E1 | Land

Santos | PETRONAS

Report

GLNG EIS Supplement.

Gas Transmission Pipeline, Soils

NOVEMBER 2009

Prepared for

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Table of Contents

Figures

Abbreviations

Abbreviation	Description
ASS	Acid Sulfate Soils
CICSDA	Callide Infrastructure Corridor State Development Area
CPIC	Common Pipeline Infrastructure Corridor
CSIRO	Commonwealth Scientific and Industrial Research Organisation
D	Dispersive soils
EIS	Environmental Impact Statement
ESA	Environmental sensitive areas
GQAL	Good Quality Agricultural Land
GSDA	Gladstone State Development Area
GSQ	Geological Survey Queensland
GTP	Gas transmission pipeline
ha	Hectares
km	Kilometre
LNG	Liquefied Natural Gas
m	Metre
R	Reactive soils
ROW	Right of way
Sa	Saline soils
So	Sodic soils

Executive Summary

A series of Gas Transmission Pipeline (GTP) route alternatives (GLNG GTP (September 2009)) to the EIS GTP (March 2009) Route have been identified by Santos. Some of the proposed deviations occur within the 1 km wide EIS GTP (March 2009) Route corridor area as mapped in the EIS, however, there are some sections which fall outside. This report includes additional terrain mapping, evaluation, assessment and reporting for the GLNG GTP (September 2009).

This report also includes additional terrain mapping, evaluation, assessment and reporting for the Common Pipeline Infrastructure Corridor (CPIC), being the shared infrastructure corridor for multiple proponents proposed by the Queensland Government between Callide and the proposed LNG facility sites on Curtis Island and is comprised by the CPIC (CICSDA Section) Route and the CPIC (GSDA Section) Route. Although it is Santos preference to utilise the CPIC Route, this is dependent on the government's resumption of the underlying land interest and negotiation of access terms and conditions.

The GLNG GTP (September 2009) is the route alternatives identified by Santos since March 2009 (as a single alignment) as the result of further engineering, geotechnical, environmental and other investigations. Santos is continuing to consider the EIS GTP (March 2009), the CPIC (CICSDA Section) Route, the CPIC (GSDA Section) Route, and the Callide Range Alternative Route and the final GTP route corridor will be determined once the final engineering design for the pipeline has been developed and is subject to Santos and/or the government obtaining the necessary underlying land interest and negotiation of access terms and conditions with respect to the CPIC Route.

Seven route alternative sectors that have involved new mapping have been designated Sections A to G inclusive. These occur together with new mapping required for part of the CPIC route designated as the CPIC (CICSDA Section) and the CPIC (GSDA Section) Route sectors. Together with the overall sheet layout plan - Figure 1, collectively these are shown in Figures 2 to 15. A generic key to the identification of terrain units throughout Figures 2 to 15 is provided in Figure 16.

Terrain unit mapping for this report has involved a compilation and amalgamation of various land resources digital datasets including GSQ regional geology, CSIRO land systems and land units details and associated soils information, superimposed over high resolution image basemaps and topographic basemaps with 5 m contour information shown.

For each of the mapping sectors in this report, the cumulative distances of the terrain units intersected along the GTP are shown in the terrain units and constraints tables and sector summary tables shown in Figures 2 to 15. The basis for the various levels of constraints and impacts assessed on a terrain unit basis, are discussed in detail in EIS Section 7.3 and in EIS Appendix L2, together with management strategies and mitigation measures proposed, which will be adopted in order to minimise potential environmental and construction impacts as much as practicable.

A general descriptive summary with respect to the levels of constraints and the areas of impacts determined within each of the new mapping sectors is also provided in the report.

1

Introduction

1.1 Background

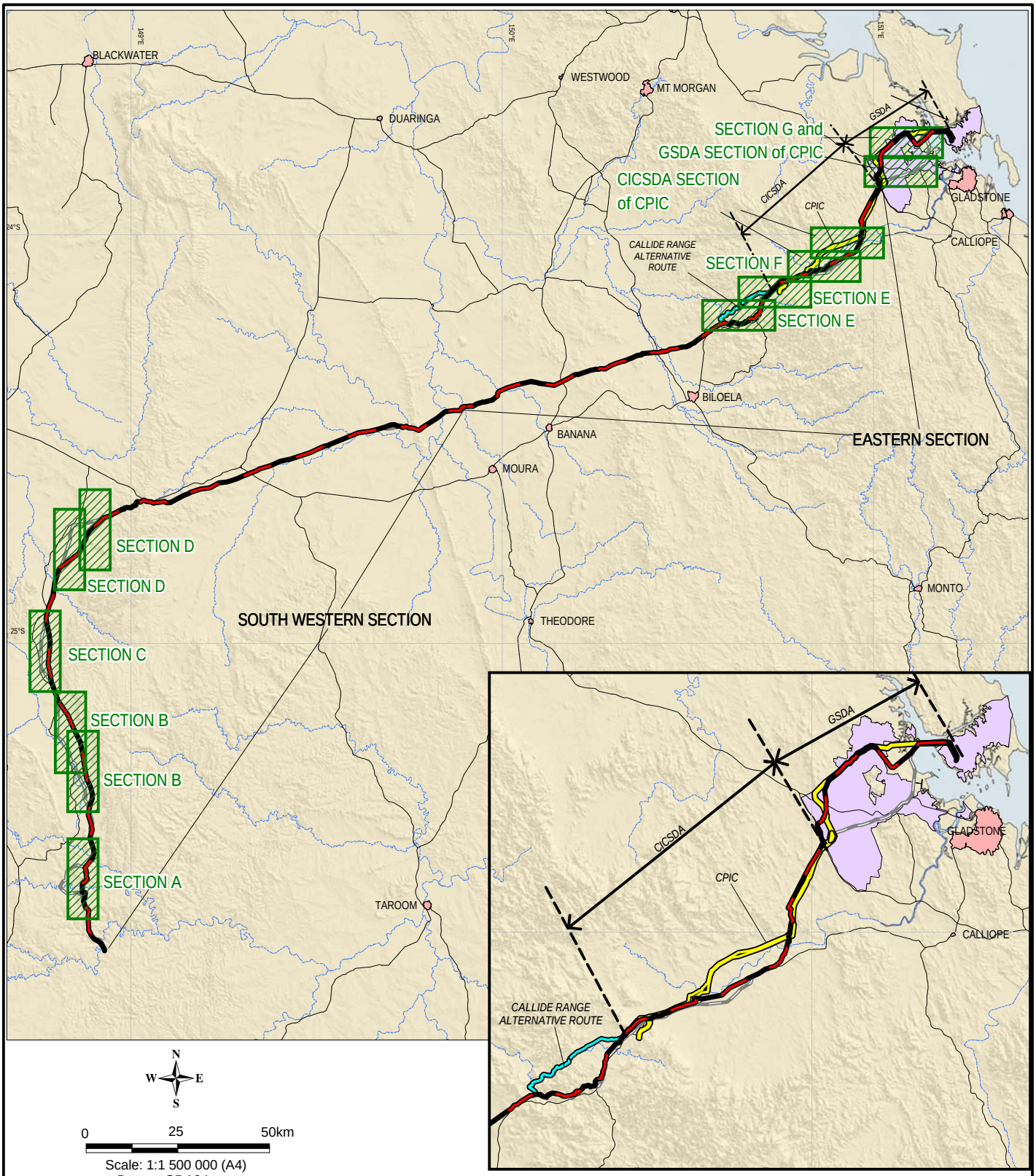
The GLNG GTP (September 2009) Route, commences just to the south of the Fairview CSG field, runs in a northerly direction for approximately 140 km, then heads in an east-north-easterly direction for approximately 280 km to Friend Point in the GSDA. The alignment then crosses the Narrows waterway and continues onto Curtis Island to the LNG facility. A series of minor deviations and some substantial re-alignments of sections of the EIS GTP (March 2009) Route have since been identified as route alternatives by Santos. Some of the proposed route alternatives occur within the 1 km wide EIS GTP (March 2009) Route corridor area as mapped in the EIS; however, there are some sections which fall outside. This report includes additional terrain mapping, evaluation, assessment and reporting for the route alternative sectors that fall outside the 1 km wide EIS GTP (March 2009) Route corridor area.

This report also includes additional terrain mapping, evaluation, assessment and reporting for the Common Pipeline Infrastructure Corridor (CPIC), being the shared infrastructure corridor for multiple proponents proposed by the Queensland Government between Callide and the proposed LNG facility sites on Curtis Island and is comprised of the CPIC (CICSDA Section) Route and the CPIC (GSDA Section) Route. Although it is Santos' preference to utilise the CPIC Route, this is dependent on the government's resumption of the underlying land interest and negotiation of access terms and conditions.

Seven route alternative sectors that have involved new mapping have been designated, Sections A to G inclusive. These occur together with new mapping required for part of the CPIC route designated as the CPIC (CICSDA Section) and the CPIC (GSDA Section) route sectors. Together with the overall sheet layout plan - Figure 1, collectively these are shown in Figures 2 to 15. A generic key to the identification of terrain units throughout Figures 2 to 15 is provided in Figure 16.

It should be noted that for the cumulative areas of constraints and levels of impacts identified on the basis of terrain units intersected along the centreline of the GTP, a maximum 40 m width of right-of-way (ROW) has been assumed. In ecologically sensitive areas (ESA) identified along the GTP corridor, clearing/disturbance along the ROW will be limited to a maximum width of 30 m in order to minimise environmental impacts as much as practicable. The areas of impact in those areas should be reduced accordingly. Excluding the CPIC, it should also be noted that the final post-construction easement width is proposed to be a maximum 30 m. The additional 10 m will be rehabilitated and returned to the landholder once construction of the pipeline is completed.

For each of the new mapping sectors identified, depending on the various levels of constraints and impacts assessed on a terrain unit basis, management strategies and mitigation measures are discussed in EIS Section 7.3 and in EIS Appendix L2, which will be adopted in order to minimise potential environmental impacts as much as practicable.



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Datum: GDA94

Map Sheet Layouts showing areas re-assessed for GLNG EIS Supplement - Soils Assessment.

GLNG Gas Transmission Pipeline (September 2009)

Callide Range Alternative Route (September 2009)

Common Pipeline Infrastructure Corridor (September 2009)

Gladstone State Development Area

EIS Gas Transmission Pipeline (March 2009)

ABBREVIATIONS

GLNG	Gladstone Liquified Natural Gas
CPIC	Common Pipeline Infrastructure Corridor
CICSDA	Callide Infrastructure Corridor State Development Area
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
SOILS ASSESSMENT

Title
MAP SHEETS LAYOUT SHOWING NEW GT PIPELINE ALIGNMENTS OVER EIS GT PIPELINE ALIGNMENT

Drawn: CA	Approved: JB	Date: 10-11-2009	Figure: **1**
Job No: **4262 6440**/6220	File No: 42626440-g-2010.wor		Rev:C A4

2

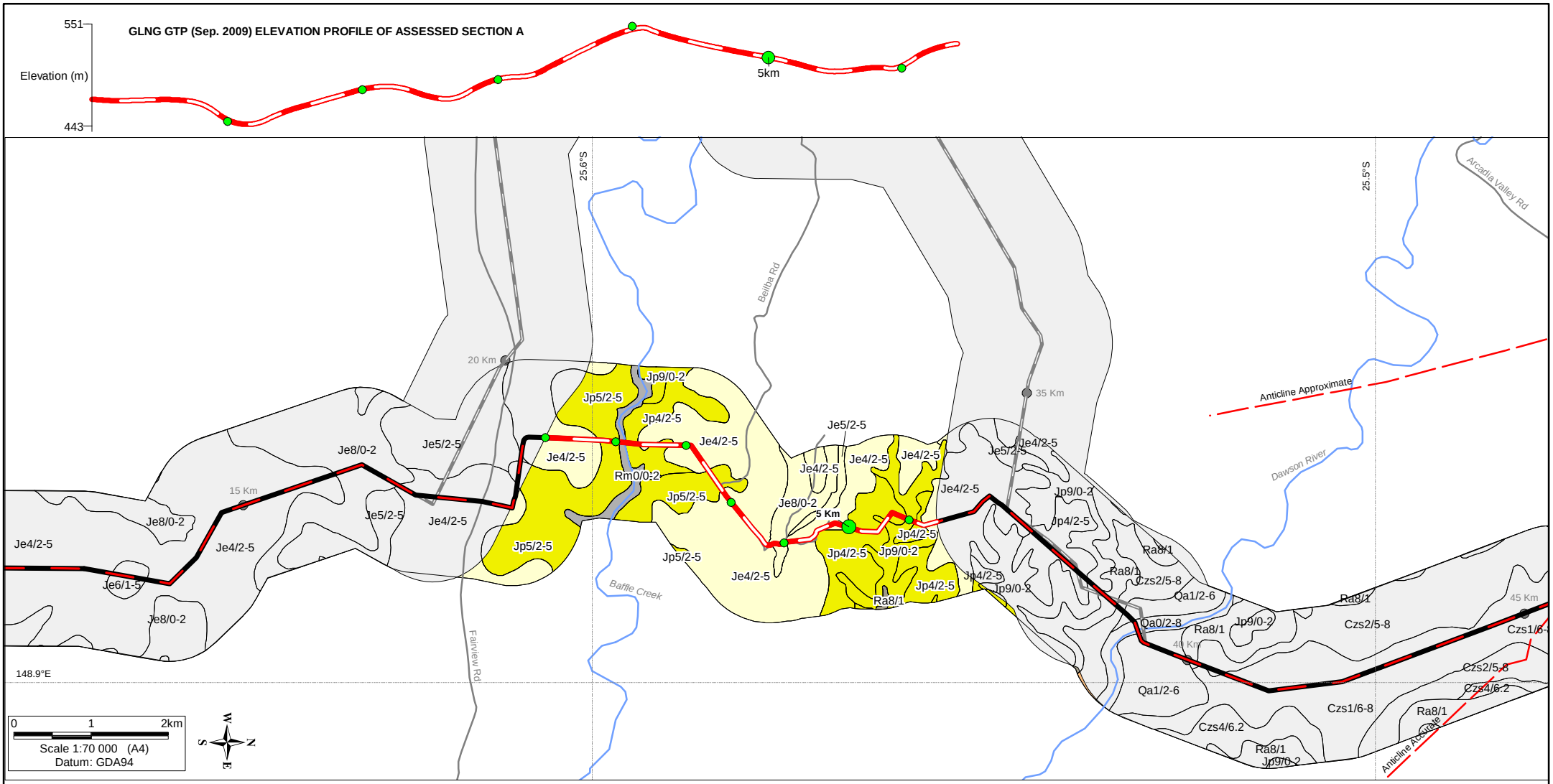
New Gas Transmission Pipeline sections

2.1 GLNG GTP September 2009 (Section A)

Section A occurs at the southern end of the alignment in the Fairview field. It cuts off a large westerly loop from the EIS GTP (March 2009) Route which had been previously chosen to avoid steep terrain and difficult to construct topography. Approximately 6.4 km of the GLNG GTP September 2009 (Section A) falls outside the 1km EIS GTP (March 2009) Route corridor area. Overall Section A shortens the GTP centreline by approximately 14.5 km as compared to the EIS GTP (March 2009) Route. The cumulative distances of the terrain units intersected along the Section A alignment centreline are shown in the "Terrain units and constraints" table shown in Figure 2.

EIS Appendix L2 provides a description and assessment of terrain units, together with the basis for the assessment of constraints and limitations. A summary of potential constraints on a terrain unit basis is included in the sector summary for Section A, provided in Figure 2, general details of which are summarised as follows:

- **Topographic constraints** - potentially high levels of topographic constraints occur over a cumulative distance of 0.5 km (2.2 ha) as a result of the Section A intersections of terrain units Rm0/0-2, Jp8/0-2 and Jp9/0-2. A moderate level of constraint has been assessed for intersections of terrain units Jp5/2-5 which cover a cumulative distance of 0.6 km (2.5 ha). The remaining 5.3 km (21.0 ha) of Section A, which intersects terrain units Jp4/2-5 and Je 4/2-5, is rated as having a low topographic constraint;
- **Excavation conditions** - potentially high levels of constraint with respect to excavation conditions have been assessed for intersections of terrain units Jp8/0-2 and Je9/0-2 which occur over a distance of approximately 0.5 km (1.8 ha). Moderate levels of constraint with respect to excavation rating have been assessed for the terrain units intersected over the remaining 5.3 km (21.0 ha) along Section A;
- **Erosion potential** - potentially high levels of constraint with regard to erosion potential have been assessed for all terrain units intersected along the 6.4 km (25.6 ha) of Section A;
- **Drainage status** - potentially high levels of constraint have been assessed for intersections of terrain unit Rm0/0-2 over a distance of approximately 0.1 km (0.4ha) which are subject to frequent erosive flood flows;
- **Problem soils** - moderate levels of constraint with respect to problem soil occurrences primarily in this area relating to soils with sodic and/or dispersive clay subsoils. These are intersected over a cumulative distance of approximately 5.3 km (21.0 ha) in particular in terrain units Jp4/2-5 and Je4.2-5. The occurrence of problem soils over the remaining 1.1 km (4.6 ha) of Section A is rated as low; and
- **Agricultural land classes** – terrain units Jp4/2-5 and Je4/2-5 which are intersected over a cumulative distance of 5.3 km (21.0 ha) have been rated as Land Class C2. Terrain unit Jp5/2-5 is intersected over a distance of 0.6 km (2.5 ha) and is rated as Land Class C3. Terrain units Rm0/0-2, Je8/0-2 and Jp9/0-2 are intersected along Section A over a cumulative distance of 0.5 km (2.2ha) and have been rated as Land Class D.



Terrain Units & Constraints Intersecting Assessed GLNG GTP (September 2009) Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Rm0/0-2	H	3	H	F4	L	D	90
Jp9/0-2	H	3-4	H	X	L	D	218
Je8/0-2	H	3-4	H	X	L	D	235
Jp5/2-5	M	2	H	W	L	C3	616
Jp4/2-5	L-M	2-3	M-H	W	L-M (So/D)	C2	1,435
Je4/2-5	L-M	2-3	H	W	M (So/D)	C2	3,818

Total GLNG GTP (September 2009) Alignment length assessed in current map sheet: 6,412m (6.4km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	5,254	-	-	5,870	1,159
Moderate Constraint	616	5,959	-	453	5,254
High Constraint	543	453	6,412	90	-

Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

- 1km Distance Markers along GLNG GTP (September 2009) Section Assessed in current Map Sheet.
- GLNG Gas Transmission Pipeline (September 2009) Section Assessed in current Map Sheet.
- GLNG Gas Transmission Pipeline (September 2009)
- EIS Gas Transmission Pipeline (March 2009)
- 5km Distance Markers along EIS GTP (March 2009)
- EIS GTP 1km Buffer (March 2009)
- Fault
- Anticline
- Syncline
- River / Creek
- Road

Note: Observe North Direction.

ABBREVIATIONS

GLNG	Gladstone Liquified Natural Gas
GTP	Gas Transmission Pipeline

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
SOILS ASSESSMENT

Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION A (MAP SHEET 1 of 1)

Drawn: CA | Approved: JB | Date: 03-11-2009

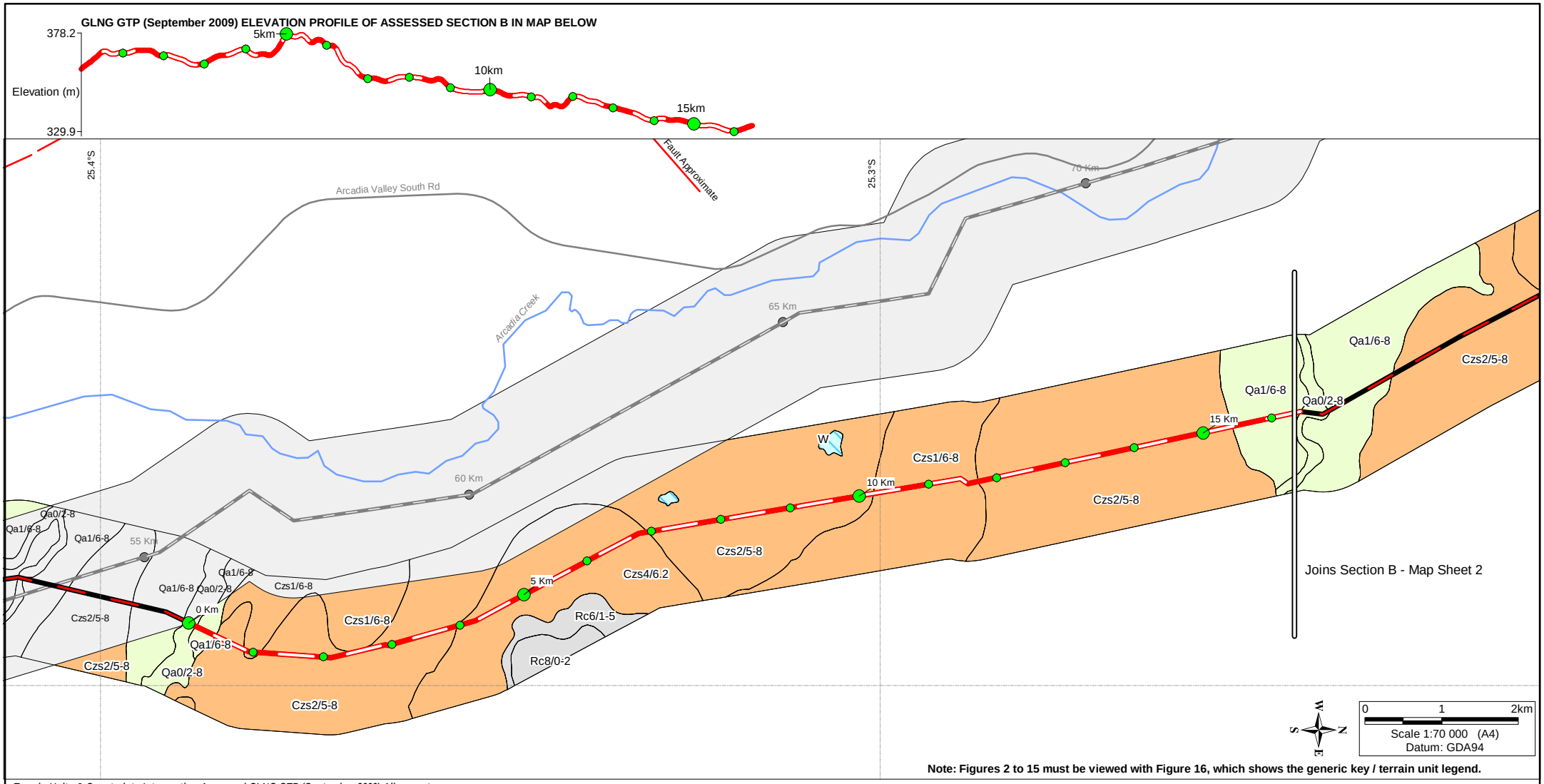
Job No: 4262 6440/6220 | File No: 42626440-g-2011.wor

Figure: 2 | Rev:B | A4

2.2 GLNG GTP September 2009 (Section B)

GLNG GTP September 2009 (Section B) is approximately 28.0 km in length. Overall this new alignment is marginally shorter (<1 km) compared to the EIS GTP (March 2009) Route. The cumulative distances of the terrain units intersected along the Section B alignment ROW are shown in the terrain units and constraints table shown in Figures 3 and 4. A cumulative overall summary of potential levels of constraints is included in the sector summary tables provided in Figures 3 and 4. General details for the sector as a whole are as follows:

- **Topographic constraints** – high topographic constraints have been assessed over a cumulative distance of 0.5 km (2.1 ha) due to Section B crossing of terrain unit Qa0/2-8. The remaining 27.5 km (109.8ha) of Section B, which intersects terrain units Qa1/6-8, Czs1/6-8, Czs2/5-8 and Czs4/6.2 are rated as having a low or low to moderate topographic constraints;
- **Excavation conditions** – moderate constraints relating to excavation conditions have been assessed over a cumulative distance of 0.5 km (3.1 ha) which relates to Section B crossing terrain unit Qa0/2-8. The remaining 27.5 km (109.8 ha) of Section B intersects terrain units with low, in parts (Czs4/6.2) low to moderate constraints with respect to excavation conditions;
- **Erosion potential** – moderate to high levels of erosion potential have been assessed for approximately 0.5 km (2.1 ha) of the Section B crossings of terrain units Qa0/2-8. The remaining 27.5 km (109.8 ha) along the Section B intersects terrain units assessed to exhibit moderate levels of erosion potential;
- **Drainage status** - potentially high levels of constraints related to frequency of flooding have been assessed for intersections of terrain units Qa0/2-8 and Qa1/6-8 over a cumulative distance of approximately 2.8 km (11.4 ha) along Section B. A further 19.7 km (78.8 ha) of Section B intersects terrain units Czs1/6-8 and Czs2/5-8 which have been rated as exhibiting moderate drainage constraints due to periodic flooding and/or impeded to poorly drained subsoil conditions. The remaining 5.5 km (21.8 ha) of Section B intersects terrain units Czs4/6.2 which have been rated as having a low level of drainage constraint;
- **Problem soils** – high levels of constraint occur involving highly reactive, sodic and/or dispersive soils that occur in terrain units Qa1/6-8 and Czs1/6-8 are intersected over a distance of 4.1 km (16.4 ha); high constraint soils with sodic and dispersive subsoils also occur over a centreline distance of 5.4 km (21.8 ha) in terrain unit Czs4/6.2. Soils with moderate constraints include reactive soils that occur in terrain units CZS2/5-8 and Qa0/2-8 over a cumulative distance of 18.4 km (73.8 ha); and
- **Agricultural land classes** – intersections of terrain unit Czs2/5-8 which occur over a cumulative distance of 17.9 km (71.7 ha) have been rated as Land Class B. Terrain units Qa1/6-8 and Czs1/6-8 which are intersected over a distance of 4.1 km (16.4 ha) have been rated as Land Class C1. Terrain units Czs4/6.2 which are intersected over a cumulative distance of 5.5 km (21.8 ha) have been rated as Land Class C2. Intersections of terrain unit Qa0/2-8 (stream-lines) occur over a distance of 0.5 km (2.1 ha) and are rated as Land Class D.



Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

Terrain Units & Constraints Intersecting Assessed GLNG GTP (September 2009) Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Qa0/2-8	H	2	M-H	F4	M (R1)	D	119
Qa1/6-8	L	1	M	F3	H (R3,So/D)	C1	1,289
Czs1/6-8	L	1	M	F2	H (R3,So/D)	C1	1,781
Czs4/6.2	L-M	1-2	M	W	H (So/D)	C2	2,959
Czs2/5-8	L	1	M	I	M (R1)	B	10,269

Total GLNG GTP (September 2009) Alignment length assessed in current map sheet: 16,420m (16.4km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	16,297	16,297	-	2,959	-
Moderate Constraint	-	119	16,297	12,050	10,388
High Constraint	119	-	119	1,408	6,028

1km Distance Markers along GLNG GTP (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)
Fault
Anticline
Syncline
River / Creek
Road

Note: Observe North Direction.

ABBREVIATIONS

GLNG	Gladstone Liquified Natural Gas
GTP	Gas Transmission Pipeline

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
SOILS ASSESSMENT

Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION B (MAP SHEET 1 of 2)

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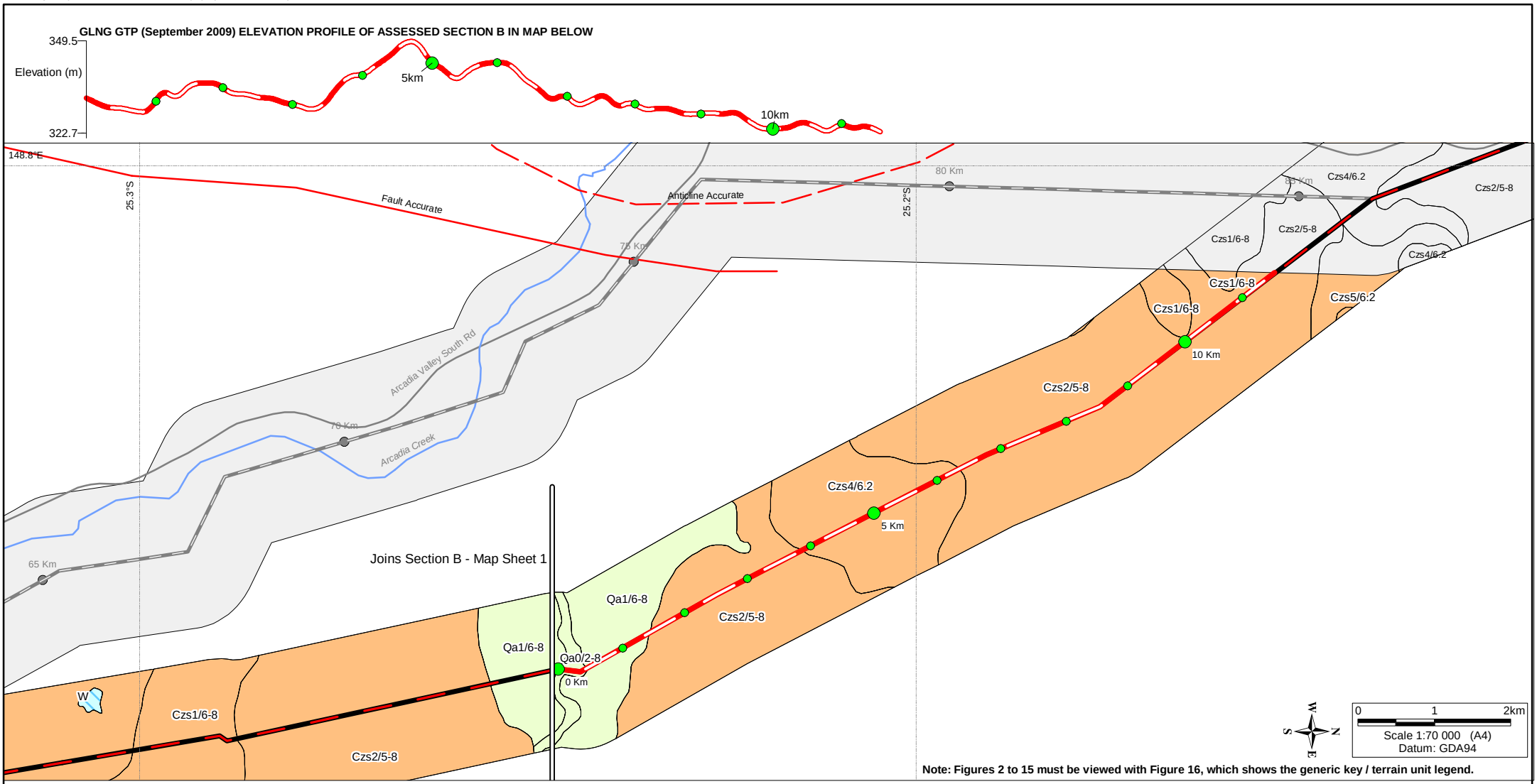
Figure: **3** | Rev:B | **A4**



Terrain Units & Constraints Intersecting Assessed GLNG GTP (September 2009) Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Qa0/2-8	H	2	M-H	F4	M (R1)	D	409
Qa1/6-8	L	1	M	F3	H (R3,So/D)	C1	1,025
Czs4/6.2	L-M	1-2	M	W	H (So/D)	C2	2,489
Czs2/5-8	L	1	M	I	M (R1)	B	7,644

Total GLNG GTP (September 2009) Alignment length assessed in current map sheet: 11,570m (11.6km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	11,158	11,158	-	2,489	-
Moderate Constraint	-	409	11,158	7,644	8,053
High Constraint	409	-	409	1,434	3,514

1km Distance Markers along GLNG GTP (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)

Fault
Anticline
Syncline
River / Creek
Road

Note: Observe North Direction.

ABBREVIATIONS

GLNG	Gladstone Liquified Natural Gas
GTP	Gas Transmission Pipeline

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
SOILS ASSESSMENT

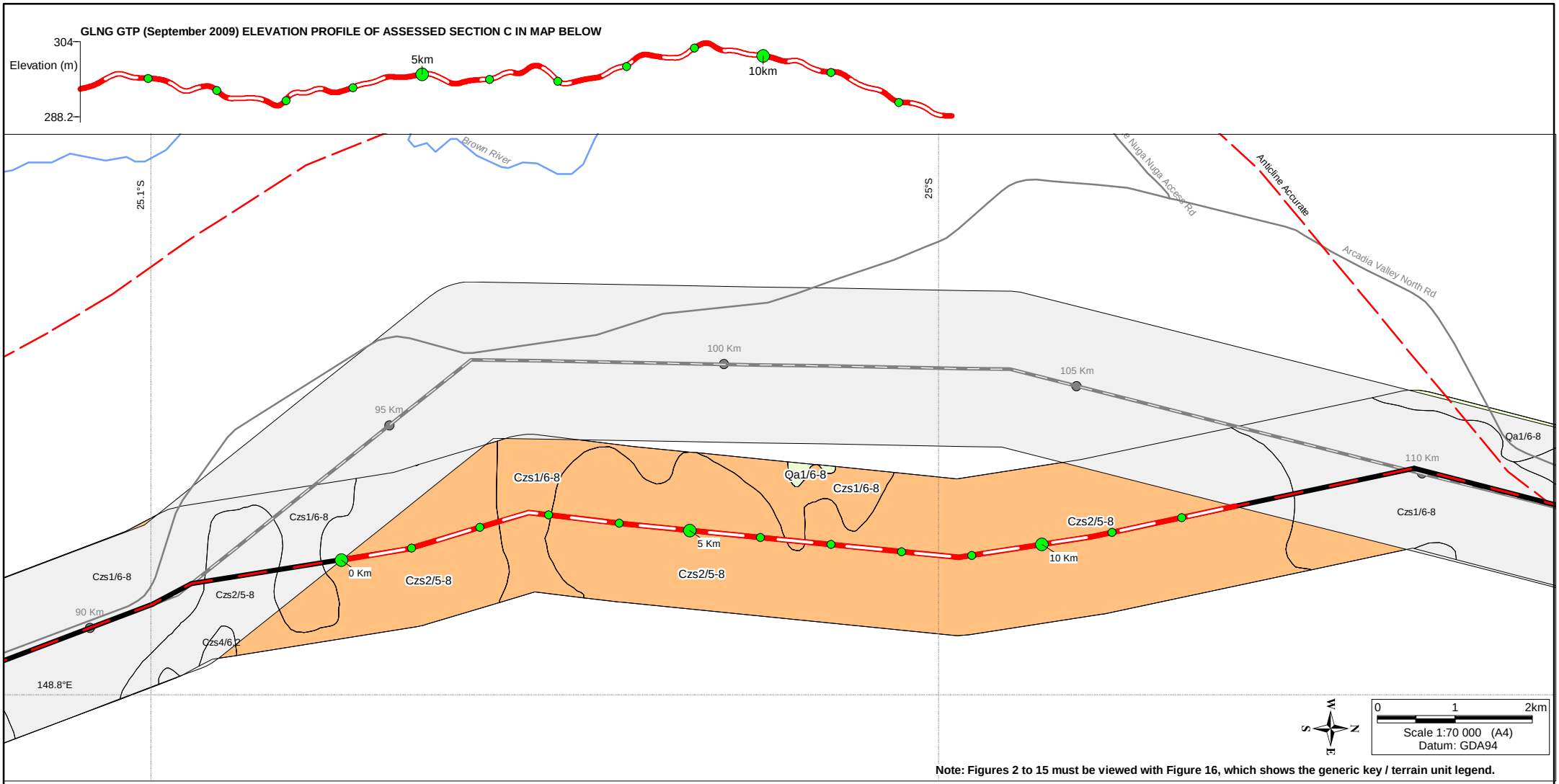
Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION B (MAP SHEET 2 of 2)

Drawn: CA | Approved: JB | Date: 03-11-2009
Job No: **4262 6440**/6220 | File No: 42626440-g-2013.wor
Figure: **4** | Rev:B | **A4**

2.3 GLNG GTP September 2009 (Section C)

GLNG GTP September 2009 (Section C) is 12.8 km in length. Section C is located approximately 2 km to the south, is about 2 km shorter and traverses less poorly drained flood prone land as compared to the EIS GTP (March 2009) Route. The cumulative distances of the terrain units intersected along Section C are shown in the terrain units and constraints table shown in Figure 5. A cumulative overall summary of potential levels of constraints is included in the sector summary tables provided in Figure 5. General details for the sector as a whole are as follows:

- **Topographic constraints** – terrain with low topographic constraints have been assessed to occur over the whole 12.8 km (51.1 ha);
- **Excavation conditions** – low constraints relating to excavation conditions have been assessed to occur over the whole 12.8 km (51.1 ha);
- **Erosion potential** – terrain with mainly moderate levels of erosion potential have been assessed to occur over the whole 12.8 km (51.1 ha);
- **Drainage status** – moderate levels of constraints related to the potential for periodic flooding have been assessed for terrain unit Czs1/6-8 over a cumulative distance of approximately 1.0 km (4.1 ha) along Section C. A further 11.7 km (47.0 ha) of the Section C alignment intersects occurrences of terrain units Czs2/5-8 which have been rated as exhibiting moderate drainage constraints due to impeded to poorly drained subsoil conditions;
- **Problem soils** – high levels of constraint related to highly reactive, sodic and/or dispersive soils associated with terrain unit Czs1/6-8 occur over a distance of 1.0 km (4.1 ha). Moderate levels of problem soil constraints due to the occurrence of shallow to medium deep reactive soils or soils with moderately strongly reactive subsoil conditions occur in terrain unit Czs2/5-8 over a cumulative distance of 11.8 km (47.0 ha); and
- **Agricultural land classes** – Section C intersections of terrain unit Czs2/5-8 which occur over a cumulative distance of 11.8 km (47.0 ha) have been rated as Land Class B. Terrain unit Czs1/6-8 which is intersected over the remaining 1.0 km (4.1 ha) along Section C have been rated as Land Class C1.



Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

Terrain Units & Constraints Intersecting Assessed GLNG GTP (September 2009) Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Czs1/6-8	L	1	M	F2	H (R3,So/D)	C1	1,027
Czs2/5-8	L	1	M	I	M (R1)	B	11,746

Total GLNG GTP (September 2009) Alignment length assessed in current map sheet: 12,770m (12.8km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	12,773	12,773	-	-	-
Moderate Constraint	-	-	12,773	12,773	11,746
High Constraint	-	-	-	-	1,027

1km Distance Markers along GLNG GTP (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)

Fault
Anticline
Syncline
River / Creek
Road

Note: Observe North Direction.

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
SOILS ASSESSMENT

Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION C (MAP SHEET 1 of 1)

Drawn: CA | Approved: JB | Date: 03-11-2009
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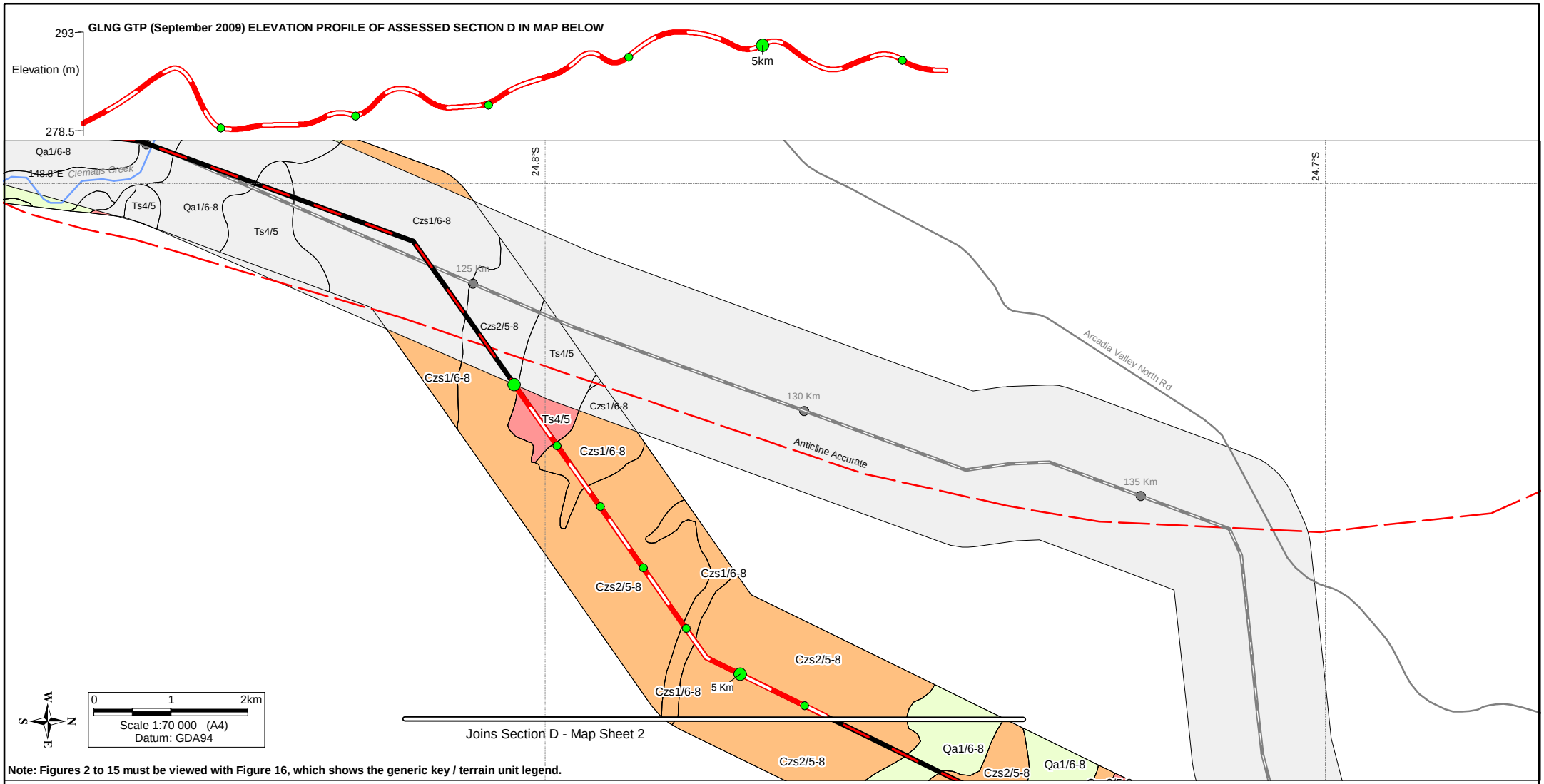
Figure: **5** | Rev:B | **A4**

2.4 GLNG GTP September 2009 (Section D)

GLNG GTP September 2009 (Section D) is 13.8 km in length. Section D is located between 1 and 3 km to the south-east and is about 2.5 km shorter as compared to the EIS GTP (March 2009) Route. Overall the terrain along Section D is generally better-drained and traverses somewhat less floodprone land compared to the EIS GTP (March 2009) Route. The cumulative distances of the terrain units intersected along the new alignment centreline and the levels of constraint identified are shown in the terrain units and constraints table shown in Figures 6 and 7. A cumulative overall summary of potential levels of constraints is included in the sector summary tables provided in Figures 6 and 7. General details for the sector as a whole are as follows:

- **Topographic constraints** – terrain units with low or low to moderate topographic constraints have been assessed to occur over 13.5 km (53.8 ha) of the Section D corridor; terrain unit Tb6/7.1 which occurs over a distance of 0.3 km (1.4 ha) along the Section D corridor at the eastern end, has been rated as presenting a moderate level of topographic constraint;
- **Excavation conditions** – low or low to moderate constraints with respect to excavation conditions have been assessed to occur over 13.2 km (52.6 ha); terrain units Tb4/8.1 and Tb6/7.1 collectively occur over 0.6 km (2.6 ha) and are rated as presenting a moderate level of constraint with respect to excavation conditions;
- **Erosion potential** – terrain units Ts4/5 and Tb6/7.1 are rated as having high erosion potential; collectively they occupy 3.0 km (11.8 ha) of Section D near the start and towards the eastern end of the new alignment. Terrain units Qa1/6-8, Czs1/6-8, Qa2/4-8, Czs2/5-8 and Tb4/6.1 all of which are rated as having a moderate level of erosion potential, collectively occur over 10.8 km (43.3 ha) of Section D;
- **Drainage status** – terrain unit Qa1/6-8 is intersected over a distance of 1.6 km (6.6 ha); these areas are frequently floodprone and represent a high level of drainage constraint. Terrain units Czs1/6-8, Qa2/4-8, Czs2/5-8, Ts4/5 and Tb6/7.1 are rated as having moderate levels of constraints due to periodic flooding potential, impeded or poor subsoil drainage or excessively well-drained surface conditions; collectively they occupy a cumulative distance of approximately 11.8 km (47.4ha). Terrain unit Tb4/8.1 occupies 0.3 km (1.2 ha) along Section D and represents a low level of drainage constraint;
- **Problem soils** – high levels of constraint related to highly reactive, sodic and/or dispersive soils associated with terrain unit Qa1/6-8 occur over a distance of 2.7 km (10.6 ha) along Section D. Moderate levels of problem soil constraints due to the occurrence of shallow to medium deep or moderately reactive soils or soils with moderately strongly sodic and/or dispersive subsoil conditions occur in terrain units Qa2/4-8, Czs2/5-8,Ts4/5 and Tb4/8.1 over a cumulative distance of 10.8 km (43.2 ha). Terrain unit Tb6/7.1 occurs over the remaining 0.3 km (1.4 ha) of Section D and has been rated as a low problem soil constraint; and
- **Agricultural land classes** – Section D intersections of terrain unit Czs2/5-8 which occur over a cumulative distance of 7.0 km (28.0 ha) have been rated as Land Class B. Terrain units Qa1/6-8, Czs1/6-8 and Qa2/4-8 collectively occur over 3.5 km (14.1 ha) along Section D and have been rated as Land Class C1. Terrain units Ts4/5 and Tb4/8.1 are intersected over a combined distance of 2.9 km (11.7 ha) and have been rated as Land Class C2. Terrain unit Tb6/7.1 is intersected over a distance of 0.3 km (1.4 ha) and has been rated as Land Class C3.



Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

Terrain Units & Constraints Intersecting Assessed GLNG GTP (September 2009) Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Ts4/5	L-M	1-2	M-H	I	M (So/D)	C2	881
Czs1/6-8	L	1	M	F2	H (R3,So/D)	C1	1,011
Czs2/5-8	L	1	M	I	M (R1)	B	4,448

Total GLNG GTP (September 2009) Alignment length assessed in current map sheet: 6,339m (6.3km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	6,339	6,339	-	-	-
Moderate Constraint	-	-	5,459	6,339	5,328
High Constraint	-	-	881	-	1,011

1km Distance Markers along GLNG GTP (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)

Fault
Anticline
Syncline
River / Creek
Road

Note: Observe North Direction.

ABBREVIATIONS

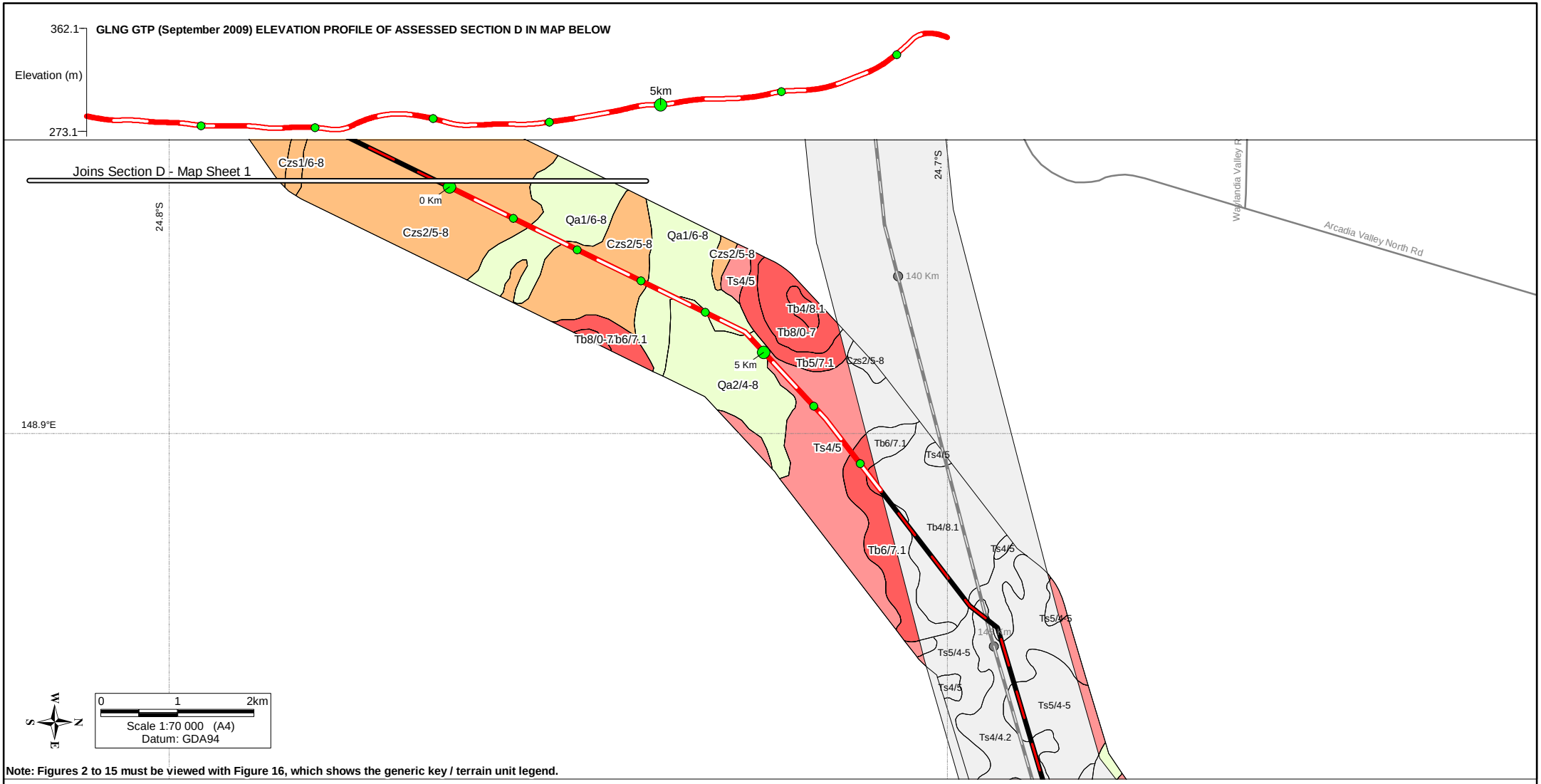
GLNG	Gladstone Liquified Natural Gas
GTP	Gas Transmission Pipeline

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
SOILS ASSESSMENT

Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION D (MAP SHEET 1 of 2)

Drawn: CA | Approved: JB | Date: 03-11-2009
Job No: 4262 6440 /6220 | File No: 42626440-g-2015.wor
Figure: 6 | Rev:B | A4



Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

Terrain Units & Constraints Intersecting Assessed GLNG GTP (September 2009) Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Tb4/8.1	L-M	2-3	M	W	L-M (R2)	C2	301
Tb6/7.1	M	2-3	M-H	W-X	L	C3	338
Qa2/4-8	L	1	M	F1	M (R3)	C1	887
Qa1/6-8	L	1	M	F3	H (R3,So/D)	C1	1,639
Ts4/5	L-M	1-2	M-H	I	M (So/D)	C2	1,732
Czs2/5-8	L	1	M	I	M (R1)	B	2,550

Total GLNG GTP (September 2009) Alignment length assessed in current map sheet: 7,448m (7.4km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	7,110	6,808	-	301	338
Moderate Constraint	338	640	5,377	5,507	5,470
High Constraint	-	-	2,071	1,639	1,639

1km Distance Markers along GLNG GTP (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)
Fault
Anticline
Syncline
River / Creek
Road

Note: Observe North Direction.

ABBREVIATIONS

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GTP	Gas Transmission Pipeline

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SOILS ASSESSMENT

Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION D (MAP SHEET 2 of 2)

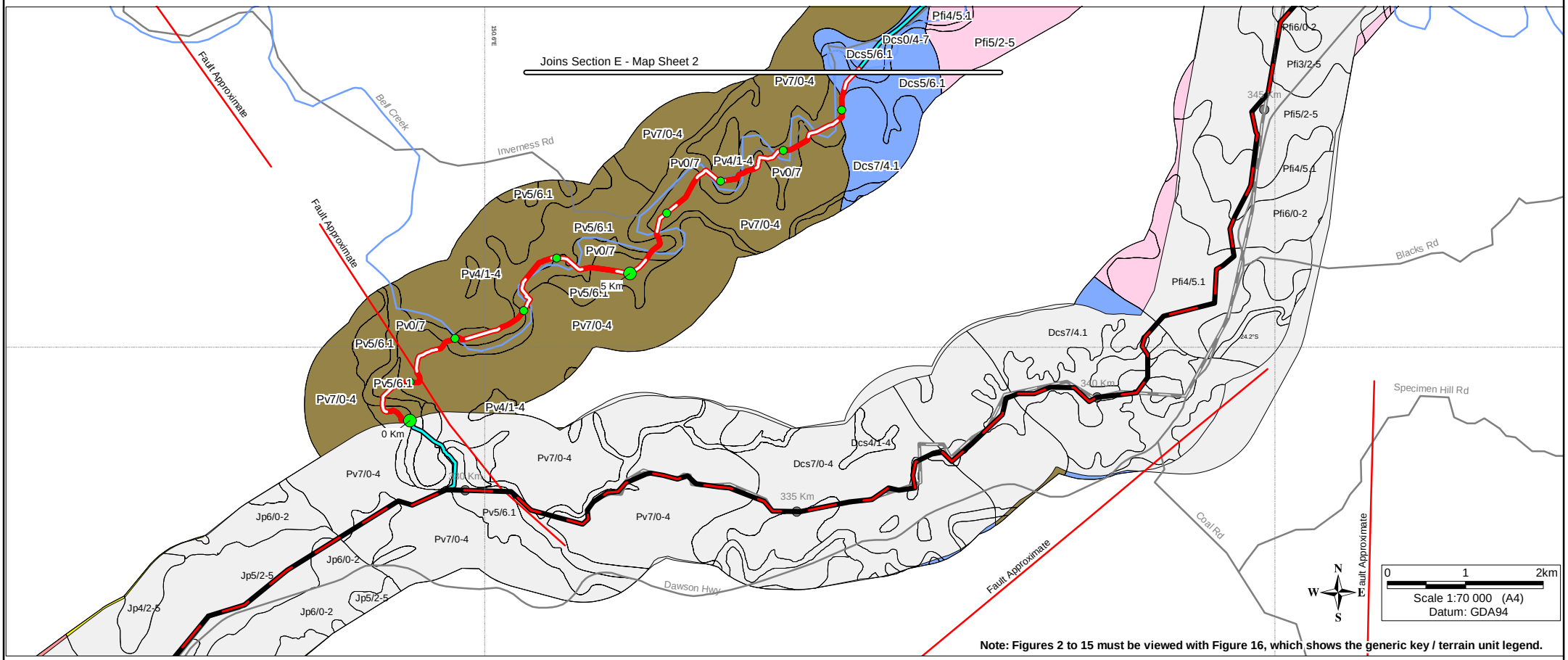
Drawn: CA | Approved: JB | Date: 03-11-2009
Job No: **4262 6440** /6220 | File No: 42626440-g-2016.wor
Figure: **7** | Rev:B | **A4**

2.5 Callide Range Alternative Route (Section E)

The Callide Range Alternative Route (Section E) is approximately 16.5 km in length running diagonally to and located some 3-5 km to the north-west of the EIS GTP (March 2009) Route. Overall Section E is notionally shorter than EIS GTP (March 2009) Route by about 0.5 km. The cumulative distances of the terrain units intersected along Section E and the levels of constraint identified are shown in the terrain units and constraints table shown in Figures 8 and 9. An overall summary of potential levels of constraints is also included in the sector summary tables provided in Figures 8 and 9. General details for Section E as a whole are as follows:

- **Topographic constraints** – terrain units Dcs7/4.1, Pv0/7 and Pv7/0-4 which have been rated as presenting potentially high topographic constraints for pipeline construction, occur over a cumulative distance of 5.5 km (22.0 ha) of Section E. Terrain units Dcs4/0-7, Pv5/6.1 and Pfi6/0-2 which occur over a distance of 3.4 km (13.8 ha) along Section E have been rated as a moderate topographic constraint. The remaining 7.6 km (30.4 ha) has been rated either as a low or low to moderate topographic constraint;
- **Excavation conditions** – moderate constraints with respect to excavation conditions have been assessed to occur over approximately 11.0 km (44.1 ha) of Section E. Terrain units Pfi3/2-5 and Pfi4/5 occur over the final 5.5 km (22.1 ha) of Section E and have been rated as presenting either low or low to moderate levels of constraint with respect to excavation conditions;
- **Erosion potential** – terrain units Dcs7/4.1, Dcs5/6.1,Pv7/0-4, Pv5/6, Pfi3/2-5 and Pfi4/5.1 are rated as having high erosion potential; collectively they occupy 13.4 km (53.5 ha) of Section E. Terrain units Dcs0/4-7, Pv4/1-4, Pv0/7 and Pfi6/0-2, which are rated as having moderate levels of erosion potential, occur over the remaining 3.1 km (12.6 ha);
- **Drainage status** – terrain units Dcs0/4-7 and Pv0/7 (streamlines and terraces) are intersected over a combined distance of 2.6 km (10.3 ha) along Section E; these areas are frequently floodprone and represent a high level of drainage constraint. Terrain units Dcs7/4.1 and Pv7/0-4 are intersected over a distance of 3.0 km (12.0 ha) and due to the general steepness of slopes, are subject to rapid runoff and constitute a moderate drainage constraint. The terrain units comprising the remaining 10.9 km (43.8 ha) along Section E are mostly well-drained and present a low drainage constraint;
- **Problem soils** – high levels of constraint related mainly to soils with sodic and/or dispersive subsoils occur in terrain units Dcs5/6.1 and also in terrain unit Dcs7/4 which tend to have highly saline subsoils. These soils occur over a combined distance of 1.9 km (7.6 ha) along Section E. Moderate levels of problem soil constraints due to the occurrence of soils with moderately strongly sodic and/or dispersive subsoil conditions occur in terrain units Pv5/6.1 and Pfi4/5.1 over a cumulative distance of 6.1 km (24.4 ha). Terrain units occurring over the remaining 8.5 km (34.1 ha) of Section E have been rated as having a low problem soil constraint; and
- **Agricultural land classes** – Section E intersections of terrain unit Dcs5/6.1, Pfi3/2-5, Pfi4/5.1 and Pfi6/0-2 which occur over a cumulative distance of 7.3 km (29.2 ha) have been rated as Land Class C2. Terrain units Pv5/6.1, Pv7/0-4, Pv4/1-4 and Dcs7/4.1 occur over a combined distance of 6.7 km (26.6 ha) and have been rated as Land Class C3. Terrain units Pv0/7 and Dcs0/4-7 occur over a combined distance of 2.5 km (9.9 ha) along Section E and have been rated as Land Class D.

CALLIDE RANGE ALTERNATIVE ROUTE (September 2009) ELEVATION PROFILE OF ASSESSED SECTION E IN MAP BELOW



Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

Terrain Units & Constraints Intersecting Assessed Callide Range Alternative Route (Sep. 2009) Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Dcs0/4-7	M	2	M	F4	L	D	95
Dcs7/4.1	H	2-4	M-H	X	M-H (Sa)	C3	251
Dcs5/6.1	L-M	2-3	M-H	W-I	M-H (So/D)	C2	371
Pv4/1-4	L-M	2-3	M	W	L	C3	428
Pv0/7	H	2-3	M	F4	L	D	2,482
Pv7/0-4	H	2-4	M-H	W-X	L	C3	2,758
Pv5/6.1	M	2-3	M-H	W	M (So/D)	C3	3,213

Total Callide Range Alternative Route (Sep. 2009) length assessed in current map sheet: 9,598m (9.6km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	800	-	-	4,012	5,763
Moderate Constraint	3,307	9,598	3,005	3,009	3,213
High Constraint	5,491	-	6,593	2,576	623

1km Distance Markers along Callide Range Alternative Route (Sep. 2009) - Section Assessed in current Map Sheet.
Callide Range Alternative Route (September 2009) Section Assessed in current Map Sheet.
Callide Range Alternative Route (September 2009)
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)
Fault
Anticline
Syncline
River / Creek
Road

Note: Observe North Direction.

ABBREVIATIONS

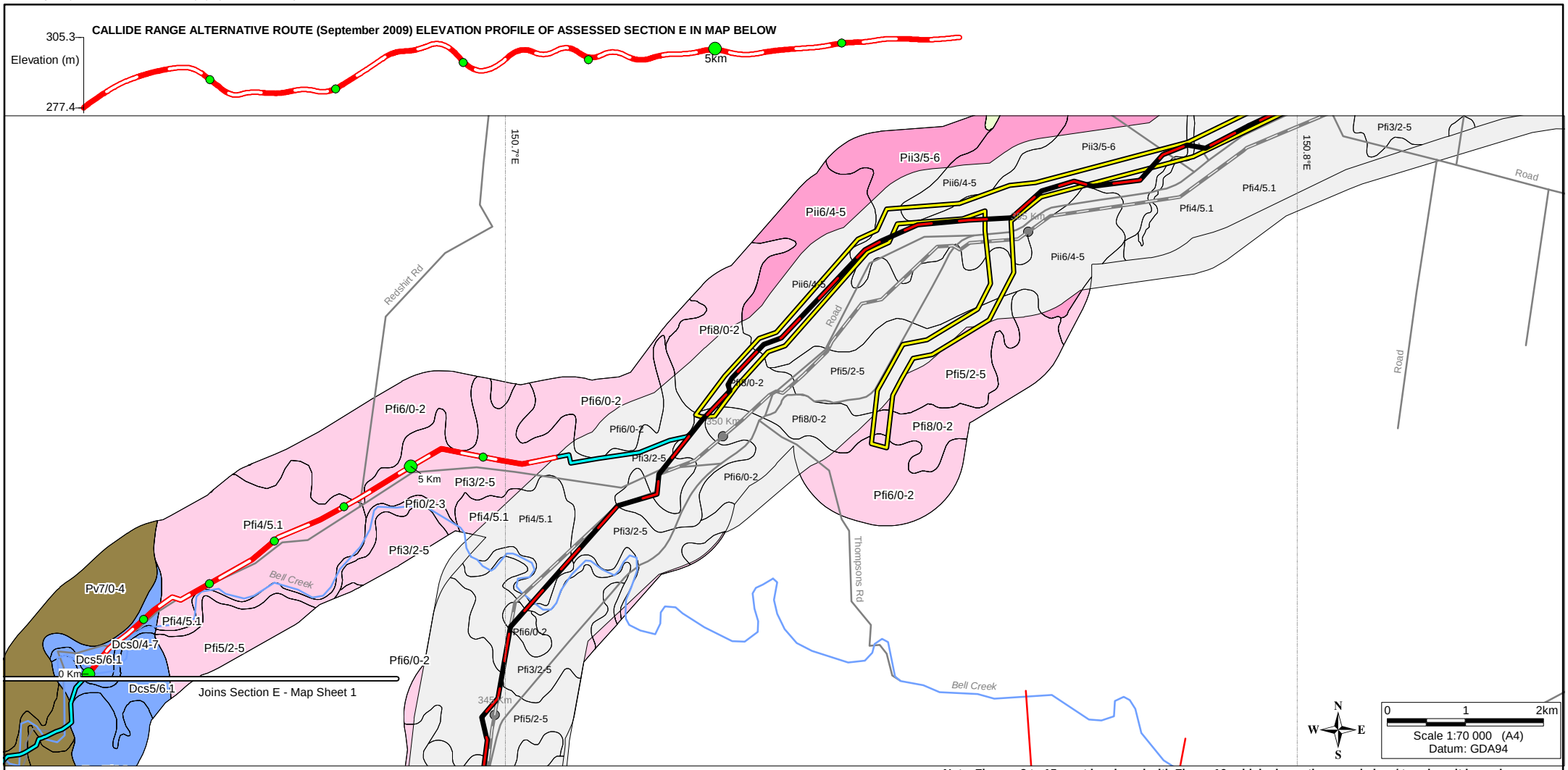
GLNG	Gladstone Liquified Natural Gas
GTP	Gas Transmission Pipeline

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
SOILS ASSESSMENT

Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION E (MAP SHEET 1 of 2)

Drawn: CA | Approved: JB | Date: 03-11-2009
Job No: 4262 6440/6220 | File No: 42626440-g-2017.wor
Figure: 8 | Rev:B | A4



Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

Terrain Units & Constraints Intersecting Assessed Callide Range Alternative Route (Sep. 2009) Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Pfi6/0-2	M	2-3	M	W	L	C2	143
Dcs5/6.1	L-M	2-3	M-H	W-I	M-H (So/D)	C2	1,274
Pfi3/2-5	L	1	M-H	W	L	C2	2,630
Pfi4/5.1	L-M	1-2	H	W	M (So/D)	C2	2,886

Total Callide Range Alternative Route (Sep. 2009) length assessed in current map sheet: 6,934m (6.9km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	6,791	5,517	-	6,934	2,774
Moderate Constraint	143	1,417	143	-	2,886
High Constraint	-	-	6,791	-	1,274

1km Distance Markers along Callide Range Alternative Route (Sep. 2009) - Section Assessed in current Map Sheet.
Callide Range Alternative Route (September 2009) Section Assessed in current Map Sheet.
Callide Range Alternative Route (September 2009)
Common Pipeline Infrastructure Corridor (CICSDA Section) (September 2009)
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)
Fault
Anticline
Syncline
River / Creek
Road

Note: Observe North Direction.

ABBREVIATIONS

GLNG	Gladstone Liquified Natural Gas
CPIC	Common Pipeline Infrastructure Corridor
CICSDA	Callide Infrastructure Corridor State Development Area
GTP	Gas Transmission Pipeline

Source: This map may contain data which is sourced and Copyright. Refer to Section 18.2 of the EIS for Ownership and Copyright.

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SOILS ASSESSMENT

Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION E (MAP SHEET 2 of 2)

Drawn: CA | Approved: JB | Date: 03-11-2009
Job No: 4262 6440 /6220 | File No: 42626440-g-2018.wor
Figure: 9 | Rev: C | A4

2.6 CPIC (CICSDA Section) Route and GLNG GTP September 2009 (Section F)

The CPIC (CICSDA Section) Route is the shared infrastructure corridor for multiple proponents proposed by the Queensland Government being the Callide Infrastructure Corridor State Development Area as gazetted 1 October 2009 between the Callide Range and the GSDA boundary (essentially the Bruce Highway). At the time of completion of the EIS the government had announced its preference for an "Energy Corridor" for common user infrastructure between the Callide and the GSDA but the particular route of the corridor had not been identified. Consequently only limited assessment of the corridor in the EIS was possible. Although it is Santos' preference to utilise the CPIC (CICSDA Section) Route, this is dependent on the government's resumption of the underlying land interest and negotiation of access terms and conditions.

The CPIC (CICSDA Section) Route deviates from the EIS GTP (March 2009) Route for a distance of approximately 16.5 km. The CPIC (CICSDA Section) Route is located up to about 4 km to the north-west of the EIS GTP (March 2009) Route. The cumulative areas (ha) of the terrain units intersected within the CPIC (CICSDA Section) Route as a whole and the levels of constraint identified are shown in the terrain units and constraints table shown in Figures 10 and 11. An overall summary of potential levels of constraints for the CPIC (CICSDA Section) Route is also included in the sector summary tables provided in Figures 10 and 11.

Also included here is further mapping which has been undertaken for a short section (3.8 km) of the GLNG GTP September 2009 (Section F) within the CICSDA. The cumulative distances of the terrain units intersected along the new alignment sector, constraints details and a sector summary are provided in the supplementary constraints tables also shown in Figure 10. General details for both the CPIC (CICSDA Section) Route and further mapping undertaken for the GLNG GTP September 2009 (Section F) within the CICSDA are summarised below.

The CPIC (CICSDA Section) Route:

- **Topographic constraints** – the alignment crossings of terrain unit Qa0/2-7 have been rated as presenting potentially high topographic constraints for pipeline construction. As mapped, the alignment corridor encompasses a total area of 19.4 ha [3.6 % of the CPIC (CICSDA Section) Route corridor area], but individual crossings vary in width from between about 75 m to150 m approximately. Terrain units Pfi0/2-3, Cr6/4-6 and Dcs6/4-7 occupy a total area of 115.6 ha (21.3 % of the CPIC (CICSDA Section) Route corridor area) have been rated as presenting a moderate topographic constraint. All of the other terrain units identified within the corridor which collectively encompass a total land area of 408.2 ha (75.1 % of the CPIC (CICSDA Section) Route corridor area) have been rated as presenting either a low or low to moderate topographic constraint;
- **Excavation conditions** – potentially high excavation constraints have been assessed to occur in terrain unit Cr6/4-6 which encompasses an area of 86.1 ha (15.9 %) of the CPIC (CICSDA Section) Route corridor area. Moderate constraints with respect to excavation conditions have been assessed to occur in terrain units Pfi0/2-3, Qa0/2-7 and Dcs6/4-7 which encompass a combined area of 48.8 ha (9.0 %). All of the other terrain units identified within the corridor which collectively encompass a total land area of 408.2 ha (75.1 %) of the CPIC (CICSDA Section) Route corridor area have been rated as presenting either a low or low to moderate excavation constraint;
- **Erosion potential** – terrain units that occur within the whole of the CPIC (CICSDA Section) Route have been rated as having moderate to high or high erosion potential;
- **Drainage status** – terrain units Pfi0/2-3, Qa0/2-7 and Qa2/6-8 which comprise streamlines and adjacent floodplains and terraces, occur over an area of 241.3 ha (44.4 %). These areas are subject to flooding and represent a potential high level of drainage constraint. Terrain units that

occur over the remainder of the CPIC (CICSDA Section) Route are mostly well-drained, locally with impeded subsoil drainage, but overall present a low drainage constraint;

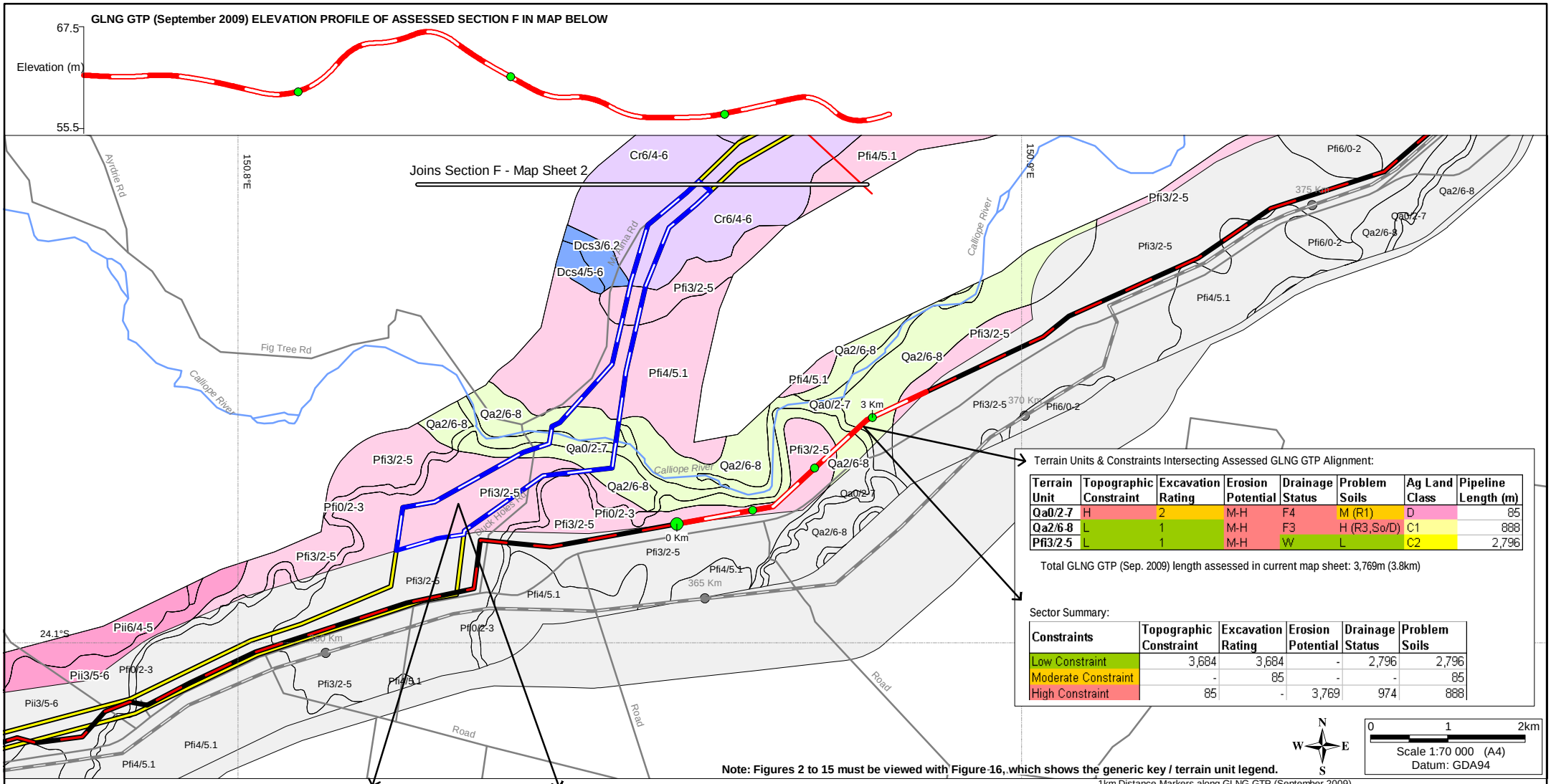
- **Problem soils** – high levels of constraint related mainly to soils with sodic and/or dispersive subsoils occur in terrain units Dcs3/6.2 (21.2 ha) and also in terrain unit Qa2/6-8 (219.9 ha) which also have deep highly reactive soil profiles. Collectively, these soils occur over an area of 241.1 ha (44.4 %) of the CPIC (CICSDA Section) Route. Soils assessed as having with moderate levels of constraints due to the occurrence of moderately strongly sodic and/or dispersive subsoil conditions occur in terrain units Cr8/4-6, Cr4/4-6 and Pfi4/5.1 over a combined area of 142.8 ha. Soils which have moderately reactive soil profiles which also represent a moderate level of constraint, occur in terrain unit Qa0/2-7 over an area 19.4 ha. Collectively, soils assessed as representing a moderate level of problem soil constraint, occur over a combined area of 162.2 ha (29.9 %) of the CPIC (CICSDA Section) Route corridor area. Terrain units which occur over the remaining 139.9 ha (25.7 %) have been rated as having a low problem soil constraint; and
- **Agricultural land classes** – terrain unit Qa2/6-8 due to the presence of gilgai micro-relief, restricted soil drainage and flooding frequency, has been rated as Land Class C1which encompasses 219.9 ha (40.5 %) of the CPIC (CICSDA Section) Route corridor area. Terrain units Cr4/4-6, Cr6/4-6, Pfi3/2-5, Pfi4/5.1, Dcs3/6.2 and Dcs6/4-7 encompass a combined area of 301.9 ha (55.6 %) and have been rated as Land Class C3. Terrain units Pfi0/2-3 and Qa0/2-7 encompass an area of 21.4 ha (3.9 %) and have been rated Land Class D.

GLNG GTP September 2009 (Section F) within the CICSDA

- **Topographic constraints** – the alignment crossing of terrain unit Qa0/2-7 over a GTP distance of approximately 0.1 km (0.3 ha) has been rated as presenting potentially high topographic constraints for pipeline construction. Terrain units Qa2/6-8 and Pfi3/2-5 which occur over the remaining 3.7 km (14.7 ha) of Section F are rated as a low topographic constraint;
- **Excavation conditions** – moderate excavation constraints have been assessed to occur in the crossing of terrain unit Qa0/2-7 over a distance of 0.1 km (0.3 ha) along Section F. The remaining 3.7 km (14.7 ha) of the alignment is rated as having a low excavation constraint;
- **Erosion potential** – each of the terrain units that occur along Section F have been rated as having moderate to high level of erosion potential, which represents a high constraint;
- **Drainage status** – terrain units Qa0/2-7 and Qa2/6-8 are subject to flooding and are locally have poor drainage conditions. These units are intersected over a distance of approximately 1.0 km (3.9 ha) and represent a high level of drainage constraint. Terrain unit Pfi3/2-5 which occurs over the remaining 2.8 km (11.2 ha) of Section F is well-drained and represents a low constraint with respect to drainage conditions;
- **Problem soils** – high levels of constraint related to the presence of highly reactive soils with sodic and/or dispersive subsoils occur in terrain unit Qa2/6-8 over a distance of 0.9 km (3.6 ha) in Section F. Soils presenting a moderate level of constraint due to the occurrence of soils which include moderately reactive soil layers occur in Terrain unit Qa0/2-7 over a distance of 0.1 km (0.3 ha) in Section F. Terrain unit Pfi3/2-5 which occurs over the remaining 2.8 km (11.2 ha) of the alignment has been assessed as presenting low problem soil constraints; and
- **Agricultural land classes** – terrain unit Qa2/6-8 occurs in Section F over a distance of 0.9 km (3.6 ha) and due to the presence of gilgai surface micro-relief, restricted soil drainage and flooding frequency, the unit has been rated as Land Class C1. Terrain unit Pfi3/2-5 occurs over a distance of 2.8 km (11.2 ha) in Section F and has been rated as Land Class C2. Terrain unit Qa0/2-7

2 New Gas Transmission Pipeline sections

(stream crossing) is intersected over a distance of 0.1 km (0.3 ha) along Section F and has been rated as Land Class D.



Terrain Units & Constraints Intersecting Assessed GLNG GTP Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Qa0/2-7	H	2	M-H	F4	M (R1)	D	85
Qa2/6-8	L	1	M-H	F3	H (R3,So/D)	C1	888
Pfi3/2-5	L	1	M-H	W	L	C2	2,796

Total GLNG GTP (Sep. 2009) length assessed in current map sheet: 3,769m (3.8km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	3,684	3,684	-	2,796	2,796
Moderate Constraint	-	85	-	-	85
High Constraint	85	-	3,769	974	888

N
W E
S

0 1 2km
Scale 1:70 000 (A4)
Datum: GDA94

Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

Terrain Units & Constraints in Assessed CPIC (CICSDA Section) (Sep. 2009):

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Corridor Area (ha)
Pfi0/2-3	M	2	H	F4	L	D	2.0
Qa0/2-7	H	2	M-H	F4	M (R1)	D	11.7
Cr6/4-6	M	3-4	M-H	W	M (So/D)	C2	35.2
Pfi4/5.1	L-M	1-2	H	W	M (So/D)	C2	36.1
Qa2/6-8	L	1	M-H	F3	H (R3,So/D)	C1	50.1
Pfi3/2-5	L	1	M-H	W	L	C2	110.6

Total area in CPIC (CICSDA Section) assessed in current map sheet: 245.7 ha

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	196.7	196.7	-	181.8	112.6
Moderate Constraint	37.2	13.7	-	-	82.9
High Constraint	11.7	35.2	245.6	63.8	50.1

1km Distance Markers along GLNG GTP (September 2009) Section Assessed in current Map Sheet.
CPIC (CICSDA Section) (Sep. 2009) Assessed in current Map Sheet
Common Pipeline Infrastructure Corridor (CICSDA Section) (September 2009)
GLNG Gas Transmission Pipeline (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)
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Anticline
Syncline
River / Creek
Road

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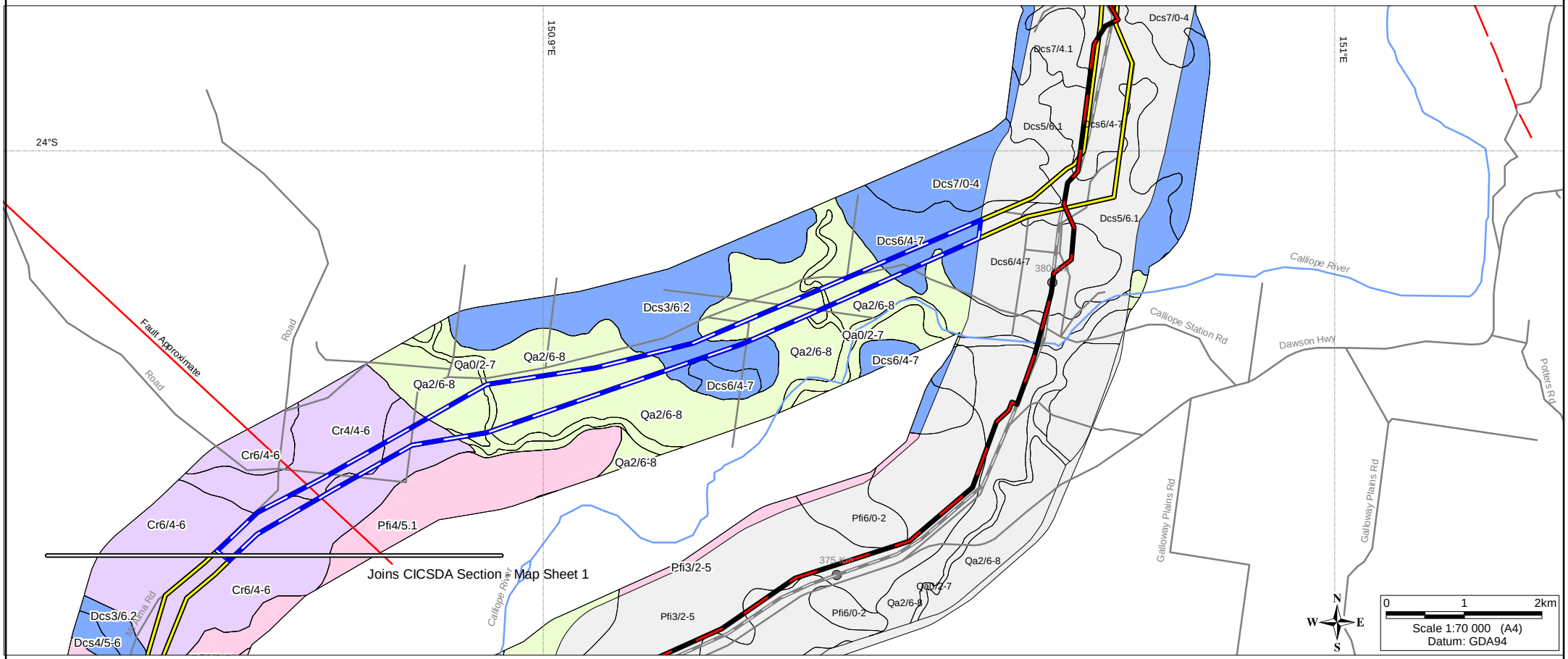
Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
SOILS ASSESSMENT

Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION F (MAP SHEET 1 of 1) AND CICSDA SECTION OF CPIC (MAP SHEET 1 of 2)

Drawn: CA | Approved: JB | Date: 10-11-2009
Job No: 4262 6440/6220 | File No: 42626440-g-2019.wor
Figure: 10 | Rev: C | A4



Terrain Units & Constraints in Assessed CPIC (CICSDA Section) (Sep. 2009):

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Corridor Area (ha)
Qa0/2-7	H	2	M-H	F4	M (R1)	D	7.7
Cr4/4-6	L-M	1-2	M-H	W	M (So/D)	C2	20.5
Dcs3/6.2	L	1	H	W-I	H (So/D)	C2	21.2
Dcs6/4-7	M	2-3	M-H	W-I	L	C2	27.3
Cr6/4-6	M	3-4	M-H	W	M (So/D)	C2	51.0
Qa2/6-8	L	1	M-H	F3	H (R3,So/D)	C1	169.8

Total area in CPIC (CICSDA Section) assessed in current map sheet: 297.5 ha

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	211.4	211.4	-	120.0	27.3
Moderate Constraint	78.4	35.1	-	-	79.2
High Constraint	7.7	51.0	297.5	177.5	191.0

Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

- CPIC (CICSDA Section) (Sep. 2009) assessed in current Map Sheet
- Common Pipeline Infrastructure Corridor (CICSDA Section) (September 2009)
- GLNG Gas Transmission Pipeline (September 2009)
- EIS Gas Transmission Pipeline (March 2009)
- 5km Distance Markers along EIS GTP (March 2009)
- EIS GTP 1km Buffer (March 2009)
- Fault
- Anticline
- Syncline
- River / Creek
- Road

Note: Observe North Direction.

ABBREVIATIONS

GLNG	Gladstone Liquified Natural Gas
CPIC	Common Pipeline Infrastructure Corridor
CICSDA	Callide Infrastructure Corridor State Development Area
GTP	Gas Transmission Pipeline

Client

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Title
GEOLOGICAL REGIMES AND TERRAIN UNITS CICSDA SECTION OF CPIC (MAP SHEET 2 of 2)

Drawn: CA | Approved: JB | Date: 10-11-2009

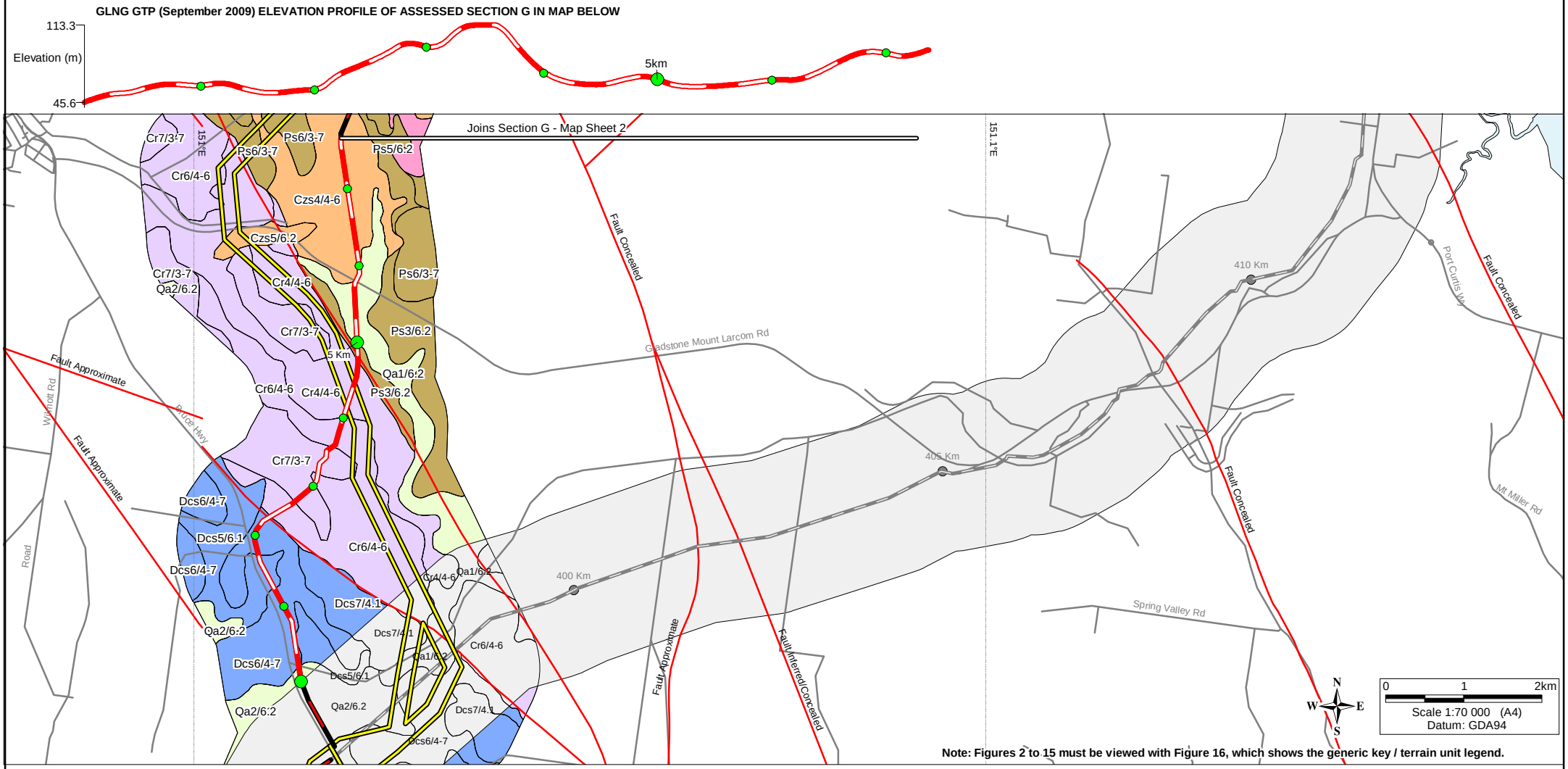
Job No: **4262 6440**/6220 | File No: 42626440-g-2020.wor

Figure: **11** | Rev: C | **A4**

2.7 GLNG GTP September 2009 (Section G)

GLNG GTP September 2009 (Section G) is approximately 24.5 km in length. Section G is approximately 5 km longer compared to the EIS GTP (March 2009) Route. The cumulative distances of the terrain units intersected along the Section G centreline and the levels of constraints identified are shown in the terrain units and constraints table shown in Figures 12 and 13. An overall summary of potential levels of constraints is included in the sector summary tables provided in Figures 12 and 13. General details for Section G as a whole are as follows:

- **Topographic constraints** – terrain units Cr7/3-7, Pv7/4-7, Pv8/0-4 and Pii8/0-4 occur over a combined distance of approximately 1.7 km (6.7ha) along Section G. These terrain units have been rated as presenting potentially high topographic constraints for pipeline construction. Terrain units Cr6/4-6, Dcs6/4-7, Pii6/4-5, Ps6/3-7, Pv5/6.1 and Czs 5/6.2 occur over a combined distance of 9.4 km (65.8 ha) and have been rated as presenting a moderate level of topographic constraints for pipeline construction. Terrain units that occur over the remaining 13.4 km (53.6 ha) are rated as presenting low or low to moderate topographic constraints;
- **Excavation conditions** – terrain units Cr7/3-7, Pv7/4-7, Pv8/0-4 and Pii8/0-4 occur over a combined distance of approximately 2.6 km (10.4 ha) along Section G. These terrain units have been rated as presenting potentially high excavation constraints for pipeline construction. Moderate constraints due to excavation conditions have been assessed to occur in terrain units Dcs5/6.1, Dcs6/4-7, Ps6/3-7, Pv5/6.1 and Czs4/4-6 which occur over a combined distance of 8.7 km (35.0 ha). The remaining 13.2 km (52.6 ha) of Section G intersects terrain units rated as having low constraints with respect to excavation conditions;
- **Erosion potential** – as mapped, terrain units that have been assessed as having high or moderate to high erosion potential, which represents a high constraint for pipeline construction, occur over 17.9 km (71.7 ha) of Section G. The remaining 6.5 km (26.2 ha) traverses terrain units rated as having a moderate level of erosion potential which constitutes a moderate constraint for pipeline construction;
- **Drainage status** – terrain unit Qa1/6.2 constitutes low-lying, locally poorly drained land which is subject to periodic flooding. This unit is intersected along the alignment ROW over a distance of approximately 1.0 km (3.9 ha) and represents a high level of drainage constraint for pipeline construction. Terrain units Qa2/6.2 and Czs5/6.2 which exhibit impeded subsoil drainage conditions and may be subject to flooding in lower-lying parts, occur over a distance of 8.5 km (33.9 ha) along Section G and have been rated as presenting a moderate level of constraint for pipeline construction. Terrain units Pv7/4-7, Pv8/0-4, PII8/0-4 and Cr7/3-7 occur over an additional distance of 1.7 km (6.7 ha) and have also been rated as presenting a moderate level of drainage constraint due to the steepness of slopes and the potential for excessively rapid run-off if cleared of vegetation. Terrain units over the remaining 13.4 km (53.6 ha) along Section G are mostly well-drained and are rated as representing a low level of drainage constraint for pipeline construction;
- **Problem soils** – high levels of constraint related to the presence of soils with moderately high to highly sodic and/or dispersive subsoils occur in terrain units Qa1/6.2, Qa2/6.2, Ps3/6.2, Dcs5/6.1 and Czs5/6.2 over a combined distance of 10.1 km (40.7 ha) along Section G. Soils presenting a moderate level of constraint due to the occurrence of moderately sodic and/or moderately dispersive soil layers occur in Terrain units Cr4/4-6, Cr6/4-6, Czs4/4-6, Pii4/5.1, Ps5/6.2 and Pv5/6.1 over a distance of 6.5 km (26.2 ha). The remaining 7.8 km (31.2 ha) has been assessed as presenting low problem soil constraints; and
- **Agricultural land classes** – terrain units which are intersected over a combined distance of 19.8 km (79.0 ha are rated as Land Class C2 – land mostly suitable for grazing of natural and some improved pastures. The remaining 4.7 km (18.9 ha) traverses terrain units rated as Land Class C3 – limited grazing lands due mainly to shallow rocky soils and the overall steepness of the land.



Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

Terrain Units & Constraints Intersecting Assessed GLNG GTP Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Qa2/6.2	L	1	H	F1	H (So/D)	C2	192
Ps3/6.2	L	1-2	M-H	W-I	M-H (So/D)	C2	233
Dcs5/6.1	L-M	2-3	M-H	W-I	M-H (So/D)	C2	482
Cr4/4-6	L-M	1-2	M-H	W	M (So/D)	C2	747
Cr7/3-7	H	3-4	M-H	X	L	C3	771
Cr6/4-6	M	3-4	M-H	W	M (So/D)	C2	908
Qa1/6.2	L	1	H	F3	H (So/D)	C2	967
Dcs6/4-7	M	2-3	M-H	W-I	L	C2	1,652
Czs4/4-6	L-M	2	M	W	M (So/D)	C2	1,705

Total GLNG GTP (Sep. 2009) length assessed in current map sheet: 7,657m (7.7km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	4,326	2,139	-	5,726	2,423
Moderate Constraint	2,560	3,839	1,705	964	3,360
High Constraint	771	1,679	5,952	967	1,874

- 1km Distance Markers along GLNG GTP (September 2009) Section Assessed in current Map Sheet.
- GLNG Gas Transmission Pipeline (September 2009) Section Assessed in current Map Sheet.
- GLNG Gas Transmission Pipeline (September 2009)
- Common Pipeline Infrastructure Corridor (GSDA Section) September 2009)
- EIS Gas Transmission Pipeline (March 2009)
- 5km Distance Markers along EIS GTP (March 2009)
- EIS GTP 1km Buffer (March 2009)
- Fault
- Anticline
- Syncline
- River / Creek
- Road

Note: Observe North Direction.

ABBREVIATIONS

GLNG	Gladstone Liquified Natural Gas
CPIC	Common Pipeline Infrastructure Corridor
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline

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Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION G (MAP SHEET 1 of 2)

Drawn: CA | Approved: JB | Date: 10-11-2009
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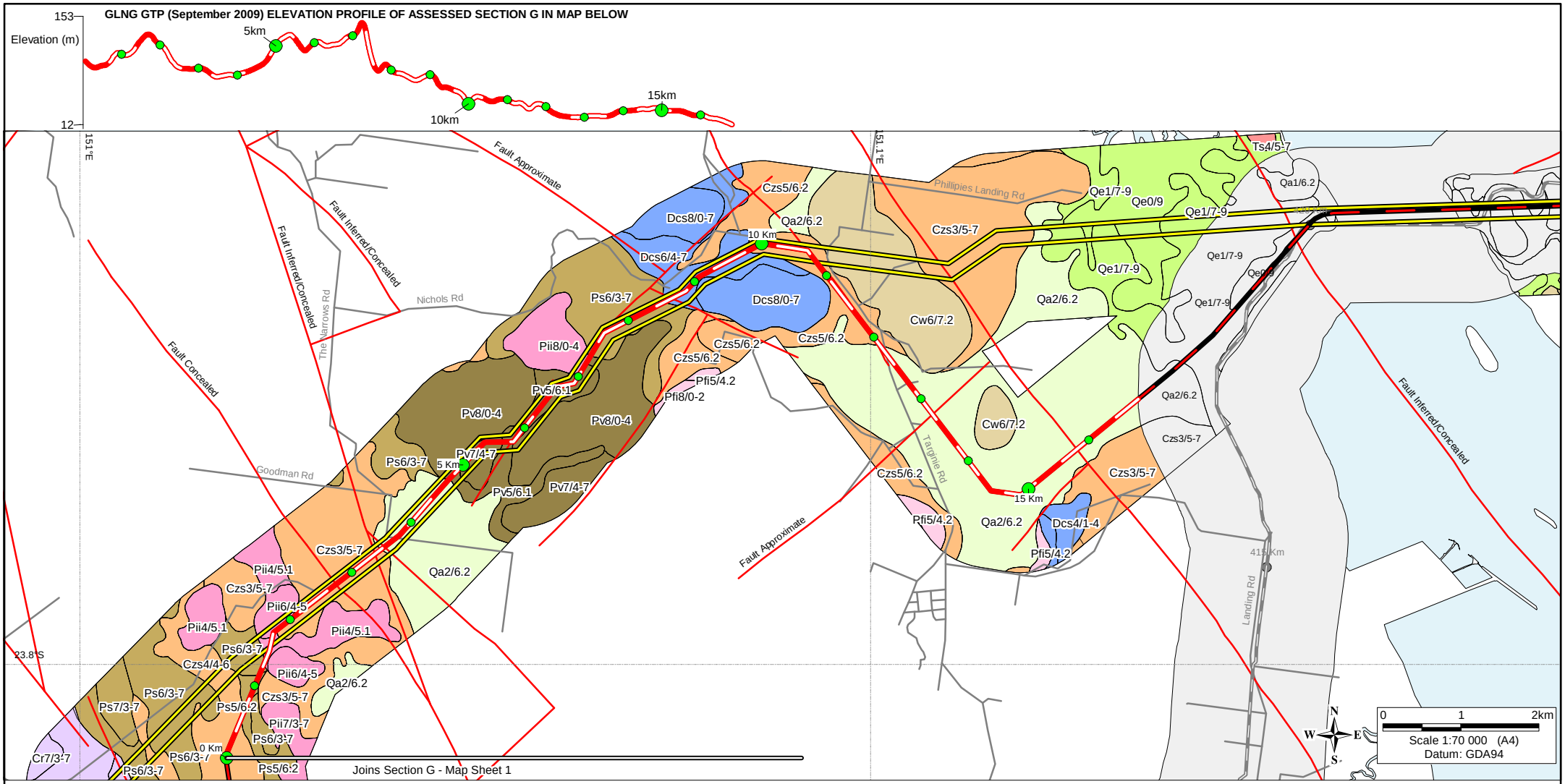
Figure: **12** | Rev: C | **A4**



Terrain Units & Constraints Intersecting Assessed GLNG GTP Alignment:

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Pipeline Length (m)
Pv8/0-4	H	2-4	M-H	W-X	L	C3	71
Pii8/0-4	H	2-4	M-H	X	L	C3	127
Pii6/4-5	M	1-2	M	W	L	C2	197
Pii4/5.1	L-M	1-2	M	W	M (So/D)	C2	364
Czs4/4-6	L-M	2	M	W	M (So/D)	C2	578
Ps5/6.2	L-M	1-2	M-H	W	M-H (So/D)	C2	582
Pv7/4-7	H	2-4	M	W-X	L	C3	712
Dcs6/4-7	M	2-3	M-H	W-I	L	C2	1,279
Ps6/3-7	M	2	M	W	L	C3	1,392
Czs3/5-7	L	1-2	M	W	L	C2	1,597
Pv5/6.1	M	2-3	M-H	W	M (So/D)	C3	1,657
Czs5/6.2	M	1-2	H	I	H (R1,So/D)	C2	2,318
Qa2/6.2	L	1	H	F1	H (So/D)	C2	5,954

Total GLNG GT Pipeline (Sep. 2009) length assessed in current map sheet: 16,830m (16.8km)

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	9,075	11,012	-	7,646	5,375
Moderate Constraint	6,843	4,906	4,840	9,182	3,181
High Constraint	910	910	11,988	-	8,272

ABBREVIATIONS

GLNG	Gladstone Liquified Natural Gas
CPIC	Common Pipeline Infrastructure Corridor
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline

Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

1km Distance Markers along GLNG GTP (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009) Section Assessed in current Map Sheet.
GLNG Gas Transmission Pipeline (September 2009)
Common Pipeline Infrastructure Corridor (GSDA Section) September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)
Fault
Anticline
Syncline
River / Creek
Road

Note: Observe North Direction.

Client

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Title
GEOLOGICAL REGIMES AND TERRAIN UNITS SECTION G (MAP SHEET 2 of 2)

Drawn: CA | Approved: JB | Date: 10-11-2009
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Figure: **13** | Rev: C | **A4**

2.8 CPIC (GSDA Section) Route

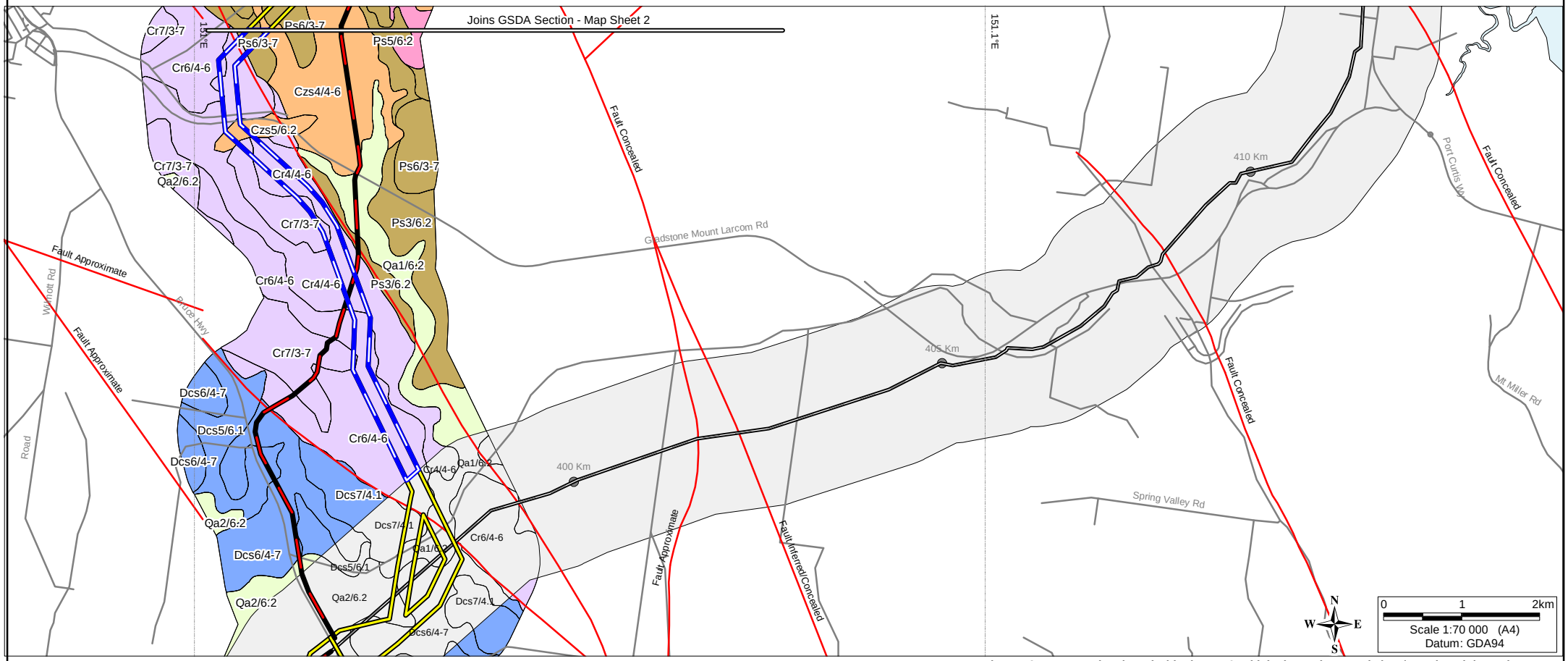
As mentioned earlier in this report, the CPIC Route is the shared infrastructure corridor for multiple proponents proposed by the Queensland Government. The CPIC (GSDA Section) Route is the section of the CPIC Route which falls within the GSDA. The various LNG proponents, including Santos, are currently working with the Queensland Government to finalise the location of the CPIC (GSDA Section) Route. As the CPIC (GSDA Section) Route was not finalised at the time the EIS was submitted, only limited assessment of the corridor was possible. Although it is Santos' preference to utilise the CPIC (GSDA Section) Route, this is dependent on the government's resumption of the underlying land interest and negotiation of access terms and conditions". Section 2.8 assesses the CPIC (GSDA Section) Route, see Figures 14 and 15.

The CPIC (GSDA Section) Route is approximately 23 km in length. The cumulative areas of the terrain units intersected along the CPIC (GSDA Section) Route and the levels of constraints identified are shown in the terrain units and constraints table shown in Figures 14 and 15. An overall summary of potential levels of constraint and impacts is included in the sector summary tables provided in Figures 12 and 13. General details for the CPIC (GSDA Section) Route as a whole are as follows:

- **Topographic constraints** – terrain units Cr7/3-7, Pv7/4-7, Pv8/0-4, Pii8/0-4 and Dcs8/0-7 occur within the corridor and occupy a combined area of approximately 33.8 ha (7.3 % of the corridor area). These terrain units have been rated as presenting potentially high topographic constraints for pipeline construction. Terrain units Cr6/4-6, Dcs6/4-7, Pii6/4-5, Ps6/3-7, Cw6/7.2, Pv5/6.1 and Czs5/6.2 occur as low hilly and hilly lands over 216.0 ha (46.6 %) of the corridor and have been rated as presenting a moderate level of topographic constraints for pipeline construction. Terrain units Qe0/9 and Qe1/7-9 which occur on the estuarine coastal and marine flats over 42.1 ha (9.1 %) of the corridor have also been rated as presenting a moderate level of topographic constraint for pipeline construction. Terrain units that occur over the remaining 171.2 ha (37.0 % of the corridor area) are rated as low or low to moderate levels of topographic constraints;
- **Excavation conditions** – terrain units Cr7/3-7, Pv7/4-7, Pv8/0-4, Pii8/0-4, Cr7/3-7 and Cr6/4-6 occur within CPIC (GSDA Section) Route and occupy a combined area of approximately 80.5 ha (17.4 %) of the corridor area. These terrain units have been rated as presenting potentially high excavation constraints for pipeline construction. Moderate constraints due to excavation conditions have been assessed to occur in terrain units Czs4/4-6, Dcs6/4-7, Ps6/3-7 and Pv5/6.1 and occupy a combined area of approximately 80.5 ha (17.4 %) of the CPIC (GSDA Section) Route corridor area. The remaining 257.1 ha (55.5 %) intersects terrain units rated as having low constraints with respect to excavation conditions;
- **Erosion potential** – terrain units Qa2/6.2, Czs5/6.2, Cr4/4-6, Cr6/4-6, Cr7/3-7, Pv8/0-4, Pii8/0-4, Dcs8/0-7 and PV5/6.1 have been assessed as having moderate to high and high erosion potential, which represents a high constraint for pipeline construction. These units occupy a combined area of approximately 240.5 ha (51.9 %) of the corridor area. Terrain units Qe1/7-6, Czs3/5-7, Czs4/4-6, Pii4/5.1, Pii6/4-5, Cw6/7.2 and Pv7/4-7 occupy a combined area of approximately 208.8 ha (45.1 %) of the CPIC (GSDA Section) Route corridor area and have been rated as presenting a moderate constraint for pipeline construction. The remaining 13.8 ha (3.0 %) have been rated as presenting a low constraint for pipeline construction;
- **Drainage status** – terrain units Qe1/7-9 and Qe0/9 occur as estuarine and marine flats which are prone to tidal inundation which represents a high level of drainage constraint for pipeline construction. These units occupy a combined area of approximately 42.1 ha (9.1 %) of the CPIC (GSDA Section) Route corridor area. Terrain units Qa2/6.2 and Czs5/6.2 are locally occasionally floodprone and /or subject to impeded subsoil drainage; terrain units Cr7/3-7, Pv7/4-7, Pv8/0-4, Pii8/0-4 and Dcs8/0-7 due to the general steepness of slopes are subject to rapid surface water

runoff. Collectively these terrain units occupy a combined area of approximately 68.2 ha (14.7 %) of the corridor area and have been rated as presenting a moderate level of drainage constraints for pipeline construction. Terrain units occur encompassing the remaining 352.8 ha (76.2 %) of the CPIC (GSDA Section) Route corridor area are mostly well-drained and are rated as representing a low level of drainage constraint;

- **Problem soils** – high levels of constraint related to the presence of soils with moderately reactive and highly sodic and/or dispersive subsoils occur in terrain units Qa2/6.2 and Czs5/6.2 (53.5 ha), together with saline and potential ASS soils (42.1 ha) in terrain units Qe0/9 and Qe1/7-9 resulting in a combined area of 95.6 ha (20.6 %). Soils presenting a moderate level of constraint due to the presence of moderately sodic and/or moderately dispersive soil layers occur in Terrain units Cr4/4-6, Cr6/4-6, Czs4/4-6, Pii4/5.1, Ps5/6.2, and Dcs8/0-7 over a combined area of 156.8 ha (33.9 %) of the CPIC (GSDA Section) Route corridor area. The remaining 210.8 ha (45.5 %) has been assessed as presenting low problem soil constraints; and
- **Agricultural land classes** – terrain units encompassing 271.0 ha (58.5 %) of the CPIC (GSDA Section) Route corridor area are rated as Land Class C2 – land mostly suitable for grazing of natural and some improved pastures. Terrain unit Cw6/7-2 occurs over an area of 24.7 ha (5.3 %) and includes areas of land which has been rated as Land Class A in higher parts and as Land Class C2 on the more steeply sloping and lower parts and hence has been rated overall as Land Class A-C2. The more steeply sloping lands including some lands with shallow rocky and sandy soils have been rated as Land Class C3 which occurs over a combined area of 125.3 ha (27.1 % of the corridor area). Terrain units Qe1/7-9 and Qe0/9 occur over a combined area of 42.1 ha (9.1 %) of the CPIC (GSDA Section) Route corridor area, have highly saline soils, are prone to periodic or regular tidal inundation and have been rated as Land Class D. Acid sulfate soils are present in the intertidal area on the mainland side of The Narrows. A project-specific plan will be developed by GLNG for handling and management of these soils.



Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

Terrain Units & Constraints in Assessed CPIC (GSDA Section) (September 2009):

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Corridor Area (ha)
Czs4/4-6	L-M	2	M	W	M (So/D)	C2	0.4
Ps6/3-7	M	2	M	W	L	C3	5.2
Czs5/6.2	M	1-2	H	I	H (R1,So/D)	C2	5.4
Cr7/3-7	H	3-4	M-H	X	L	C3	9.3
Cr6/4-6	M	3-4	M-H	W	M (So/D)	C2	46.6
Cr4/4-6	L-M	1-2	M-H	W	M(So/D)	C2	65.7

Total area in CPIC (GSDA Section) assessed in current map sheet: 132.7 ha

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	66.1	71.1	-	117.9	14.5
Moderate Constraint	57.2	5.6	5.6	14.7	112.7
High Constraint	9.3	55.9	127.0	-	5.4

CPIC (GSDA Section) (Sep. 2009) assessed in current Map Sheet
Common Pipeline Infrastructure Corridor (GSDA Section) (September 2009)
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)
Fault
Anticline
Syncline
River / Creek
Road

Note: Observe North Direction.

ABBREVIATIONS

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Title
GEOLOGICAL REGIMES AND TERRAIN UNITS GSDA SECTION OF CPIC (MAP SHEET 1 of 2)

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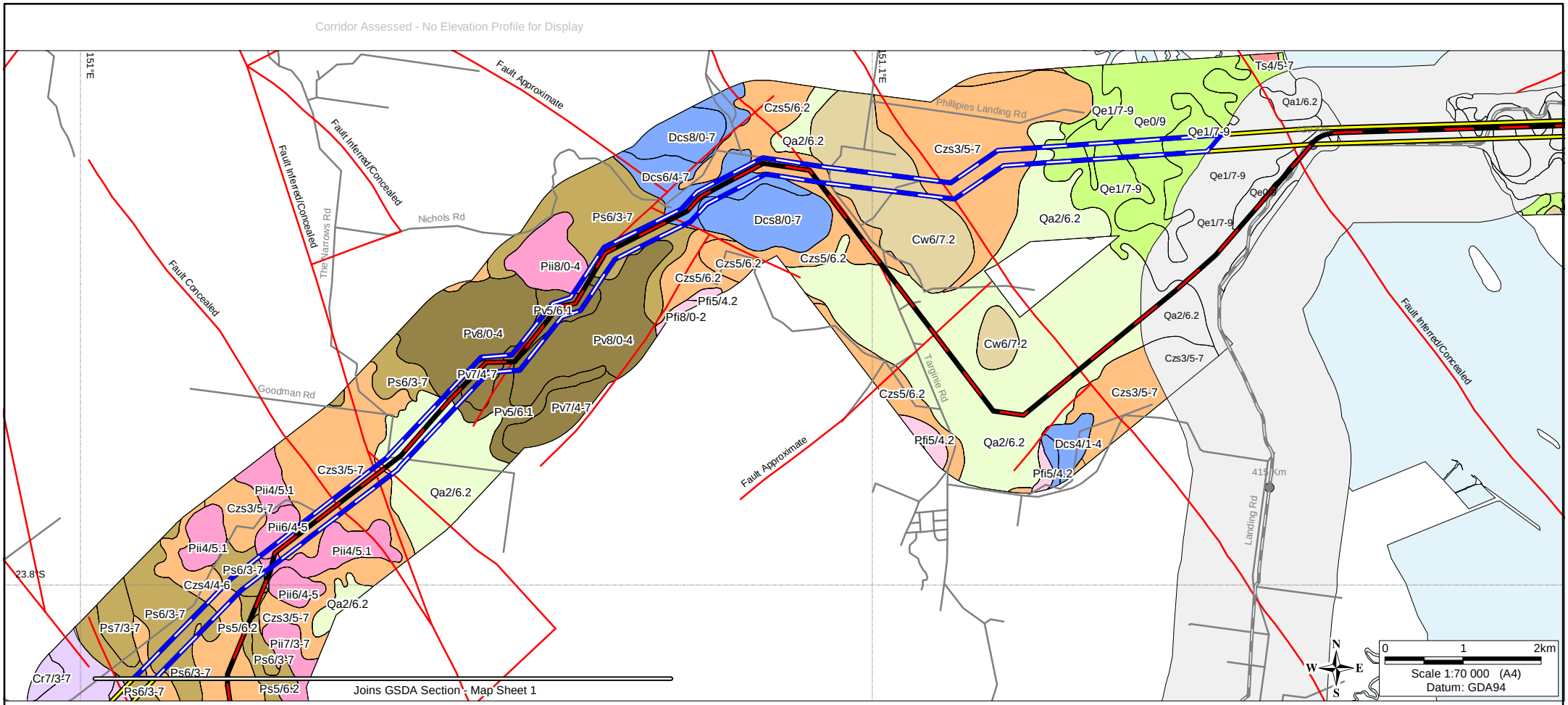
Figure: 14 | Rev: C | A4



Terrain Units & Constraints in Assessed CPIC (GSDA Section) (September 2009):

Terrain Unit	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils	Ag Land Class	Corridor Area (ha)
Ps5/6.2	L-M	1-2	M-H	W	M-H (So/D)	C2	0.0
Dcs8/0-7	H	2-4	M-H	X	M (So/D)	C3	2.1
Pii8/0-4	H	2-4	M-H	X	L	C3	2.3
Pii4/5.1	L-M	1-2	M	W	M (So/D)	C2	3.1
Pii6/4-5	M	1-2	M	W	L	C2	4.8
Pv8/0-4	H	2-4	M-H	W-X	L	C3	7.9
Czs4/4-6	L-M	2	M	W	M (So/D)	C2	9.7
Pv7/4-7	H	2-4	M	W-X	L	C3	12.2
Qe0/9	M	1-2	L-M	F4	H (Sa,ASS)	D	13.8
Czs5/6.2	M	1-2	H	I	H (R1,So/D)	C2	19.1
Dcs6/4-7	M	2-3	M-H	W-I	L	C2	23.9
Cw6/7.2	M	1-2	M	W	L (R1)(Locall	A-C2	24.7
Qe1/7-9	M	1-2	M	F3	H (Sa,ASS)	D	28.3
Qa2/6.2	L	1	H	F1	H (So/D)	C2	29.0
Pv5/6.1	M	2-3	M-H	W	M (So/D)	C3	29.2
Ps6/3-7	M	2	M	W	L	C3	57.1
Czs3/5-7	L	1-2	M	W	L	C2	63.3

Total area in CPIC (GSDA Section) assessed in current map sheet: 330.6 ha

Sector Summary:

Constraints	Topographic Constraint	Excavation Rating	Erosion Potential	Drainage Status	Problem Soils
Low Constraint	105.1	186.1	13.8	234.9	196.3
Moderate Constraint	200.9	119.9	203.2	53.5	44.1
High Constraint	24.5	24.5	113.5	42.1	90.1

Note: Figures 2 to 15 must be viewed with Figure 16, which shows the generic key / terrain unit legend.

CPIC (GSDA Section) (Sep. 2009) assessed in current Map Sheet
Common Pipeline Infrastructure Corridor (GSDA Section) (September 2009)
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
5km Distance Markers along EIS GTP (March 2009)
EIS GTP 1km Buffer (March 2009)
Fault
Anticline
Syncline
River / Creek
Road

Note: Observe North Direction.

ABBREVIATIONS

GLNG	Gladstone Liquified Natural Gas
CPIC	Common Pipeline Infrastructure Corridor
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline

Client: LNG / URS

Project: GLADSTONE LNG PROJECT
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Title: **GEOLOGICAL REGIMES AND TERRAIN UNITS GSDA SECTION OF CPIC (MAP SHEET 2 of 2)**

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Figure: 15 | Rev: C | A4

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Generic Key to the Identification of Terrain Units

GEOLOGICAL REGIME		LANDFORM – TERRAIN TYPE		SOILS	
Symbol	Description	Type	Surface Form and Slope	Group	Soil Types [1]
Qe	Quaternary (Holocene) Estuarine Sediments	0	Channel floors, banks and active levees of major streams and waterways with irregular steep, and locally benched bank slopes and low flood terraces. Locally tidal mangrove and marine flats and tidal inlets with mangroves fringing.	0	Extensive areas of rock outcrop, locally with skeletal to shallow usually stony or gravelly soils.
Qa	Quaternary Alluvium			1	Skeletal, rocky or gravelly soils (>60% coarse fragments) with sandy, silty, loamy or clayey soil matrix (K- Uc1, Um1, Gn1, Uf1).
Czs	Cainozoic Sediments	1	Floodplains, alluvial flats, lower stream terraces and flat to broadly depressional backplains, slopes typically <1%; periodically floodprone and locally poorly drained areas. Locally comprising estuarine/marine plains, extratidal and supratidal flats subject to periodic tidal inundation; slopes mostly <0.5%.	2	Sand soils; shallow to deep uniform or weakly gradational profiles; includes stratified alluvial soils, residual sand soils, earthy sands (Uc1-Uc6) [2] ; Rudosols or Tenosol Soil Orders. [3]
Ts	Tertiary Sediments				
Tb	Tertiary Volcanic Rocks mostly basalt				
Jp	Jurassic Precipice Sandstone	2	Flat to gently undulating or gently inclined intermediate to higher stream terraces, older alluvial plains or, floodplains and higher stream terraces, with slopes generally <2%; occasionally floodprone in lower-lying areas and along tributary drainage channels.	3	Coarse to medium-textured soils; uniform or gradational profiles; predominantly sandy earths, silty or clayey sand profiles (Uc4-5, Um1-3); Tenosols or Podosol Soil Orders.
Je	Early-Middle Jurassic Evergreen Formation			4	Medium-textured sandy, sandy loam or silt to clay loamy surface uniform or gradational profiles, often (siliceous or ferruginous) gravelly or stony soils; (Um4-7, Gn1-2); Tenosols, Kandosols or Ferrosol Soil Orders.
Jh	Early Jurassic Hutton Sandstone				
Rc	Early-Middle Triassic Clematis Group	3	Undulating plain and gently rolling to broadly rounded rises with gently inclined planar to concave intervening lower-lying broadly depressional areas; slopes mostly in the range 1-3%.	5	Sandy to loamy surface duplex soils with neutral to acidic, in places strongly acidic sandy clay to medium to heavy clay subsoils (Dr1-5, Dy1-5); Chromosol or Kurosol Soil Orders.
Rm	Triassic Moolayember Formation				
Ra	Triassic Arcadia Formation, Rewan Group	4	Undulating to strongly undulating plains and rolling rises, locally flat to undulating upland plateau crestal areas and undulating uplands; with slopes mostly in the range 3-5%.	6	Fine sandy, silty or clay loamy surface duplex soils with neutral to alkaline often calcareous, sodic and locally saline medium to heavy clay or heavy clay subsoils; (Db-Dd-Dy1-5); Chromosols, Sodosols or Calcarosols Soil Orders.
Ps	Permian Sediments				
Pv	Permian Volcanics	5	Gently to moderately inclined planar to concave intermediate to lower hill and ridge slopes or convex planar dissection slope interfluves; slopes variable mostly within the range 5-12%.		
Pfi	Late Permian-Early Triassic Felsic Intrusives				
Pii	Late Permian Intermediate Intrusive Rocks	6	Isolated low rounded hills and rises and low hilly lands mostly with broadly rounded crestal areas and hill slopes in the range 12-25%.	7	Uniform fine-textured (non-cracking) clay soils or gradational clay loam or light clay surface soils with acidic or alkaline often sodic and/or saline medium to heavy clay subsoils – locally incipient cracking clays; (Uf5-6); Dermosol or Hydrosol Soil Orders.
Ct	Carboniferous Torsdale Volcanics	7	Steep hilly lands with mostly narrow rounded hill and ridge crests and steep irregular planar hill and ridge slopes mostly in the range 20-40%.		
Cr	Carboniferous Rockhampton Group			8	Uniform fine-textured (cracking) clay soils, locally with thin self-mulching surficial soils with dark grey, brown or black mostly alkaline or alkaline over acidic heavy clay subsoils; (Ug5-Ug6); Vertosols Soil Order.
Cw	Carboniferous Wandilla Formation	8	Steep to very steep ridges and high hilly lands; mostly with narrow rounded ridge and spur crests, with slopes typically in the range 30-50%, with local sub-vertical rocky scarps and bluffs		
Dcs	Late Devonian Intermediate Extrusive Rocks			9	Uniform, weakly gradational or weak duplex soils with highly organic silty to clay loamy surficial soils and seasonally or permanently saturated often gleyed and saline silty clay or medium to heavy clay subsoils; Um, Dd-Dy, Uf-Ug 5-6 profiles; Organosols, Hydrosols some Vertosol Soil Orders.
Sf	Silurian-Devonian Volcaniclastic Rocks				
W	Water Body	9	Very steep high hilly to mountainous lands or very steep to locally sub-vertical or vertical escarpment slopes 35 ->100%.		
D	Disturbed Area – not mapped				
Note:	Refer to EIS Report Section 1.3 for more detailed descriptions of Geological Regimes.		**Example**: **Terrain Unit Qa2/6-7** Qa (Geological Regime) 2 (Landform) 6-7 (Soils)		**Notes:-** (1) – Soil profile form and texture class (2) – Principal Profile Form (Northcote, 1974) (3) – Australian Soil Classification (Isbell, 1996) Dual symbols eg (2-7) indicate both soil types may be present.

Note: This Figure 16 must be viewed with Figure 2 to 15

Project

GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
SOILS ASSESSMENT

Drawn: CA | Approved: JB | Date: 03-11-2009

Job No: **4262 6440** /6220 | File No: 4262640-g-2025.wor

Title

GENERIC KEY TO THE IDENTIFICATION OF TERRAIN UNITS

Figure: **16**

A4 | Rev: A

3

Conclusions

3.1 New Alignments

Terrain unit mapping for new sectors of the GTP route have been compiled as shown in Figures 1 to 16 inclusive. The terrain units intersected along the new alignments including those which occur within the CPIC Route have been assessed in relation to potential constraints and associated impacts for the construction and operations of the GTP and associated facilities.

- With respect to the Agricultural Land Classes identified, the only occurrences of terrain units representing (high constraint) good quality agricultural land (GQAL) - Class A, were identified for the CPIC (GSDA Section) Route. In that area the Class A lands occur in association with Land Class C1 which collectively occupy an area of only 24.7 ha which represents approximately 5 % of the corridor area. GQAL lands also classified as (high constraint) Land Class B, occurs more extensively in GLNG GTP September 2009 Sections B, C and D, where they occupy 71.6 ha (64 %), 47.0 ha (92 %) and 28.0 ha (51 %) of the respective Section ROWs;
- High topographic constraints have been identified to occur in Callide Range Alternative Route (Section E) along approximately 33 % of the ROW alignment. High topographic constraints have also been identified in GLNG GTP September 2009 Sections A, B and G and CPIC (CICSDA Section) Route along 8.5 %, 1.8 %, 6.9 % and 2.3 % of the respective ROW alignments. High topographic constraints have also been identified in GLNG GTP September 2009 (Section G), CPIC (CICSDA Section) Route and CPIC (GSDA Section) Route;
- Potentially high constraint excavation conditions have been identified to occur in Supplementary EIS Route Alternatives Sections A and G along 7.1 % and 10.6 % of the respective ROW alignments, High constraint excavation conditions also occur in CPIC (CICSDA Section) Route and CPIC (GSDA Section) Route which occupy 16.1 % and 17.4 % of the respective corridor areas;
- Terrain units rated as presenting high constraints with respect to erosion potential occur in all new mapping sections except GLNG GTP September 2009 (Section C). GLNG GTP September 2009 (Section A) and CPIC (CICSDA Section) Route includes lands with high erosion potential throughout. GLNG GTP September 2009 (Sections B, D, G); Callide Range Alternative Route (Section E) and CPIC (GSDA Section) Route includes lands with moderate to high or high erosion potential which occupy 1.8 %, 21.4 %, 81 %, 73.2 % and 51.9 % of the respective alignment ROWs and sector corridor areas;
- Areas with high drainage constraints for pipeline construction mainly due to flooding frequency and/or poor drainage conditions occur along the section alignment ROWs or designated corridor areas as follows:- GLNG GTP September 2009 Section A (1.4 %), Section B (10.2 %), Section C (0 %), Section D (11.9 %), Section G (3.9 %), Callide Range Alternative Route Section E (15.5 %), CPIC (CICSDA Section) Route (44.4 %, GLNG GTP September 2009 Section F (3.8 km section) (25.8 %) and CPIC (GSDA Section) Route (9.1 %); and
- Potentially high constraints for pipeline construction due to presence of problem soils (R3/So/D and/or ASS), with the exception of GLNG GTP September 2009 (Section A) (nil), have been identified to occur as follows:- GLNG GTP September 2009 Section B (34.1 %), Section C (8.0 %), Section D (19.2 %), Section G (41.4 %), Callide Range Alternative Route (11.5 %) CPIC (CICSDA Section) Route (33.3 %), GLNG GTP September 2009 Section F (3.8 km section) (23.6 %), and CPIC (GSDA Section) Route (20.6 %).

For each of the new mapping sectors where potentially high levels of constraints and impacts have been assessed on a terrain unit basis, management strategies and mitigation measures proposed in

3 Conclusions

EIS Section 7.3 and in EIS Appendix L2, will be adopted in order to minimise potential environmental impacts as much as practicable.

4

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 15th July 2009.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between September and October 2009 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

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