request for additional information, dated 01/12/2011

GLNG (no date) O&M Procedures – Pipeline Abandoning Document

GLNG (no date a) Pipeline – GLNG Project Environmental Management Plan (3380-GLNG-3-1.3-0007)

GLNG (no date b) Gas Transmission Pipeline Operations and Maintenance Procedures

International Erosion Control Association (IECA) (2008) Best Practice Erosion and Sediment Control

O2 (2012) Concept Dewatering, Hydrotest Water and Land Release Management Plan, Marine Crossing – Gas Transmission Pipeline

Queensland Government (May 2010) Coordinator-General's evaluation report for an environmental impact statement, Gladstone Liquefied Natural Gas-GLNG project

Queensland Government, Environmental Protection Agency (December 2005) Queensland Water Recycling Guidelines

Santos (2007) Environment, Health and Safety Management Guide Accessed [online] February 2011, Available at.
http://www.glng.com.au/library/EIS/Appendices/BB3_Health%20and%20Safety%20FINAL%20PUBLIC.pdf

Santos Petronas (2010) GLNG Gas Transmission Pipeline Weed Management Plan (Document Number: 3380-GLNG-3-1.3-0006-DOC)

URS (2009) Final Report GLNG Environmental Impact Statement – Waste Management Plan (Ref 42626220)

URS (2009a) GLNG Project – Environmental Impact Statement

URS, (2009b) Supplementary EIS

The Australian Pipeline Industry Association (APIA): Code of Environmental Practice – Onshore Pipelines, March 2009

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Appendix A


Abbreviations



Appendix A

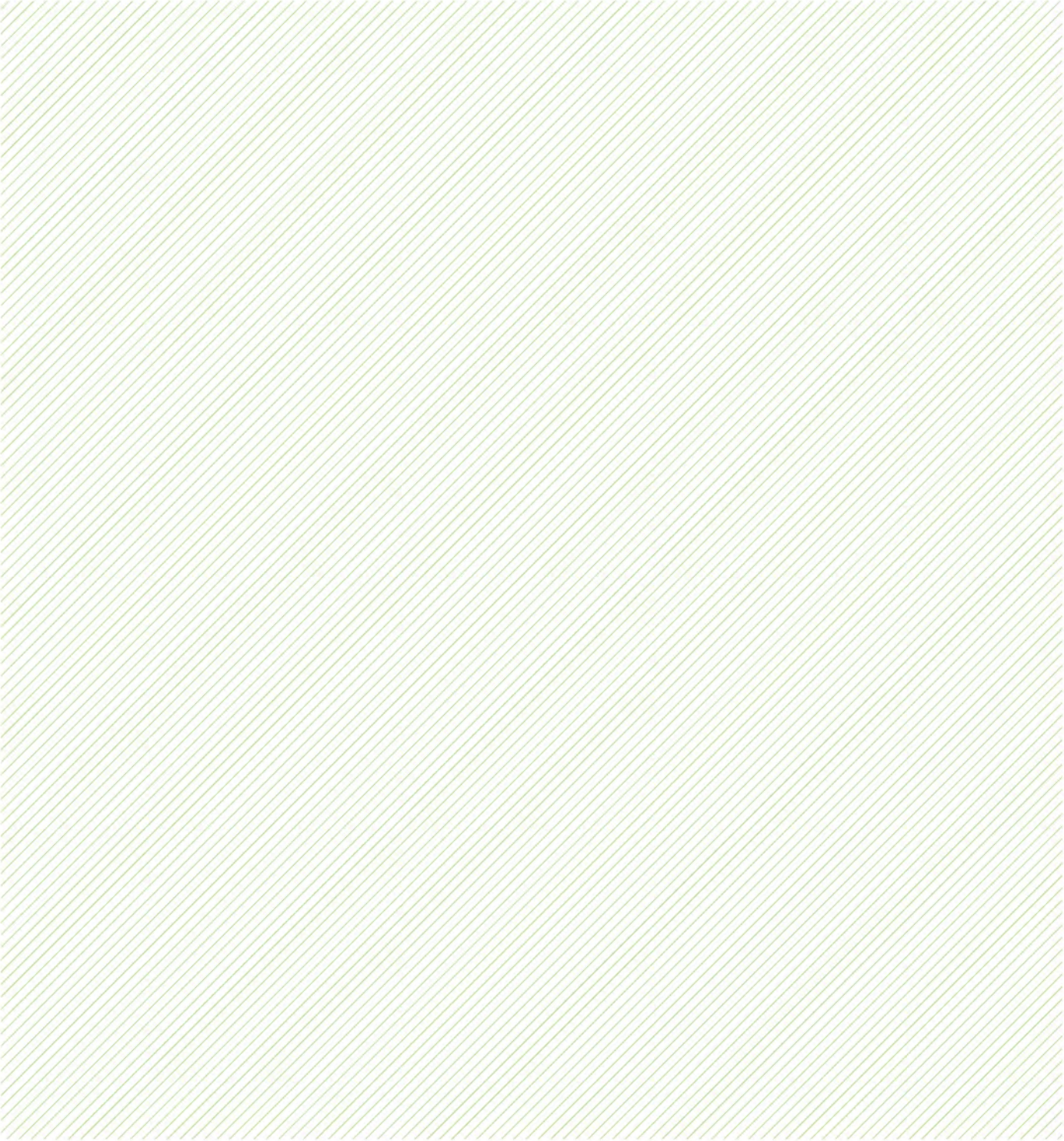
Abbreviation	Description
AIM	Audit and Inspection Manager
APIA Code	Australian Pipeline Industry Association Code of Environmental Practice for Onshore Pipelines
APLNG	Australia Pacific Liquefied Natural Gas
AS	Australian Standard
AS/NZS	Australian Standard/New Zealand Standard
ASS	Acid Sulfate Soil
ASSMP	Acid Sulfate Soils Management Plan
CEMP	Construction Environmental Management Plan
CG	Coordinator General
CMP	Construction Management Plan
Contractor	Construction Contractor (to be advised)
CSG	Coal Seam Gas
C&I	Construction and Industrial
DERM	Department of Environment and Resource Management
DMP	Dredge Management Plan
DNRMW	Department of Natural Resources, Mines and Water
EA	Environmental Authority
EHSMS	Environment Health and Safety Management System
EHS&S	Environmental, Health, Safety & Security
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EP Act	<i>Environmental Protection Act 1994</i>
EP Reg	<i>Environmental Protection Regulation 2008</i>
EP (WM) Reg	Environmental Protection (Waste Management) 2000
EP Waste Reg	Environmental Protection Regulations 2008
ERA	Environmentally Relevant Activity
ERP	Emergency Response Plan
FEED	Front End Engineering Design
GPL 300	Gladstone Port Lot 300
GLNG	Gladstone Liquefied Natural Gas
GPC	Gladstone Port Corporation
GTP	Gas Transmission Pipeline
HDPE	High Density Polyethylene
DHWLRMP	Dewatering, Hydrotest Water and Land Release Management Plan
IECA	International Erosion Control Australasia
IMS	Incident Monitoring System

Abbreviation	Description
LNG Facility	Liquefied Natural Gas Facility
MEDLI	Model for effluent disposal using land irrigation
MRF	Material Recovery Facility
MSDS	Material Safety Data Sheet
MSW	Municipal Solid Waste
Mtpa	Million Tonnes per Annum
NEPM	National Environment Protection Measures
NHMRC	National Health and Medical Research Council
NPI	National Pollution Inventory
N/A	Not Applicable
Pigging	Pipe Cleaning Activities
PPE	Personal Protective Equipment
PVM	Preventative Vehicle Maintenance
PVMW	Preventative Vehicle Maintenance Workshops
PWMP	Pest and Weed Management Plan
QCLNG	Queensland Curtis Liquefied Natural Gas
Qld	Queensland
RMP	Road use Management Plan
ROW	Right-of-Way
SSMP	Significant Species Management Plan
SMESCP	Stormwater Management, Erosion and Sediment Control Plan
STP	Sewage Treatment Plant
t	Tonnes
TBM	Tunnel Boring Machine
TPRA	Temporary Pipe Receiving Area
TPSA	Temporary Pipe Storage Area
WMP	Waste Management Plan
WIMP	Wastewater Irrigation Management Plan
WMRC	Waste Management and Recycling Contractor
WWTP	Wastewater Treatment Plant
WONS	Weeds of National Significance
WRR Act	<i>Waste Reduction and Recycling Act 2011</i>



Appendix B

Figures

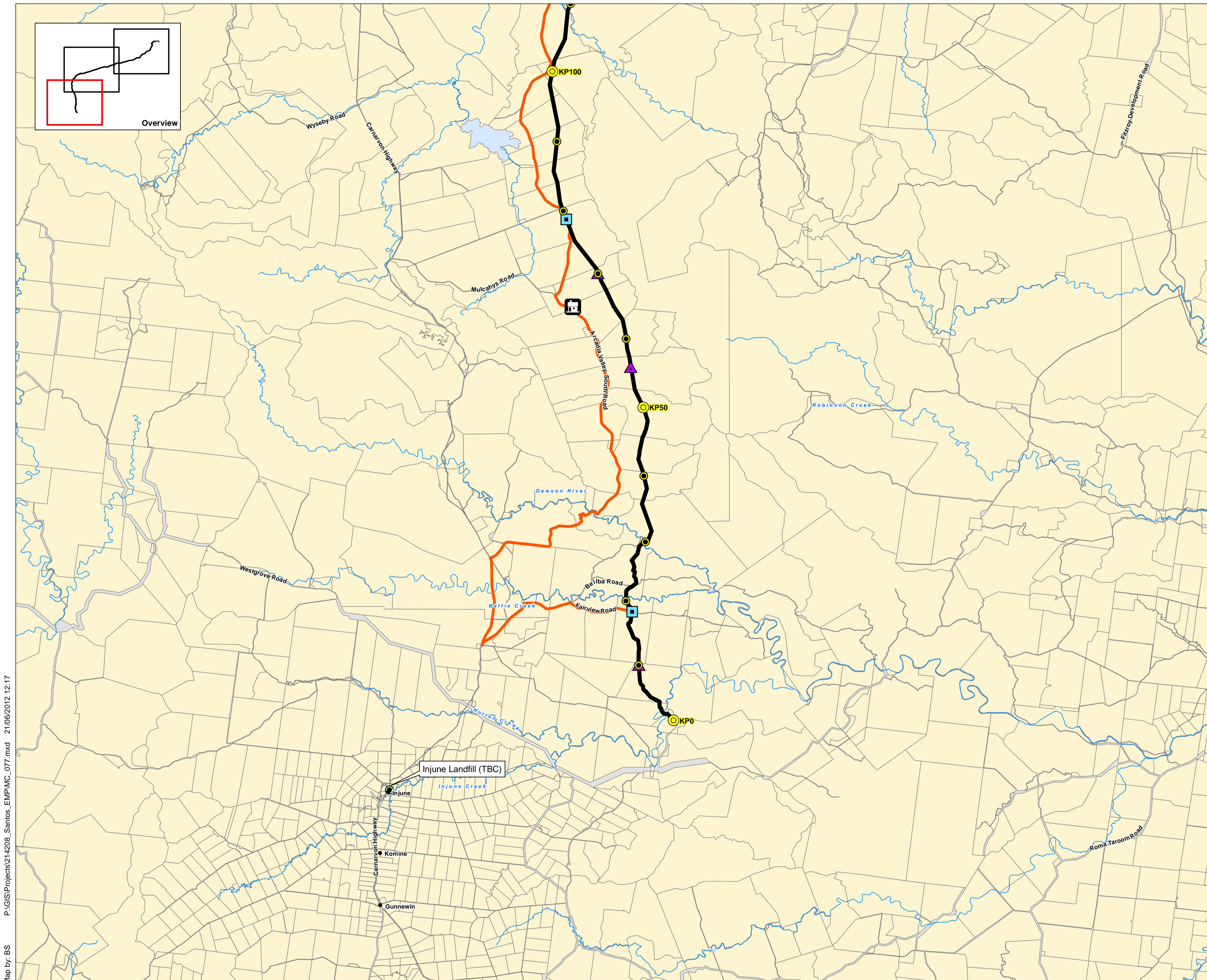


Waste Management Plan

- Gas Transmission Pipeline (GTP)
 - Mainland GTP
 - Marine Crossing GTP
 - Curtis Island GTP
- Kilometre Post Distance Marker
 - 50km
 - 10km
- Road Haulage Route
 - Waste to Benaraby Landfill; regulated waste and recyclables to SE Qld
 - Other GLNG haulage route
- Access Road
 -
- Port Alma Temporary Pipe Receiving Area
 -
- Landfill
 -
- Sewage Treatment Plant
 -
- Temporary Pipe Storage Site
 - ▲
- Construction Camp
 -
- Vehicle Washdown and RoW Access Point (Indicative Location Only)
 -
- Saipem Waste Contractor Depot
 -
- Barge Haulage Route
 -
- Cadastre
 -
- Rail
 - +—
- Watercourse
 -
- Major Road
 -

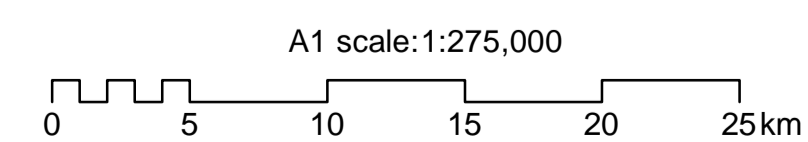
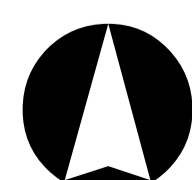
Source:
 Gas Transmission Pipeline (GTP): Santos, Apr 2012.
 Fishermans Landing and Western Basin Reclamation Area, Aurecon, Feb 2011.
 Protected Areas: Department of Environment and Resource Management, Feb 2011.
 Cadastre: Department of Environment and Resource Management, Jun 2011.
 Temporary Pipe Storage Site: GLNG Pipeline Logistics Study, GHD, Nov 2009.
 Vehicle Washdown Points: Aurecon, Feb 2011.
 Construction Camps: GLNG Pipeline Logistics Study, GHD, Nov 2009.

Waste and Recovered Material Haulage Route Appendix B Figure 1 (Page 1 of 3)



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Map by: BS



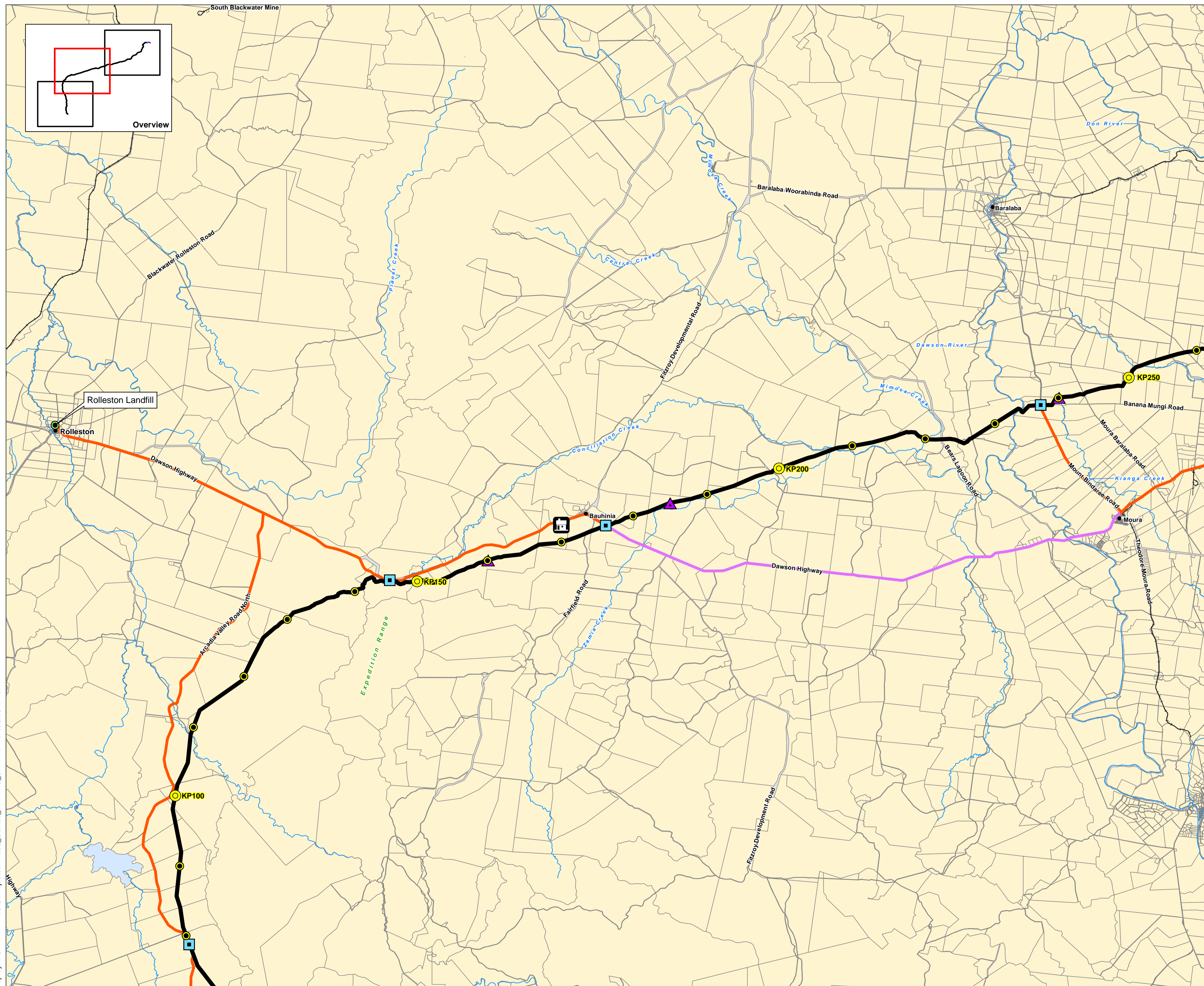
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Waste Management Plan

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 - Construction Camp
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 - Saipem Waste Contractor Depot
 - - - Barge Haulage Route
 - Cadastre
 - Rail
 - Watercourse
 - Major Road

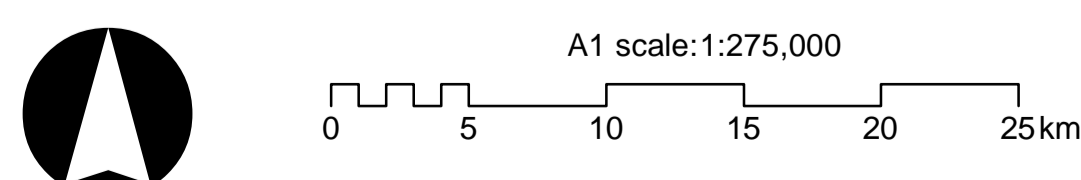
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 Gas Transmission Pipeline (GTP): Santos, Apr 2012.
 Fishermans Landing and Western Basin Reclamation Area, Aurecon, Feb 2011.
 Protected Areas: Department of Environment and Resource Management, Feb 2011.
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Waste and Recovered Material Haulage Route Appendix B Figure 1 (Page 2 of 3)



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Map by: BS



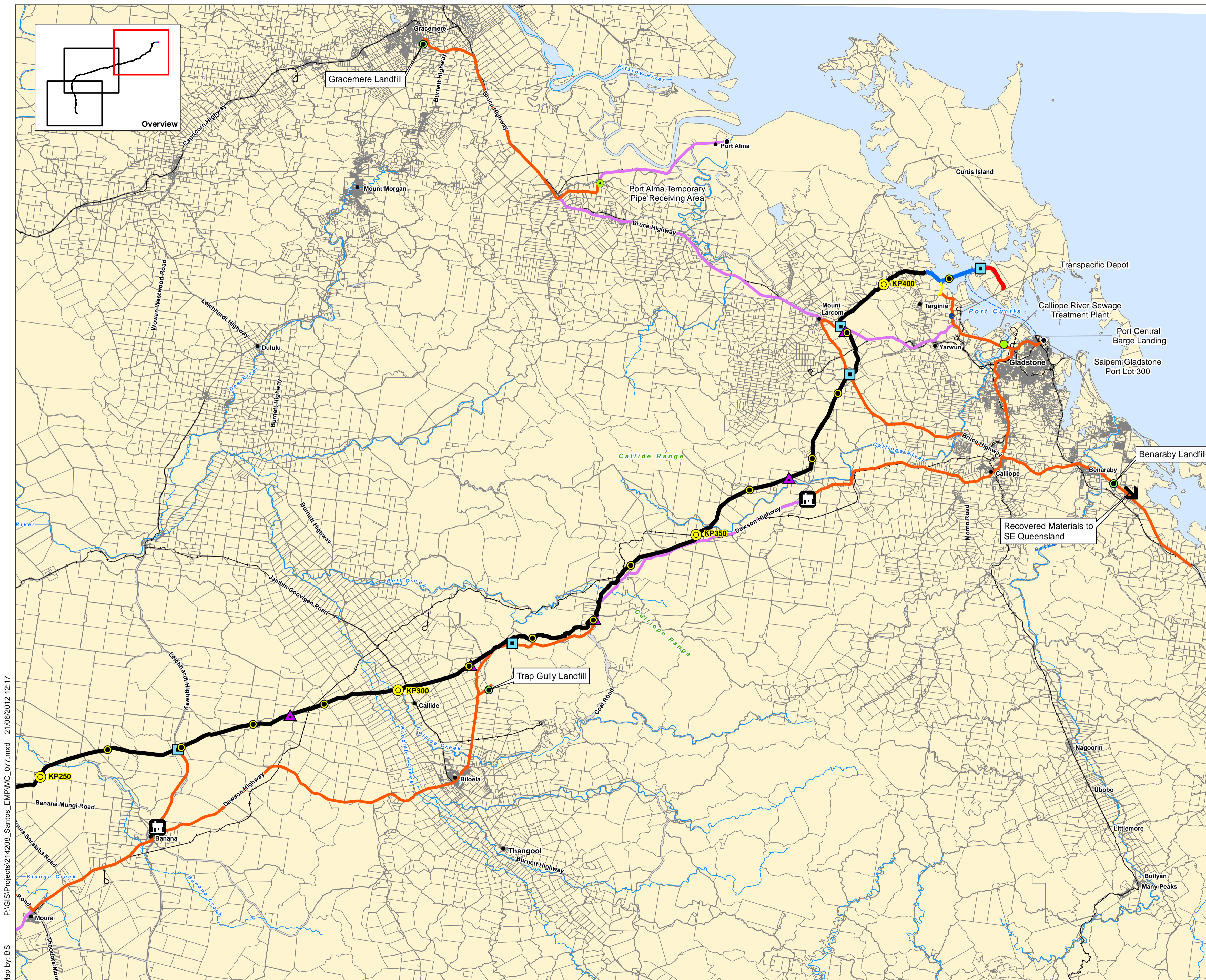
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 Coordinate system: GCS GDA 1994

Waste Management Plan

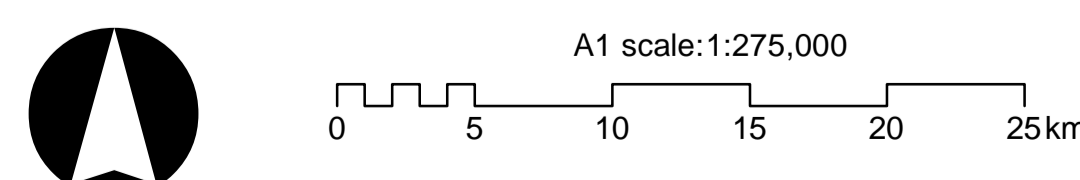
- Gas Transmission Pipeline (GTP)
 - Mainland GTP
 - Marine Crossing GTP
 - Curtis Island GTP
- Kilometre Post Distance Marker
 - 50km
 - 10km
- Road Haulage Route
 - Waste to Benaraby Landfill; regulated waste and recyclables to SE Qld
 - Other GLNG haulage route
- Access Road
 -
- Port Alma Temporary Pipe Receiving Area
 -
- Landfill
 -
- Sewage Treatment Plant
 -
- Temporary Pipe Storage Site
 - ▲
- Construction Camp
 -
- Vehicle Washdown and RoW Access Point (Indicative Location Only)
 -
- Saipem Waste Contractor Depot
 -
- Barge Haulage Route
 -
- Cadastre
 -
- Rail
 -
- Watercourse
 -
- Major Road
 -

Source:
 Gas Transmission Pipeline (GTP): Santos, Apr 2012.
 Fishermans Landing and Western Basin Reclamation Area, Aurecon, Feb 2011.
 Protected Areas: Department of Environment and Resource Management, Feb 2011.
 Cadastre: Department of Environment and Resource Management, Jun 2011.
 Temporary Pipe Storage Site: GLNG Pipeline Logistics Study, GHD, Nov 2009.
 Vehicle Washdown Points: Aurecon, Feb 2011.
 Construction Camps: GLNG Pipeline Logistics Study, GHD, Nov 2009.

Waste and Recovered Material Haulage Route Appendix B Figure 1 (Page 3 of 3)



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 Map by: BS



GLNG No: XXXX-XX-XXXX
 Coordinate system: GCS GDA 1994

Waste Management Plan

- Gas Transmission Pipeline (GTP)
 - Mainland GTP
 - Marine Crossing GTP
 - Curtis Island GTP
- Kilometre Post Distance Marker
 - 5km
 - 1km
- Construction Site Pads
- Access Road
- Road Haulage Route
 - Waste to Benaraby Landfill; regulated waste and recyclables to SE Qld
 - Other GLNG haulage route
- All waste and materials from Curtis Island
 - Barge Landing (Indicative Location Only)
 - Vehicle Washdown and RoW Access Point (Indicative Location Only)
 - Temporary Pipe Storage Site
 - Saipem Waste Contractor Depot
 - Potential Beneficial Tunnel Spoil Reuse Options
 - Protected Area
 - Cadastre
 - Rail

Source:
 Gas Transmission Pipeline (GTP): Santos, Apr 2012.
 Aerial: Santos, 2011.
 Protected Areas: Department of Environment and Resource Management, Feb 2011.
 Cadastre: Department of Environment and Resource Management, Oct 2011.
 Temporary Pipe Storage Site: GLNG Pipeline Logistics Study, GHD, Nov 2009.
 Vehicle Washdown Point: Aurecon, Feb 2011.

Note:
 Barge landing and routes are approximate only.

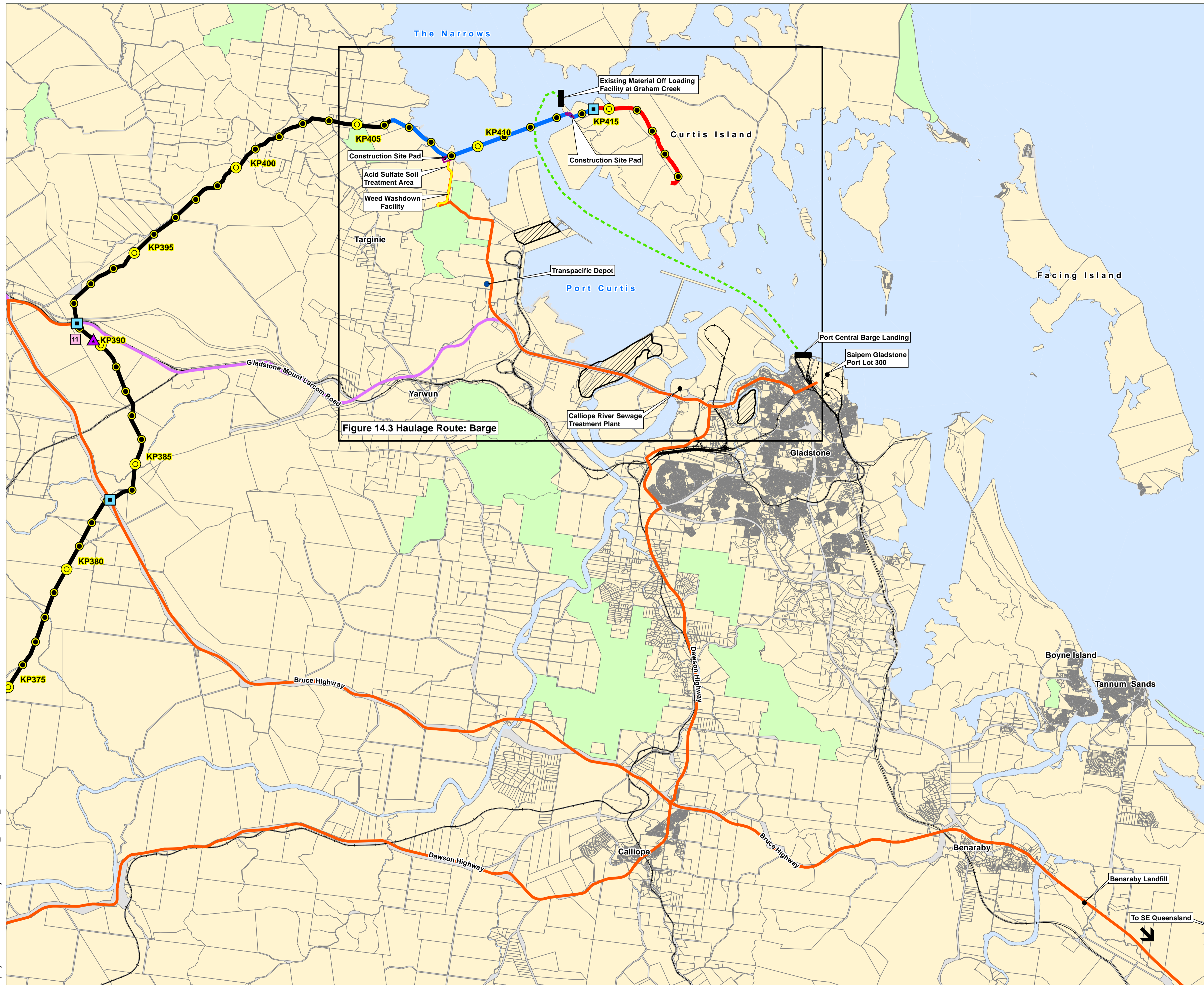
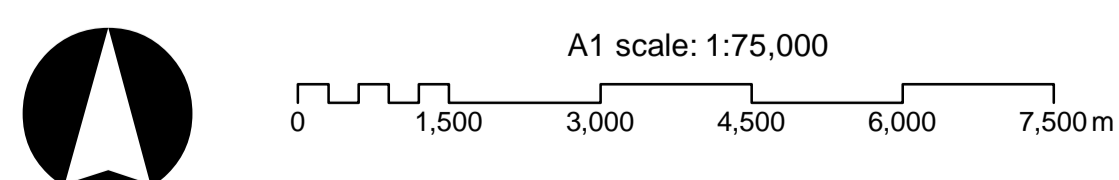


Figure 14.3 Haulage Route: Barge

Waste and Recovered Material Haulage Route: Overview Appendix B Figure 2

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Map by: RB



Waste Management Plan

- Gas Transmission Pipeline (GTP)**
- Mainland GTP
 - Marine Crossing GTP
 - Curtis Island GTP
 - ⊕ GTP Marine Crossing Reference Point
- Construction Site Pads**
- ▨ Weed Washdown Facility (Indicative)
 - Access Road
- Road Haulage Route**
- Waste to Benaraby Landfill; regulated waste and recyclables to SE Qld
 - Other GLNG haulage route
- Barge Haulage Route**
- All waste and materials from Curtis Island
 - Drill cuttings
 - Barge Landing (Indicative Location Only)
 - ▣ Vehicle Washdown and RoW Access Point (Indicative Location Only)
 - ▨ Potential Beneficial Tunnel Spoil Reuse Options
 - Rail

Source:
Gas Transmission Pipeline (GTP): Santos, Apr 2012.
Aerial: Santos, 2011.
Fishermans Landing and Western Basin Reclamation Area, Aurecon, Feb 2011.
Vehicle Washdown Point: Aurecon, Feb 2011.

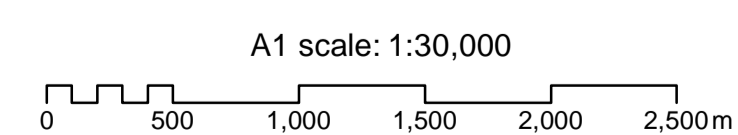
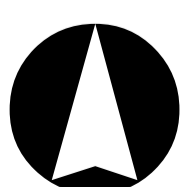
Note:
Barge landing and routes are approximate only.

Waste and Recovered Material Haulage Route: Barge Appendix B Figure 3



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Map by: RB



GLNG No: XXXX-XX-XXXX
Coordinate system: GCS_GDA_1994



Appendix C
Chemical inventory – Marine Crossing



Chemical register

Key:

1. Hardware, Glues & Sealants	2. Paints & Solvents	3. Fuels
4. WTP	5. Concrete Products	6. Oils & Lubricants
		7. Hygiene/Office

Workplace: GLNG Marine Crossing

Product name	Supplier (if applicable)	U.N. No.	Physical description	Class dangerous good and/or Hazardous substance	Maximum quantity on site	Location in workplace	MSDS Issue Date	MSDS Available Yes/No
1								
Bentocryl 86	Sud-Chemie	N/A		N/A			14/09/2010	Yes
CRC Brakleen Aerosol	CRC	1950		HS, DG Class 2			14/07/2008	Yes
Flexovit Reinforced Cutting Off Wheels	Saint-Gobain	N/A		HS			15/04/2011	Yes
Hempel Hempatex Hi-Bluid 46410	Hempel's Marine Paints	1263		HS, DG Class 3			19/02/2008	Yes
Hilti Hit Max	Hilti	N/A	Grey Paste	HS			1/09/2009	Yes
Loctite 747 Primer T (Non-aerosol)	Henkel	2831		HS, DG Class 6.1			19/02/2008	Yes
Loctite 747 1 Primer	PPG Industries Aerospace	1993		HS, DG Class 3			23/10/2008	Yes
Parchem Fosroc Nitobond Har	Parchem	N/A		N/A			16/02/2010	Yes
Selleys Liquid Nails (solvent based)	Selleys	1133		HS, DG Class 3			10/03/2010	Yes
Selleys Polyfilla Expanding Foam (aerosol)	Selleys	1950		HS, DG Class 2			17/06/2008	Yes
Selleys Roof & Gutter Silicone Sealant	Selleys	N/A		N/A			13/03/2009	Yes
Septone Parts Wash	Septone	N/A		HS			7/10/2011	Yes
Sikadur 33 Part A	Sika	N/A		HS			14/06/2007	Yes
Sikadur 33 Part B Normal	Sika	N/A		HS			14/06/2007	Yes
Sika Rugasol 90	Sika	N/A		N/A			23/01/2012	Yes
Sika Rugasol C	Sika	N/A		N/A			1/08/2011	Yes
Sika Sikasil C	Sika	N/A		N/A			8/07/2010	Yes
Sika Sikaflex 11FC	Sika	N/A		N/A			27/10/2019	Yes
Sika Sikaflex PRO	Sika	N/A		HS			6/05/2011	Yes
Silicone Sealant (White) #512-799	RS Components	N/A		N/A			15/04/2011	Yes
Silver Brazing Flux F100	Toshiba	1811		HS, DG Class 8			28/03/2008	Yes
Solvent_Cement_Type_N	Vinidex	1133	blue glue for PVC pipe	DG Class 3		Container	1/11/2008	Yes
2								
Dulux 066-Line Accent Gloss Enamel	Dulux	1263		HS, DG Class 3			15/04/2011	Yes
Dy Mark Mine Marking Aersosol	Dy-Mark	1950		HS, DG Class 2.1			1/10/2010	Yes
Hempels thinner 08080	Hempel's Marine Paints	1307		HS, DG Class 3			30/05/2008	Yes
Line Marking Paint	RS Components	1950		HS, DG Class 2.1			23/07/2010	Yes
Wattyl Killrust Cold Galvit (for aerosols)	Wattyl	1263		HS, DG Class 3			16/09/2008	Yes
Wattyl Killrust Fishoilene Aerosol	Wattyl	1950		HS, DG Class 2			15/07/2008	Yes
3								
Diesel (automotive)	Caltex	N/A	Liquid, dark	HS		Multiple	21/02/2012	Yes
Kerosene - Recochem Home Kerosene	Rechochem	1223		HS, DG Class 3			16/04/2010	Yes
Petrol - Shell Unleaded Petrol	Shell	1203		HS, DG Class 3			31/12/2008	Yes
4								
Aluminium Sulfate	Baker's	N/A	White powder	HS	1 tonne	WTP - container	13/11/2009	Yes
Formazine Turbidity solution	Yeokal	N/A	Milky liquid suspension	N/A	1 litre	Env office	19/12/2011	Yes
pH 4 buffer	Yeokal	N/A	Colourless liquid	N/A	1 litre	Env Office	19/12/2011	Yes
pH 10 buffer	Yeokal	N/A	Colourless liquid	N/A	1 Litre	Env Office	19/12/2011	Yes
Poly aluminium chloride - HyBind 2001	Eimco Water	N/A	Colourless liquid	N/A		WTP	2/02/2010	Yes
Sodium Hydroxide - Optireg 1001	Ovivo	1824		HS, DG Class 8		WTP	1/02/2010	Yes
Sodium Bisulphate - Dry Acid	Pool Resources	N/A		HS		WTP	15/05/2011	Yes
Sulphuric Acid - Optireg 1003	Ovivo	2796		HS, DG Class 8	1000L	WTP	17/02/2012	Yes
5								
AMC AUS-BEN (Bentonite)	Australian Mud Company	N/A		HS			6/05/2009	Yes

BASF Masterkure 404	BASF	N/A		HS			28/01/2010	Yes
BASF Masterkure 100WB Clear	BASF	N/A		N/A			10/07/2009	Yes
BASF Masterkure 100WB White	BASF	N/A		HS			3/03/2010	Yes
BASF Meyco SA160 T	BASF	N/A		HS			11/05/2011	Yes
Concrete - Blue Circle Premium Blended Concrete Mix	Blue Circle	N/A		HS			15/04/2011	Yes
Concrete - Cement Australia Portland Cement	Cement Australia	N/A		HS			20/11/2009	Yes
Concrete - Readymix Sprayed Concrete	Readymix	N/A		HS			15/10/2010	Yes
Concrete - Vandex Grey	Vandex	N/A	Light grey powder	HS			1/03/2012	Yes
Grout - BluCem GP60 Construction Grout	Bluey	N/A	Light grey powder	HS			27/02/2008	Yes
Grout - GroutAid	Elkem AS	N/A		N/A			8/07/2010	Yes
Hilti Hit Hy 150	Hilti	N/A	Grey Paste	HS			11/05/2010	Yes
Hilti Hit - RE 500	Hilti	3259		HS, DG Class 8			9/04/2010	Yes
Hydrated Lime	Adelaide Brighton	3262	Powder	HS, DG Class 8			28/08/2009	Yes
Interstate Form Release Agent	Interstate Energy	N/A		HS			7/10/2011	Yes
Sika Formol	Sika	N/A		HS			15/04/2011	Yes
Sodium Silicate Solution	PQ Australia	N/A		HS			24/06/2008	Yes
Stabilizer (admixture for concrete & mortar)	Tachibana Material	N/A		N/A			30/09/2009	Yes
6								
Air Tool Lubricant	RS Components	N/A	Metal Processing Oil	N/A			13/01/2012	Yes
Drill Lubricant - BP Rock Drill Compound	Castrol	N/A		N/A			6/12/2007	Yes
Drill Lubricant - Shell Torcula Oil 32	Shell	N/A		N/A			29/01/2010	Yes
Drill Lubricant - Sud-Chemie Bentonil HR	Sud-Chemie	N/A		N/A			30/10/2009	Yes
Engine Oil - BP Vanellus M30	Castrol	N/A		N/A			12/01/2012	Yes
Engine Oil - Super 2 Stroke Oil	Peak Lubricants	N/A		N/A			1/08/2008	Yes
Gear Lubricant - Ampol Gearlube TA 80W	Caltex	N/A	Oil, Dark	HS			29/01/2010	Yes
Gear Lubricant - Mobil (USA) SHC 630	ExxonMobil	N/A		HS			19/06/2009	Yes
Gear Lubricant - Shell Omala Oil F 320	Shell	N/A		N/A			3/01/2012	Yes
General Lubricant - Lanotec Heavy Duty Liquid Lanolin Aerosol	Lanotec	1950		DG Class 2			29/01/2010	Yes
General Lubricant - TG&S Standard Pipe Jointing Lube	Thomas Grozier & Son	N/A		N/A			8/02/2010	Yes
General Lubricant - WD-40 3-In-One Multi-Purpose Oil	WD-40 Company	N/A		N/A			29/04/2011	Yes
Grease - BP Energrease MG-EP 2	Castrol	N/A		N/A			13/01/2012	Yes
Grease - Equilon Alvania EP Grease 2	Equilon Alvania	N/A		N/A			6/08/2010	Yes
Hydraulic Oil - Condat D 46	Condat	N/A		HS			22/04/2009	Yes
Hydraulic Oil - Oilman Masterlube 68 Hydraulic Oil	Oilman Group	N/A		N/A			16/08/2011	Yes
Hydraulic Oil - Shell Tellus Oil T68	Shell	N/A		N/A			29/01/2010	Yes
TBM - Condat WR 89 S	Condat	N/A	N/A	N/A			6/02/2009	Yes
TBM - Condat WR 89	Condat	N/A	N/A	N/A			6/02/2009	Yes
TBM - Condat HBW	Condat	N/A	N/A	N/A			12/05/2009	Yes
TBM - Condat GR 217 EP2	Condat	N/A	N/A	N/A			26/03/2009	Yes
7								
Bleach Concentrate	Septone	1791		HS, DG Class 8			30/05/2008	
Blockettes Deoderant tablets	Septone	3077	Blocks for urinals	HS, DG Class 9		Amenities	15/10/2010	Yes
Disinfectant Liquid	Septone	N/A	Liquid	N/A			2/06/2008	Yes
Glen 20 Surface Spray	Reckitt Benckiser	1950	Aerosol / mist	HS, DG Class2.1		Amenities	26/02/2010	Yes
Hand Wash - Lightning Fresh Hand cleaner	Lightning Products	N/A		HS		Amenities	8/12/2009	Yes
Insect Repellent - Aeroguard Tropical Strength (aerosol)	Reckitt Benckiser	1950	clear spray/mist	HS, DG Class 2.1			7/05/2009	Yes
Sun Cream - Piz Buin Mountain Sun Cream	Johnson & Johnson	N/A	White viscous liquid	N/A			2/02/2009	Yes



Appendix D
Sandblasting Grit information



GMA Garnet

The Natural Abrasive



Blasting Grade Product Data Sheet

Average Chemical Composition (Typical)

SiO ₂ *	36%
Al ₂ O ₃	20%
FeO	30%
Fe ₂ O ₃	2%
TiO ₂	1%
MnO	1%
CaO	2%
MgO	6%

* Refers to SiO₂ bound within the lattice of the homogeneous garnet crystal (no free silica)

Physical Characteristics (Typical)

Bulk Density	2.3T/m ³
Specific Gravity	4.1
Hardness (moh)	7.50-8.0
Melting Point	1250°C
Shape of natural grains	sub-angular

Other Characteristics (Typical)

Conductivity	10-15ms/m (max 25ms/m)
Radioactivity	Not detectable above background
Moisture Absorption	Non-hygroscopic, Inert
Total Chlorides	10-15ppm (max 25ppm)
Ferrite (free iron)	less than 0.01%*
Lead	less than 0.002%*
Copper	less than 0.005%*
Other Heavy Metals	less than 0.01%*
Sulphur	less than 0.01%*

* Generally below detectable levels.

GMA Garnet is certified by the California Air Resources Board for dry unconfined blasting. GMA Garnet meets all known current chemical limits for free silica and heavy toxic metals including ISO 11126-10: E2000 and US Navy specification MIL-A-22262 B(SH).

Mineral Composition (Typical)

Garnet (Almandite)	97-98%
Ilmenite	1-2%
Zircon	0.20%
Quartz (free silica)	<0.5%
Others	0.25%

Blast Grade Product Range

Typical Results	New-Steel	Speed-Blast	Premium-Blast
Profile (microns)	45-55	50-70	50-85
Consumption (kg/m ²)	7-10	8-10	10-12
Cleaning Rate (m ² /hour)	20-25	15-25	15-20

Standard Packing

- * 80 x 25kg multilayer paper bags shrinkwrapped to 2 MT pallets, or
- * 80 x 25kg multilayer paper bags packed into 2 T bulk bags or
- * 2,000kg top and bottom spouted bulk bags with internal PVC liner, or
- * Loose bulk.

The information set forth herein is based on technical data believed to be accurate; it is intended for use by persons having technical skill and at their own discretion and risk. Since conditions of use are outside our control, GMA makes no warranties, express or implied, concerning the use or disposal of this product and assumes no liability in connection with any use of this information.



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MATERIAL SAFETY DATA SHEET

SECTION 1 – IDENTIFICATION

Product Name : **GMA Garnet**
Other Names : garnet sand, almandine garnet, PremiumBlast, SpeedBlast, NewSteel, 30/60 mesh, 50 mesh, 60 mesh, 80 mesh, 120 mesh, 600/250
Recommended Use : blast cleaning abrasive, water jet cutting abrasive, water filtration media
Supplier : GMA Garnet Pty Ltd
Address : 122 Goulds Rd, Geraldton, Western Australia 6532
Telephone Number : +61 8 9923 6000 (Australia)
: +1 8 32243 9300 (United States)
Fax Number : +61 8 9923 3747
E-mail : sales@gmagarnet.com.au
Emergency Number : +61 8 9923 6000; 24 hours: +61 402 293 603 (Australia)
: +1 8 32243 9300; 24 hours: +1 713 301 0354 (United States)

SECTION 2 - HAZARDS IDENTIFICATION

Non Dangerous but **Hazardous** according to NOHSC: 1008(2004)

The product as supplied contains traces of quartz (crystalline silica) which when used as an abrasive can break down to respirable dust size (particles small enough to go into deep parts of the lung when breathed in). Respirable crystalline silica is a listed carcinogenic substance which may cause silicosis and cancer.

The product is dominantly garnet (almandine variety) which is a Non-Hazardous substance. Traces of dust in the unused product are from calcium carbonate which is also Non-Dangerous and Non-Hazardous.

Risk Phrase: T R49 - contains crystalline silica which may cause cancer by inhalation.

Safety Phrase: S22 - do not breathe dust liberated from used product.

SECTION 3 – COMPOSITION / INFORMATION ON INGREDIENTS

This material is a natural mixture of almandine garnet and other trace minerals.

Chemical Name	CAS Number	Proportion (weight %)
Almandine Garnet $\text{Fe}_3\text{Al}_2(\text{SiO}_4)_3$	1302-62-1	Greater than 97%
Ilmenite FeTiO_3	103170-28-1	Less than 2.0%
Calcium Carbonate CaCO_3	471-34-1	Less than 1.5%
Zircon ZrSiO_4	149040-68-2	Less than 0.2%
Quartz SiO_2 (Crystalline Silica)	14808-60-7	Less than 0.2%





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SECTION 4 – FIRST AID MEASURES

No acute or chronic health effects known in workers arising from short or long term exposure to this product. Note that crystalline silica is present at low levels and chronic exposure, by way of dust inhalation, may cause silicosis and cancer.

- Swallowed Non toxic. There are no known health effects resulting from accidental ingestion of small amounts that may occur during normal handling. Ingestion of larger amounts may cause irritation due to abrasiveness. Seek medical attention if symptoms develop.
- Eye Particle and dust exposure may cause eye irritation due to abrasiveness. Flush with plenty of clean water for at least 15 minutes or until particles are removed. Seek medical attention if irritation or soreness persists.
- Skin There are no known health effects from skin contact that may occur during normal handling. Seek medical attention if symptoms develop. Contact with material under pressure will damage skin by abrasion. Clean and dress any open wounds and seek medical attention. Inhaled: Exposure to dust created by use as a blast cleaning media may cause throat and lung irritation, coughing or shortness of breath. Move to fresh air and blow nose to remove particulates from nasal passages. Seek medical attention if symptoms persist.

It is recommended that eyewash facilities are available in the workplace.

SECTION 5 – FIRE FIGHTING MEASURES

Flammability	: Non-flammable.
Flashpoint	: Non-explosive.
General Hazard	: This product is non-flammable and does not support combustion.
Extinguishing Media	: Use media suitable for the material that is burning.

SECTION 6 – ACCIDENTAL RELEASE MEASURES

No special precautions necessary. Wear safety equipment as for normal handling. If possible, vacuum the material to avoid generating unnecessary dust, otherwise, sweep any spillages.

SECTION 7 – HANDLING AND STORAGE

No special precautions necessary. Storage areas should be ventilated and dust generation minimised when handling loose bulk product. Use good housekeeping practices to keep dust to a minimum.



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SECTION 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Standards	Crystalline silica (quartz) respirable dust: 0.1 mg/m ³ TWA (time weighted average) may be exceeded when the product is used for dry blast cleaning (respirable dust is ≤ 7 microns particle equivalent aerodynamic diameter) Total dust (inspirable): 10 mg/m ³ TWA
Engineering Controls	Maintain ventilation and/or dust collection to reduce exposure to dust generated during handling, use and clean-up. Maintain a clean and safe work environment and monitor effectiveness.
Personal Protection	Follow local, state or federal guidelines for the use of personal protection equipment. Blast cleaning operations should use an air fed abrasive blast hood conforming with Australian Standards 1715 and 1716, such as a Nova 2000, as well as leather (or equivalent) gloves and apron when in use. Hearing protection should also be worn when blast cleaning.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Appearance	: Pink to red coloured free flowing sand.
Odour	: Odourless.
pH	: 7.0 to 8.5
Vapour Pressure	: Not applicable.
Boiling Point	: Not applicable.
Melting Point	: Approximately 1250°C
Radioactivity	: Not detectable above background levels.
Solubility in Water	: Insoluble.
Specific Gravity	: 4.1
Flammability	: Non-flammable.
Hardness	: 7.5 – 8.0 Mohs
Bulk Density	: Approximately 2.3 t/m ³
Particle Size	: Average range between 0.1 – 0.6mm, depending on grade.

SECTION 10 – STABILITY AND REACTIVITY

Chemical Stability	: Stable and inert material under normal and anticipated storage, handling and use conditions.
Conditions to Avoid	: None known.
Incompatible Materials	: None known.
Decomposition	: Not applicable.
Hazardous Reactions	: None known.



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SECTION 11 – TOXICOLOGICAL INFORMATION

Note that crystalline silica is present at low levels, typically less than 0.1%, and chronic exposure to crystalline silica dust through inhalation may cause silicosis and cancer.

SECTION 12 – ECOLOGICAL INFORMATION

This material is a naturally occurring mineral with no known ecotoxicity. It is insoluble in water and unlikely to contaminate waterways or food chains.

SECTION 13 – DISPOSAL CONSIDERATIONS

Follow local, state or federal guidelines for disposal of inert solid waste, e.g. for landfill.

MATERIAL CONTAMINATED OR REDUCED TO DUST IN USE MAY NEED SPECIAL HANDLING AND DISPOSAL. IT IS THE RESPONSIBILITY OF THE USER TO UNDERTAKE ANY EVALUATION CLASSIFICATION AND DISPOSAL OF MATERIAL AFTER USE.

SECTION 14 – TRANSPORT INFORMATION

No special precautions necessary. It is recommended to keep bags closed and dry bulk loads covered to prevent dust generation and moisture incursion.

SECTION 15 – REGULATORY INFORMATION

No known additional regulations for this product.

SECTION 16 – OTHER INFORMATION

This MSDS has been prepared by GMA Garnet Pty Ltd in accordance with the National Code of Practice for the Preparation of Material Safety Data Sheets 2nd Edition [NOHSC:2011(2003)].

Date of Issue: April 2012
Revision 6

As per Worksafe Guidance Note NOHSC 3017, each user should review the information in the specific context of the intended application.

End of MSDS.



Appendix G
Mosquito and Midge Management Plan
(MMMP)

GLNG Gas Transmission Pipeline

Mosquito and Midge Management Plan

Document Number: 3380-GLNG-4-1.3-0009

PREPARED BY:

Title	Name	Signature	Date
Senior Civil Engineer	Georgina Squire		28.06.12

ENDORSED BY:

Title	Name	Signature	Date

APPROVED BY:

Title	Name	Signature	Date

DATE	REV	REASON FOR ISSUE	AUTHOR	ENDORSED	APPROVED
23.03.11	1	DRAFT for review and verification	CS		
30.03.11	2	Final	CS	SJM	
08.04.11	3	Amended Final	CS	CC	
15.04.11	4	Final for Legal review	CS		
30.05.11	5	LEGAL COMMENTS ADDRESSED	CC		
15.07.11	6	FOR AGENCY REVIEW	CC		
09.05.12	7	Construction methodology updated	GS		
22.06.12	8	GLNG comments addressed	MH		
28.06.12	9	For Santos Sustainability Review	MH		

This document contains confidential information and is not to be disclosed to any third parties without prior written permission from the Vice President GLNG Operations.

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1. Introduction

This Mosquito and Midge Management Plan (MMMP) has been developed to manage mosquitoes and biting midges for the purposes of public health, community wellbeing and for the health of onsite workers associated with the Marine Crossing Gas Transmission Pipeline (GTP) Project.

Mosquitoes pose a risk to human health as a number of species are vectors for many serious diseases, such as Ross River Virus and Barmah Forest Virus. Midges, although a nuisance, do not pose any serious risk to human health. For this reason and the fact that there are limited control measures specifically for biting midge species, this MMMP largely focuses on mosquito management.

1.1 Aim

This MMMP aims to meet the goal of Integrated Pest Management (IPM) by combining a variety of reasonable, practical, effective and economical pest control measures to reduce the risk of increase in population numbers and disease from mosquitoes resulting from the development of the Marine Crossing GTP Project, while having minimal impact on the environment. This MMMP provides a framework for identifying and monitoring potential mosquito breeding sites as well as outlining procedures for implementing risk management strategies during the construction and operation phases of the Project.

2. Legislative and policy framework

2.1 Relevant legislation

Relevant legislation associated with the management and control of mosquito and biting midge populations within the Marine Crossing GTP Project include:

- *Public Health Act 2005 / Public Health Regulation 2005*
- *Work Health and Safety Act 2011*
- *Environmental Protection Act 1994 (EP Act)*
- *Coastal Protection and Management Act 1995*
- *Fisheries Act 1994*
- *Sustainable Planning Act 2009 (SPA)*
- *Agricultural Chemicals Distribution Control Act 1966 (ACDC Act)*
- *Chemical Usage (Agricultural and Veterinary) Control Act 1998*
- *Nature Conservation Act 1992 (NC Act)*
- *Marine Parks Act 2004*
- *Transport Infrastructure Act 1994*

2.2 Relevant standards and guidelines

Relevant policies and codes associated with the management and control of mosquito and biting midge populations within the Marine Crossing GTP Project include:

- Gladstone Regional Council Mosquito Management Plan (GRCMMP) (Gladstone Regional Council (GRC), 2010)
- Operational Policy Pest Management – Mosquito and biting midge control (Department of Environment and Resource Management (DERM), 2011)
- Guidelines to minimise mosquito and biting midge problems in new development areas (Queensland Health (QH), 2002)

- Mosquito Management Code of Practice for Queensland (Local Government Association of Queensland (LGAQ), 2002)
- AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines

3. Aspects and potential impacts

3.1 Potential for species and prevalence

3.1.1 Breeding areas

Likely mosquito species and breeding areas

This MMMP outlines the mosquito species likely to be significant within the Marine Crossing GTP Project based on vector capability, nuisance value and seasonal variation. While there are likely to be many mosquito species present within the greater Gladstone area, there are some species that are of greater importance because of their ability to transmit disease or to be significant pests. A number of mosquito species are associated with breeding in freshwater pools and/or intertidal wetlands and may be broadly divided into freshwater and intertidal species. Mosquitoes within both of these categories have the potential to become disease vectors and are therefore outlined within this MMMP.

Potential onsite freshwater habitats for mosquitoes include:

- Stormwater drainage systems
- Pooled water in banded areas, containers or other vessels
- Low lying areas temporarily flooded by high rainfall
- Areas created during construction works (trenches)
- Construction water and sedimentation ponds

Intertidal species are likely to utilise mangrove habitats as well as saltwater marshland as breeding sites. In particular, mangrove areas are likely to provide ideal habitat conditions for breeding. Intertidal wetlands (including mangrove areas) are adjacent to the Marine Crossing GTP Right of Way (RoW) and associated construction areas.

Existing potential breeding areas and suitable habitat locations for mosquitoes and biting midges are shown in Figure 3.1.

The mosquito species likely to be significant pests within the Marine Crossing GTP Project are briefly described in Table 3.1.

Table 3.1 Potentially favourable habitat conditions for mosquito species

Species	Favourable breeding site conditions	Preferred habitat
<i>Aedes aegypti</i>	<ul style="list-style-type: none"> • A container breeding species • A major vector for Dengue fever, Yellow fever and a potential vector of Murray Valley encephalitis and Ross river virus 	Freshwater
<i>Culex annulirostris</i>	<ul style="list-style-type: none"> • Preferred breeding habitats include freshwater wetlands and low lying grassy areas that are commonly inundated following rain, as well as irrigation areas having heavy organic effluent component • A vector of Ross River virus, Barmah Forest virus, Japanese encephalitis and Kunjin virus 	Freshwater
<i>Culex quinquefasciatus</i>	<ul style="list-style-type: none"> • Utilises containers, troughs and drainage channels as breeding sites 	Freshwater

Species	Favourable breeding site conditions	Preferred habitat
<i>Ochlerotatus vittiger</i>	<ul style="list-style-type: none"> Preferred breeding sites consist of depressions filled by summer rain 	Freshwater
<i>Ochlerotatus notoscriptus</i>	<ul style="list-style-type: none"> Breeds in artificial containers A suitable vector for Barmah Forest virus and Ross River virus 	Freshwater
<i>Ochlerotatus alternans</i>	<ul style="list-style-type: none"> Breeding can occur in temporary brackish pools and marshes on the coast Can reach relatively high pest levels following extended periods of rain An aggressive biter, especially in and around mangroves and will attack throughout the day and night Can travel 5 km to 8 km from breeding sites in search of food May continue to be a pest from one to three weeks after breeding areas are inundated 	Intertidal wetlands
<i>Ochlerotatus vigilax</i>	<ul style="list-style-type: none"> Utilises a variety of saline habitats including salt marshes filled as a result of tidal inundation A primary coastal vector of Ross River virus, Barmah Forest virus and other arboviruses in Queensland Feeds on humans and animals during the day or night Can travel up to 40 km from breeding sites 	Intertidal wetlands
<i>Culex sitiens</i>	<ul style="list-style-type: none"> Utilises temporary brackish pools and salt marshes filled as a result of tidal inundation as breeding sites A vector of Ross River virus Has the ability to travel long distances from breeding habitat 	Intertidal wetlands
<i>Verrallina funerea</i>	<ul style="list-style-type: none"> Can breed in both fresh and slightly brackish water A major pest where residential housing is in close proximity to breeding sites Does not readily disperse from its breeding habitat 	Intertidal wetlands

Likely midge breeding areas

Areas of mangroves and estuarine areas with sandy beaches are potential breeding grounds for midges. Midge population numbers peak monthly and are associated with tidal patterns and also peak seasonally during the summer months. There is no suitable habitat located within the Marine Crossing GTP Project, and as such no specific management measures for the biting midge will be included in this MMMP. However, GRC will be notified of any management measures developed and implemented for the reduction of mosquito breeding sites within the Marine Crossing GTP Project or any potential breeding sites identified during visual monitoring activities. Indirect control measures will be implemented in accordance with this MMMP and the GRCMMP. This information may also be used by GRC to tailor management programmes for these species.

3.1.2 Species prevalence

No field investigations were completed to quantify or monitor mosquito or biting midge numbers or species distribution within the Marine Crossing GTP Project during the EIS. However, under the GRCMMP, the GRC has committed to mapping all mosquito breeding areas within their jurisdiction, including regional areas of significance. The strategy developed for mapping all mosquito breeding areas includes the inspection and documentation of each mosquito breeding site and identifying any specific environmental issues with each site (GRC, 2010). It is envisaged that the information and data compiled through GRC's strategy commitments will be used to inform proposed treatment and control methodologies adopted/approved for each location.

**Marine Crossing
GTP Mosquito and Midge
Management Plan**

Reference Point	Easting	Northing
A	307885.00	7372070.00
B	308384.00	7371825.00
C	309893.00	7370692.00
D	314290.76	7372243.30
E	315000.00	7372593.00

Reference Points and associated Coordinates

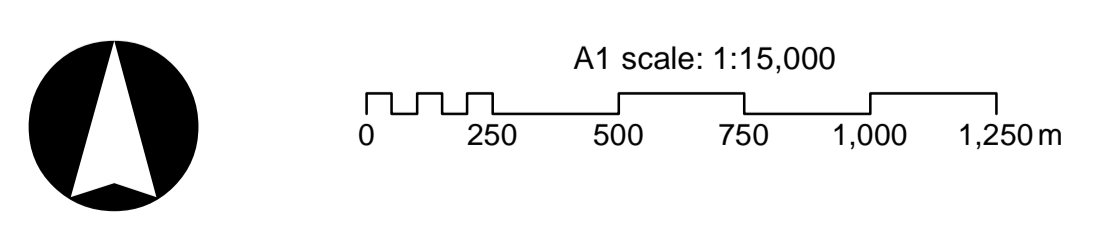


- Gas Transmission Pipeline (GTP)
- Mainland GTP
 - Marine Crossing GTP
 - Curtis Island GTP
 - + GTP Marine Crossing Reference Point
 - Construction Site Pads
 - Acid Sulfate Soils Treatment Area
 - Weed Washdown Facility (Indicative)
 - Proposed Access Road
 - Water Points
 - Highest Astronomical Tide
 - Watercourses
- Note: High Astronomical Tide (HAT) is approximate and indicative only.

Source:
Gas Transmission Pipeline (GTP): Santos, Apr 2012.
Aerial: Santos, Feb 2011.
Indicative Project Footprint: Aurecon, GLNG May 2012.
Watercourses: Department of Environment and Resource Management, Sep 2011.

**MMMP - Potential Habitat
Figure 3.1**

P:\GIS\Projects\214208_Santos_EMP\MC_068.mxd 14/06/2012 08:53
Map by: RB



GLNG No: XXXX-XX-XXXX
Coordinate system: GCS_GDA_1994

3.2 Summary of aspects and potential impacts

The key environmental aspects and their associated potential impacts relevant to the construction activities, locations and work areas are outlined in Table 3.2.

Table 3.2 Environmental aspects and impacts for mosquito and biting midge

Item	Outcome
Environmental aspect	<ul style="list-style-type: none"> • Pooling of water • Changed surface water hydrology • Habitat modification
Construction activity that have potential to create breeding areas	<ul style="list-style-type: none"> • Bulk earthworks, including clearing and grading, cut and fill, compacting, levelling, shaping, gravel covering, backfilling, trenching and blasting • Stockpiling of bulk topsoil and cleared vegetation • Soil and sediment movement • Water management, including water diversion, storage and release/discharge • Facilities and structures management, including operation, maintenance and housekeeping • Systems management, including Erosion and Sediment Controls (ESC) and waste containment, storage, treatment, transport and disposal • Rehabilitation and site reinstatement, including backfilling, compaction and ripping, replacement of topsoil, revegetation and re-sowing pastures, and removal of the Access Road and access tracks
Construction location/work areas associated with potential breeding areas	<ul style="list-style-type: none"> • Upgrading and construction of the Access Road and access tracks within the Marine Crossing GTP ROW • Site preparation for camp, stockpiling and laydown area construction • Installation and maintenance for ESC, stormwater and wastewater measures/facilities (temporary and permanent structures), including drainage trenches, embankments, sediment traps, ponds, storage treatment and discharge points • Low hazard dam design, construction, operation and maintenance • Installation and relocation of services/site facilities • Operation and maintenance of facilities, including washdown facilities, sewage treatment facilities, refuelling stations and workshops • Installation of the GTP • Rehabilitation and reinstatement of embankments, landforms, vegetation and cultivation areas, trenches, drains, ponds and dams
Environmental impact	<ul style="list-style-type: none"> • Increase mosquito and biting midge breeding sites • Impacts on human health, including site workers and personnel • Impacts on human (and animal) health of nearest sensitive receptors, including residents and site personnel at neighbouring commercial/industrial sites and members of the community • Increased risk of exposure of site personnel to existing breeding sites and dispersal locations • Nuisance complaints

4. Objectives, performance criteria and targets

The specific details on objectives, performance criteria and targets of the MMMP are outlined in Table 4.1.

Table 4.1 Objectives, performance criteria and targets

Item	Outcome
Objectives	<ul style="list-style-type: none"> Comply with GRC requirements Treatment strategies implemented comply with the Mosquito Management Code of Practice for Queensland (LGAQ, 2002) Achieve continual improvement in risk assessment and impact management performance through periodic review of surveillance and treatment activities and procedures
Performance criteria	<ul style="list-style-type: none"> Comply with legislative requirements and permit/development approval conditions Communicate findings, performance and corrective actions implemented to GRC and the Regional Mosquito Management Forum annually or on request from GRC No environmental harm resulting from the implementation of mosquito management or treatment strategies No outbreaks of mosquito-borne disease within the Marine Crossing GTP Project area All staff to be adequately trained in mosquito and biting midge exposure prevention and awareness prior to work commencing
Targets	<ul style="list-style-type: none"> Identify triggers for initiating treatment strategies (refer Section 5.2) Develop treatment strategies that environmentally sound, effective and cost efficient Identify suitable surveillance procedures and treatment efficacy targets Staff training details correctly recorded in training register and available for auditing purposes Implementation of all mitigation measures outlined in this MMMP

5. Implementation strategy

5.1 Risk assessment and management approach

Under this MMMP it is proposed to adopt a risk management approach to managing the risks associated with the Marine Crossing GTP Project relating to the potential impacts of biting midge and mosquito species. The risk management process is based on AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines. Adopting this approach provides a structured method for the identification, assessment, management, monitoring and reporting of risks potentially affecting or affected by the Marine Crossing GTP Project.

In order for a risk to exist there must be the potential for an event to occur, a pathway of exposure and a receptor. These are described in the following sections.

5.1.1 Event

The potential events associated with biting midge and mosquito species have been identified as impacts in Table 3.2, which include:

- Increased mosquito breeding sites affecting human health (site personnel, nearest sensitive receptors and community)
- Exposure of site personnel to existing biting midge and mosquito breeding sites and dispersal locations resulting in nuisance complaints and affecting human health

5.1.2 Receptors

The potential receptors include:

- Site personnel
- Neighbouring residents
- Members of the community utilising areas surrounding the Marine Crossing GTP Project

5.1.3 Pathways for exposure

The potential pathways for exposure include:

- Construction activities associated with the Marine Crossing GTP Project, which bring humans into contact with breeding sites or dispersal locations due to:
 - Location of the activity
 - Timing of the activity (daily shift and/or seasonal)
 - Nature of the activity resulting in the creation of pooled water (permanent or temporary) due to design of water storage structures, earthmoving for drainage and placement of material stockpiles, placement of equipment items creating opportunities for containing runoff or rainfall and release/discharge of water and wastewater from storage/treatment facilities/locations
- Operational activities associated with the Marine Crossing GTP ROW, which create opportunities for increased human contact with breeding sites or dispersal locations due to differential settlement or subsidence of GTP ROW or other backfilled areas creating habitat suitable for additional breeding sites

5.1.4 Risk assessment and management process

The risk assessment and management process will follow the fundamental process of:

- Identify risks

- Manage risks and potential for exposure
- Monitor, record and report risk, exposure and potential impacts identified
- Review, audit and update treatment strategies, procedures and mitigation measures to achieve continual improvement in performance and compliance with performance criteria for this MMMP

5.1.5 Treatment triggers

Triggers for treatment will largely depend upon the target environment, the terrain, accessibility and location of breeding sites, the mosquito species involved, tidal flows and the weather conditions. Considerations may include:

- Tides
- Rainfall events
- Season
- Potential for exposure of site personnel
- Complaints received
- Scheduled work
- Visual inspection results

It is difficult to predict a definitive level of rainfall that will necessitate treatment. A number of variables such as duration and amount of rainfall received, the period since the last rainfall event, barometric air pressure, wind velocity and temperature may all combine in different combinations, with different outcomes. The variability of these elements precludes the ability to consistently place definitive measurement on such elements.

This MMMP will be updated following the completion of the initial identification of risks, within one month of the six-monthly review and update of the risk assessment and/or within one month of reporting/consultation with GRC or the Regional Mosquito Management Group Forum or when requested by the administering authority outlined in Table 5.1 and will aim to specify treatment thresholds. Guidance will also be sought from GRC for evaluation of trigger conditions and when it is considered that a major mosquito event is imminent.

Risk assessment and management actions are outlined in Table 5.1

Table 5.1 Risk assessment and management actions

Action	Task	Timing	Responsibility	Trigger/s
Identify risks	<ul style="list-style-type: none"> Review GRC mosquito breeding area mapping 	Pre-disturbance	Construction Contractor	<ul style="list-style-type: none"> Pre-disturbance action requirement
	<ul style="list-style-type: none"> Document potential breeding sites, high risk locations for exposure of site workers and personnel through construction activities and high risk times for exposure to breeding sites or dispersal locations 	Pre-disturbance	Construction Contractor	<ul style="list-style-type: none"> Pre-disturbance action requirement
	<ul style="list-style-type: none"> Establish communication pathways and systems for consultation/participation with GRC and the Regional Mosquito Management Group Forum 	Pre-disturbance	Construction Contractor	<ul style="list-style-type: none"> Annual reporting schedule On request from GRC, QH or Department of Environment and Heritage Protection (DEHP) (formerly DERM)
	<ul style="list-style-type: none"> Establish treatment triggers and thresholds for implementing corrective actions for treatment strategies 	Pre-disturbance	Construction Contractor	<ul style="list-style-type: none"> Health, Safety and Security Management Plan (HSSMP) requirements On request from Health, Safety and Security Manager Complaint/s received
	<ul style="list-style-type: none"> Establish communication pathways and systems for promoting mosquito management awareness, monitoring and reporting mosquito-related health issues/statistics affecting site personnel and managing complaints 	Pre-construction	Construction Contractor	<ul style="list-style-type: none"> Induction training schedule Health, Safety and Security Management Plan (HSSMP) requirements On request from Health, Safety and Security Manager
	<ul style="list-style-type: none"> Review construction program and work schedule 	Pre-construction and construction	Construction Contractor	<ul style="list-style-type: none"> Monthly programming and scheduling updates
	<ul style="list-style-type: none"> Schedule visual inspections of construction activities within the Marine Crossing GTP Project 	Construction	Construction Contractor	<ul style="list-style-type: none"> Daily inspection schedule
Manage risks and potential exposure	<ul style="list-style-type: none"> Implement design constraints for water storage facilities 	Pre-construction and construction	GLNG Operations and Construction Contractor	<ul style="list-style-type: none"> Design/construction specifications

Action	Task	Timing	Responsibility	Trigger/s
	<ul style="list-style-type: none"> Develop site procedures and specifications for water management onsite, maintenance of water storage and housekeeping for construction work areas and disturbance areas 	Pre-construction	Construction Contractor	<ul style="list-style-type: none"> Identification of potential breeding site/s Identification of potential exposure opportunities
	<ul style="list-style-type: none"> Implement treatment strategies and corrective actions when trigger levels/threshold criteria exceedances are identified during monitoring 	Construction	Construction Contractor	<ul style="list-style-type: none"> Visual inspection results
	<ul style="list-style-type: none"> Implement changes to construction program and work schedule to minimise exposure opportunities at high risk locations or during high risk periods 	Construction	Construction Contractor	<ul style="list-style-type: none"> Daily triggers – dawn/dusk and outgoing tides Seasonal triggers – summer months and high rainfall periods Meteorological event triggers, including significant rainfall events (2 year ARI event or greater)
Monitor, record and report risk/s, exposure and potential impacts identified	<ul style="list-style-type: none"> Conduct visual inspections of site conditions, housekeeping performance and maintenance requirements for drainage measures, water storage 	Construction	Construction Contractor	<ul style="list-style-type: none"> Daily visual inspection schedule
	<ul style="list-style-type: none"> Complete monitoring checklist for visual inspections and report new locations for potential breeding sites or exposure opportunities 	Construction	Construction Contractor	<ul style="list-style-type: none"> Weekly monitoring report schedule
	<ul style="list-style-type: none"> Record on ongoing basis, health data and statistics for site workers and personnel affected by mosquito-related health impacts 	Construction	Construction Contractor	<ul style="list-style-type: none"> Complaints received First aid/medical treatment records Absenteeism data (eg medical certificates)
	<ul style="list-style-type: none"> Record on ongoing basis, complaints received relating to mosquito nuisance 	Construction	Construction Contractor	<ul style="list-style-type: none"> Complaints received
	<ul style="list-style-type: none"> Report health data and statistics for site works and personnel affected by mosquito-related health impacts 	Construction	Construction Contractor	<ul style="list-style-type: none"> Annual reporting schedule On request by GRC or QH HSSMP requirements
	<ul style="list-style-type: none"> Report the number of complaints received relating to mosquito nuisance 	Construction	Construction Contractor	<ul style="list-style-type: none"> Monthly reporting schedule On request by GRC, QH or DEHP
	<ul style="list-style-type: none"> Review and update risk assessment 	Construction	Construction Contractor	<ul style="list-style-type: none"> Marine Crossing GTP Project auditing schedule GRCMMP (GRC, 2010) Guidelines to minimise mosquito and biting midge problems in new development areas (QH, 2002)

Action	Task	Timing	Responsibility	Trigger/s
	<ul style="list-style-type: none"> Report on risk assessment findings and performance of treatment strategies implemented to GRC and the Regional Mosquito Management Group Forum 	Construction	Construction Contractor	<ul style="list-style-type: none"> Annual reporting schedule On request by GRC GRCMMP (GRC, 2010) Mosquito Management Code of Practice for Queensland (LGAQ, 2002)
	<ul style="list-style-type: none"> Report awareness training data (number of inductions completed), visual inspection performance, site personnel health monitoring and risk assessment review findings and corrective actions implemented to GRC and the Regional Mosquito Management Group Forum 	Construction	Construction Contractor	<ul style="list-style-type: none"> Annual reporting schedule
	<ul style="list-style-type: none"> Review and evaluate the performance of treatment strategies implemented 	Construction and operation	Construction Contractor and GLNG Operations	<ul style="list-style-type: none"> Marine Crossing GTP Project auditing schedule GRCMMP (GRC, 2010) Mosquito Management Code of Practice for Queensland (LGAQ, 2002) Guidelines to minimise mosquito and biting midge problems in new development areas (QH, 2002)

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5.2 Treatment strategies

To achieve environmentally sustainable outcomes, this MMMP focuses on indirect management controls, such as site management and inspection, promoting awareness, personal protection and design controls. The use of direct management controls, such as chemicals and habitat modification are regarded as the least preferred methods and shall be implemented under the direction of GRC and/or DNRM (formerly DERM).

In the event that direct control measures are required, permits and development approvals will be required for work undertaken by GLNG Operations, unless the work/activities comply with a relevant exemption or a self-assessable code. Work that is likely to require a permit or development approval from the administering authority/authorities or that may be prohibited development within specified areas of the Marine Crossing GTP Project includes:

- Operational work for habitat modification (eg runnelling)
- Use of chemical control measures/agents

The relevant legislation will include (but not be limited to):

- *Fisheries Act 1994*
- *Marine Parks Act 2004*
- *Nature Conservation Act 1992*
- *Sustainable Planning Act 2009*
- *Transport Infrastructure Act 1994*

The potential triggers for environmental permits, development approvals or prohibited development are summarised in Table 5.2.

Table 5.2 Summary of permit, approval and prohibited development triggers for approved direct control measures for mosquito and biting midge

Legislation	Permit/ approval	Trigger description/s	Direct control activity
<i>Sustainable Planning Act 2009 (SPA)</i>	Development approval for operational work	<ul style="list-style-type: none"> • Assessable development (under Schedule 3 of SPA) • Disturbance of marine plants / habitat (<i>Fisheries Act 1994</i>) • Fish stocking in ponds (<i>Fisheries Act 1994</i>) • Operational work within a waterway (<i>Fisheries Act 1994</i>) • Operational work below occurring below Mean High Water Springs (MHWS) or between MHWS and Highest Astronomical Tide (tidal work) (<i>Coastal Protection and Management Act 1995</i> and <i>Transport Infrastructure Act 1994</i>) • Resource Entitlement for operational work on State land (under Schedule 14 of SPA) • Resource Allocation for use of State resources under the <i>Fisheries Act 1994</i> or the <i>Coastal Protection and Management Act 1995</i> 	<ul style="list-style-type: none"> • Habitat modification involving runnelling • Operational work to modify drainage structures, overland flow paths or waterways • Operational work (tidal work)
<i>Fisheries Act 1994</i>	Resource allocation	<ul style="list-style-type: none"> • Use of State resource/s administered under the <i>Fisheries Act 1994</i> 	<ul style="list-style-type: none"> • Removal or excavation of material from a waterway

Legislation	Permit/ approval	Trigger description/s	Direct control activity
<i>Coastal Protection and Management Act 1995</i>	Resource allocation	<ul style="list-style-type: none"> Use of State resource/s administered under the <i>Coastal Protection and Management Act 1995</i> 	<ul style="list-style-type: none"> Removal or excavation of material from below High Water Mark (MHWS) or within a Coastal Management District
<i>Marine Park Act 2004</i>	Marine park permit or prohibited development	<ul style="list-style-type: none"> Operational work within a Marine Park or Protection Zone 	<ul style="list-style-type: none"> Operational work within tidal areas of Curtis Island that are subject to the Dugong Protection Zone and other QPWS managed areas
<i>Nature Conservation Act 1992</i>	Clearing permit	<ul style="list-style-type: none"> Clearing protected plants 	<ul style="list-style-type: none"> Clearing for operational work associated with habitat modification activities

The following is a list of management strategies to be adopted for the Marine Crossing GTP Project during construction activities.

5.2.1 Personal protection

- Personnel will wear hats, socks, and loose fitting, light coloured clothing with long pants and long sleeves when outdoors. Head nets and gloves will also be worn, if required. Head nets with meshes are recommended. Sleeves and collars will be kept buttoned and trousers tucked into boots. In severe cases clothing may be impregnated with pyrethrum
- Where practicable, personnel will avoid peak biting times; specifically at dusk
- Personnel will be educated on the mosquito and midge problem onsite and educated in management strategies and responsibilities for their own health (through induction, regular communication and posters throughout the construction site)
- The workforce will be notified if there is a mosquito or biting midge problem and individuals will implement appropriate personal protection measures
- When required, personnel will use tropical strength mosquito repellents

5.2.2 Design

- All onsite work offices and day accommodation for the Marine Crossing GTP Project will be air conditioned and screened. Screens will be the correct mesh size, fit tightly and be in good repair. All screen doors on buildings will open outward and have automatic closing devices. Where required, Bifenthrin barrier treatments around personnel areas will be implemented to reduce adult biting midge numbers

5.2.3 Source reduction

Container breeding

Management actions for container and vessel breeding include:

- The creation of areas and structures in which water could be retained for more than five days will be avoided (eg vigilance relating to potential mosquito breeding habitat)
- The Project area will be inspected daily for the presence of any containers and vessels capable of holding water (including bunded areas) to prevent water pooling. These areas will be drained and treated as required

Drainage systems

Drains will be constructed in a manner that does not lead to the creation of new mosquito breeding sites. The design of drainage systems will consider the following design features:

- Erosion control measures will be installed on drain batters to prevent silting
- Erosion control measures will be visually inspected daily and silt removal will be conducted as required, in accordance with the Stormwater Management and Erosion and Sediment Control Plan (SMESCP) to prevent creation of favourable breeding conditions
- Any plant species selected to stabilise slopes will be terrestrial and not be likely to invade water bodies and create breeding grounds for mosquitoes
- Drainage design will prevent the accumulation of silt and debris that may create pooling of water or favourable breeding conditions
- All maintenance of drains will be carried out in accordance with procedures which ensure that further habitats for mosquitoes or midges are not created by wheel ruts
- Drains will be maintained free of siltation and debris
- Drains will be inspected as per the monitoring programme in Table 5.1

Construction

Construction activities may create mosquito/biting midge breeding sites. In order to minimise the potential for this to occur, the following actions will be implemented:

- Access roads will be fitted with culverts where necessary, in order to prevent water ponding upstream, and thus prevent mosquito breeding
- Regular dewatering of trenches will minimise the potential for any standing water during trenching activities
- Regular reuse and/or removal of water from all water storage systems, such as the sedimentation pond, water treatment plant, hydrotest water dam and freshwater storage tanks will minimise sources of standing water and thereby minimising the potential for mosquito breeding and larvae forming on the edges of the water storage tanks or ponds
- Construction site pads will be constructed of compacted gravel and concrete hardstand surfaces, which will direct water to drain to the stormwater storage and prevent mosquito access to excess water
- Reinstated sites will be recontoured to the original surface profiles to prevent ponding

5.2.4 Controls

Chemical controls

If necessary and under the direction of GRC, Department of Natural Resource Management (DNRM) (formerly DERM), DEHP or QH, areas that cannot be managed with other controls (eg planning and risk management methods) will be treated as required with a control agent. Relatively few chemicals can be recommended for use in wetlands, whether natural or constructed (usually flow into natural water systems), because of environmental concerns. The importance of pre-inspection activities is further reinforced when considering the selection of the most suitable treatment chemical, as the effectiveness of the approved control agent is dependent on local conditions and the mosquito species that is being targeted.

Consultation will be undertaken with GRC and QH prior to the planning of and implementation of this management option.

If chemical controls are to be used, in addition to controls specified by GRC or other administering authorities, the following management actions will be adhered to:

- A suitably qualified consultant will be engaged to develop a treatment programme that meets the Mosquito Management Code of Practice (LGAQ, 2002)
- A licensed and experienced operator will be engaged to undertake the chemical treatment
- Only environmentally safe bio-rational agents would be used for larval control and adulticiding. Chemicals used will be registered and used in accordance with manufacturer's instruction
- Treatments will not be undertaken prior to a breeding event
- Areas identified for treatment will consider proximity to environmentally sensitive areas and appropriate buffer zones will be designated
- A treatment register will be maintained and will include:
 - Areas treated
 - Date and time of treatment
 - Equipment
 - Pilot/operator
 - Insecticide dose
 - Insecticide batch measure
 - Result

Larviciding

Larviciding is the control of mosquito larvae prior to their metamorphosis into adult flying mosquitos. Several products are available for use in larvicidal applications and selection of these products will be confirmed prior to construction.

It should be noted chemicals should only be used after full assessment of potential adverse effects, consideration of the receiving environment and onsite risk/benefit analysis.

Adulticiding

Adulticiding is the control of adult, mature mosquitoes following their metamorphosis from the larval form. This stage of the lifecycle constitutes the pest stage. Several products are available for use in adulticidal applications and selection of these products will be confirmed prior to construction.

5.3 Management and mitigation measures

The mitigation and management measures to be implemented are outlined in Table 5.3. The person(s) responsible for compliance with this MMMP during the construction period and operational phase and their responsibilities are also summarised in Table 5.3.

Table 5.3 Mitigation measures for mosquitoes and biting midges

Actions	Action timing	Responsibility
Review aerial photography and ecological survey data and identify potential mosquito and biting midge breeding locations that exist within the Marine Crossing GTP Project area and surrounding areas up to 1 km from the boundary	Pre-disturbance	Construction Contractor
Develop a site register and record all potential mosquito and biting midge breeding sites identified within the Marine Crossing GTP ROW and associated construction areas	Pre-disturbance	Construction Contractor

Actions	Action timing	Responsibility
Identify all potential mosquito and biting midge breeding sites recorded in the site register that occur within the Marine Crossing GTP Project area and 1 km buffer, on detailed design drawings	Pre-disturbance	Construction Contractor
Physically locate and flag all potential mosquito and biting midge breeding sites, recorded in the site register and marked on detailed design drawings, that occur within the Marine Crossing GTP Project area, in the field using cadastral survey	Pre-disturbance	Construction Contractor
Identify treatment triggers and adopt threshold criteria that result in the initiation/implementation of specified control strategies, monitoring, reporting or corrective actions and external notification procedures	Pre-disturbance	Construction Contractor
Develop procedures that provide guidance for the approved response to triggering of threshold criteria	Pre-disturbance	Construction Contractor
Identify proposed construction activities that will potentially exacerbate mosquito and biting midge impacts	Pre-construction	Construction Contractor
Develop specific avoidance measures and incorporate the implementation of these measures in the relevant Work Method Statements (WMS) and Job Safety and Environmental Assessments (JSEAs)	Pre-construction and construction	Construction Contractor
Review site layout plans and identify (and relocate) activities that can be relocated within the Marine Crossing GTP Project area, away from identified potential mosquito breeding sites	Pre-construction and construction	Construction Contractor
Review site layout plans and detailed design drawings and identify and communicate locations within the Marine Crossing GTP Project that are no-go zones or restricted activity areas during specified times of the day (eg dawn and dusk within 500 m of intertidal areas or creeks), during particular seasons or for a specified time after a threshold meteorological event	Pre-construction and construction	Construction contractor
Review the construction work schedule and identify (and reschedule) activities that can be rescheduled to occur during the cooler and drier periods of the year during daytime hours (not dawn or dusk hours)	Pre-construction and construction	Construction Contractor
Review detailed design drawings and site layout plans and identify structures (temporary and permanent) that will potentially exacerbate mosquito and biting midge impacts	Pre-construction and construction	Construction Contractor
Develop and implement specific indirect control measures for managing mosquito and biting midge impacts throughout construction that will be documented and implemented through design specifications and construction site maintenance procedures	Pre-construction and construction	Construction Contractor
Develop and implement a daily visual monitoring procedure for detecting the presence of mosquito and biting midge and favourable habitat conditions (naturally occurring and construction-related)	Pre-construction	Construction Contractor
Conduct daily visual inspections, identify, record and report favourable habitat conditions (naturally occurring and construction-related), ineffectiveness and/or non-conformance with avoidance and control measures, activity specifications, design specifications, WMS, JSEAs and triggers for corrective actions	Construction (daily)	Construction Contractor

Actions	Action timing	Responsibility
Identify and communicate visual monitoring parameters and performance criteria that will be adopted during operation and maintenance of the Marine Crossing GTP to measure, monitor and report ineffectiveness or non-conformance due to changed conditions and trigger corrective action and maintenance activities to manage and control mosquito and biting midge impacts	Post-construction	GLNG Operations
Develop and implement a visual monitoring procedure that will be implemented during operation and maintenance inspections to measure, monitor and report ineffectiveness or non-conformance due to changed conditions	Operation and maintenance	GLNG Operations

5.4 Reporting and record keeping

5.4.1 Construction phase

During the construction period, the Construction Contractor will be responsible and will undertake the following:

- Retain a copy of the MMMP onsite for reference by appropriate personnel and provide a copy to contractors and subcontractors
- Ensure compliance with the MMMP
- Ensure that contractors and subcontractors engaged in the construction are advised of their responsibilities to undertake their activities in accordance with the MMMP
- Ensure that contractors and subcontractors engaged in the construction activities within the Project area are advised of their responsibilities regarding mosquito management
- Ensure that an auditing/monitoring programme is implemented
- Ensure appropriate records are kept and maintained
- Ensure performance and compliance with the MMMP is reported in the monthly performance report to GLNG
- Prepare incident reports and implement corrective actions
- Recommend additions or changes to the MMMP based on experience gained from implementation of the MMMP

5.4.2 Operational phase

During the operational phase and subsequent de-commissioning period, GLNG Operations will be responsible and will undertake the following:

- Retain a copy of the MMMP
- Ensure compliance with the MMMP
- Ensure appropriate records are kept and maintained on-site
- Ensure that the monitoring programme is implemented on an as needed basis
- Prepare incident reports and implement corrective actions as required

5.4.3 Continual improvement

This MMMP will be reviewed annually to ensure GRC, DNRM and QH requirements and standards are met and make any necessary changes to improve the MMMP

5.5 Training and awareness

All construction personnel will be made aware of the MMMP during the Project Environmental Induction Programme. A register of induction training will be maintained.

6. Compliance evaluation

6.1 Mosquito and midge population monitoring

To determine the ongoing prevalence and distribution of mosquito and larvae and to enable timely control activities the following monitoring will be undertaken during the peak mosquito breeding season (December to March), as outlined in Table 6.1

Table 6.1 Ongoing monitoring programme during peak breeding season

Monitoring sites	Frequency
Visual inspection for site condition and housekeeping (all active areas)	Daily
Pooled water and containers around the site	
Pooled water Visual inspection	Weekly
Sampling of mosquito larvae	Upon request by administering authority
Stormwater drainage systems	
Visual inspection	Daily
Sampling of mosquito larvae	Upon request by administering authority
Areas with pooled water Visual inspection	Weekly
Construction site pads, including ponds and water storage facilities	
Visual inspection	Daily
Sampling of mosquito larvae	Upon request by administering authority
Areas with pooled water Visual inspection	Weekly
Sampling of mosquito larvae	Upon request by administering authority
Low lying areas	
Visual inspection	Weekly following heavy rain events
Sampling of mosquito larvae	Upon request by administering authority

In addition to this monitoring, close liaison with GRC and QH will occur to obtain results of any previous surveys undertaken within the area, and to be notified of major mosquito events within the Marine Crossing GTP Project area.

7. Non-conformance

Non-conformance, preventative and corrective action procedures are detailed in Section 5.6 of the CEMP.

7.1 Corrective Action

The GLNG Project community relations grievance management process and complaints register will be developed and implemented under the Construction Environmental Management Plan (CEMP) to capture complaints from individuals or communities with respect to any issues including mosquito and midge prevalence.

7.2 Notification of vector borne disease

A register will be maintained of any construction personnel member infected by the following vector borne diseases:

- Ross River virus
- Japanese encephalitis
- Malaria (unspecified and other)
- Malaria Falciparum
- Malaria Malariae
- Malaria Ovale
- Malaria Vivax
- Barmah Forest virus
- Dengue fever

Data on vector borne disease numbers for the region can be requested from QH if deemed necessary. However, these records are not always indicative of the mosquito problem as records only show those who have been diagnosed by a doctor and do not link the result to the area of transmission.

8. References

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