4 GEOLOGY AND SOILS

4.1 INTRODUCTION

This chapter responds to submissions received on the Queensland Curtis LNG (QCLNG) Project draft environmental impact statement (EIS) relating to geology and soils for the Pipeline Component.

Where changes to the Project description, as detailed in *Volume 2, Chapters 8* and *12*, have affected geology and soils, these impacts and measures to mitigate them are described.

4.2 RESPONSES TO SUBMISSIONS

Submissions and responses relating to geology and soils for the Pipeline Component are summarised in *Table 4.4.1*.

Table 4.4.1 Responses to Submissions on the draft EIS

Issue raised	QCLNG Response	Relevant submission(s)
This section does not acknowledge the potential disturbance of soil conservation structures on good quality agricultural land (GQAL). On some cropping land in the proposed corridor landholders have built contour banks and waterways to control erosion from overland run-off. Such works can be identified on aerial photographs or other imagery. While such works may be reinstated after construction, there is a risk of uncontrolled run-off where soil conservation measures are disturbed during construction and routine inspections.	See *Section 4.2.1.*	32
The further studies noted in the EIS should be provided. For example, surveys of problem soils, geotechnical investigations of ranges, and studies of flora/fauna. The findings should include a detailed assessment of the measures provided to prevent and or minimise impacts to environmental values.	See *Section 4.2.2.*	32
Table 4.4.4 is incorrect. Local governments determine GQAL in their planning schemes. The Department of Environment and Resource Management (DERM) provides the data stating the agricultural land class (A, B, C and D). Some local governments classify Class C agricultural land as GQAL. Planning guidelines supporting SPP1/92 state: "In some areas, Class C land (where pastoral industries predominate) are also considered to be GQAL." Consequently a greater area of GQAL will be affected than *Section 4.2.3* of the EIS states.	See *Section 4.2.3.*	32

4.2.1 Soil Conservation Structures

The potential for the disturbance of soil conservation structures such as contour banks, diversion banks, artificial waterways, strip cropping and other run-off control measures has been assessed. Aerial photographs of the three pipeline routes were used to identify structures primarily located in upland cultivation areas or areas that have been cultivated and returned to improved pasture.

There are probably many other areas where soil conservation works were conducted but poor maintenance has impaired their capacity to accommodate run-off. Some of these structures may not be readily apparent in aerial photographs. In most cases, however, the areas containing such works have been returned to grazing.

The lengths of pipeline that are likely to intercept lands protected by soil conservation structures are:

- Export Pipeline (based on 380 km length): 450 m, mainly around KP 255 and KP 269
- Woleebee Creek route: 750 m, mainly around KP 30 and 38.5
- Water Collection Header, including the section of the upstream infrastructure corridor (UIC) where the water Collection Header collocates with the gas Collection Header: 870 m, various locations.

All soil conservation works were identified as contour banks with short sections of constructed waterway. No major diversion works or areas of strip cropping are likely to be traversed by the pipelines. Many works, particularly along the water Collection Header route, are on pasture land that may have been cultivated in the past.

Measures to minimise the effect of pipeline construction and maintenance on soil conservation works will include:

- checking the existing soil conservation works layout. This may involve liaison with landholders or a Department of Environment and Resources Management (DERM) adviser to determine whether the proposed works are compatible with the existing run-off control layout
- preparation of a run-off control plan integrating existing works with any erosion control measures associated with pipeline construction
- ensuring the pipeline trench and/or associated stockpiles do not divert run-off water onto cropping land or areas with existing erosion, or significantly increase run-off into existing soil conservation measures
- ensuring access tracks do not pass directly over contour banks where possible. Tracks should pass at the bottom of the bank.

Where a contour bank must be crossed, temporary erosion control works may be required. After pipeline establishment, the required capacity of the original

structure would be reinstated. Such sites will be recorded for monitoring and maintained for the duration of the pipeline operation.

4.2.2 Geotechnical Studies

QGC will undertake geotechnical investigation under the petroleum survey licence to define construction methodology and detailed design for various landforms such as creek crossings and to derive a cost estimate for the pipeline construction. These surveys will be done over several months. Construction contractors commonly conduct more detailed assessment to better inform final construction techniques. A pipeline licence is normally in place at that stage which allows for the level of detailed investigation required.

4.2.3 Good Quality Agricultural Land

A revised summary of the potentially affected areas of GQAL is provided in *Table 4.4.2*. This table has been revised to address the presence of Class C land along the pipeline routes where it has been designated as GQAL. The GQAL along the Woleebee Creek route has also been included.

Table 4.4.2 indicates that the Project could affect 520 ha of Class A land, 636 ha of Class B land and 260 ha of Class C land. The majority of the Woleebee Creek route is Class B land.

A primary objective of route planning has been to avoid GQAL, particularly Class A and Class B, and land permanently used for cropping. The routes pass predominantly through Class C land that is not designated as GQAL involving cultivation.

Table 4.4.2 Summary of GQAL

	Supplementary EIS						Draft EIS				
Pipeline route	**GQAL affected (km)***			**GQAL affected (ha)***			**GQAL affected (km)***		**GQAL affected (ha)***		**Comments**
	Class A	**Class B**	**Class C***	**Class A**	**Class B**	**Class C***	**Class A**	**Class B**	**Class A**	**Class B**	
Export	54	66	32	214	264	128	54	66	212	268	Class A predominantly south and east of Taroom and Callide Valley (including alluvium).
Woleebee Creek	5	39	11	18	156	44	N/A	N/A	N/A	N/A	Class A mainly in a small area south-west of Wandoan. The route is predominantly on improved pasture.
Water Collection Header and UIC	36	27	11	288	216	88	36	27	288	216	Class A mainly alluvium and tertiary plains near Condamine River.
Lateral	N/A	N/A	N/A	N/A	N/A	N/A	45	24	180	96	Mainly west of Wandoan, predominantly improved pasture.
Total	**95**	**132**	**54**	**520**	**636**	**260**	**135**	**117**	**680**	**580**	

*GQAL categories are based on *Planning Guidelines – The Identification of Good Quality Agricultural Land (State Planning Policy 1/92)* for those local authority areas traversed by the pipeline (see Attachment 2 in guidelines). Many local authorities in the study area do not designate Class C land as GQAL.

Where the route does traverse GQAL (particularly Class A or Class B lands used for permanent or intermittent cropping), measures to minimise the effects on existing or potential agricultural uses will include:

- careful controls on the excavation and reinstatement of the original soil profiles within the pipe cover material. The soil profile will be retained to maintain productive value. Depth of cover will be increased, for example, to 1.2 m. Landholders will be consulted regarding cultivation practices and the most appropriate burial depth where cropping land will be traversed
- ensuring the final land surface has been reinstated to a level suitable for the unimpeded passage of cultivation implements and will not cause diversions of run-off which may cause erosion in lower slope areas
- where soil conservation structures may be disturbed, implement controls as described in *Section 4.2.1*
- attention to implementation of sediment and erosion control measures within cultivated lands adjacent to the area to be disturbed
- installation of erosion control works such as whoa-boys along the pipeline corridor. These will divert run-off water away from cropping land and onto stable grassed outfalls
- placement of access tracks to avoid interference with cultivation and harvesting activities where practicable.

4.3 CHANGES TO PROJECT DESCRIPTION

A key change to the Project in relation to the Pipeline Component is the inclusion of the Woleebee Creek section of the gas Collection Header.

4.3.1 Environmental Values

The physical characteristics of the Woleebee Creek section of the pipeline are summarised in *Figure 4.4.1*, *Figure 4.4.2*, *Figure 4.4.3* and *Table 4.4.3*. They address the soil types, erosion risk and GQAL along the Woleebee Creek pipeline route. The data comes from literature reviews and aerial photographs.

Figure 4.4.1 and *Table 4.4.3* indicate that the Woleebee Creek route comprises:

- predominantly shallow dark and brown cracking clay (vertosol) soils with a generally low to moderate erosion risk. Texture contrast soils along the route are mainly on low sloping terrain
- mainly Class B GQAL. Most of the area is used for grazing on improved pasture and only minor areas are Class A GQAL and suited to permanent cropping.

Projection UTM MGA Zone 56 Datum GDA 94

0 3 6 9 Kilometres

N

Source Note:
1:250,000 Topographic vector copyright Geoscience Australia

Legend:

- Soils overlying recent alluvium
- Soils overlying fine grained sedimentary rocks
- Soils overlying deeply weathered sedimentary and unconsolidated sediments
- Railways
- Roads

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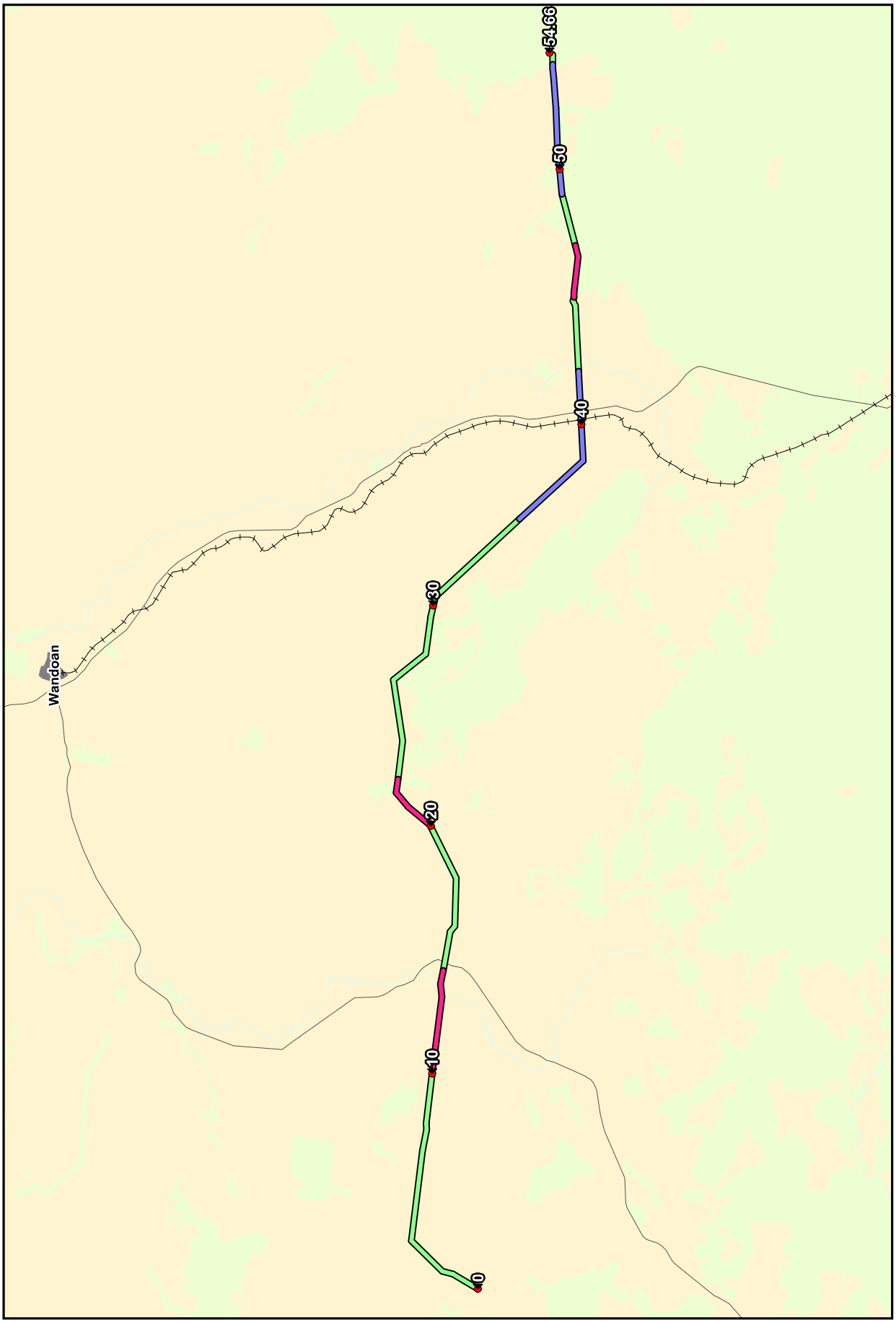
Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business
Drawn	Unidel
Approved	CDiP
Date	18.01.2010
sEIS Volume	**4** **Figure** **S4.4.1**
File No:	E05-P-MA-96221
Revision	Supplementary

Title **Woleebee Creek Route Soils**



Datum GDA 94

Projection UTM MGA Zone 56

0 3 6 9

Kilometres

N

Source Note:
1:250,000 Topographic vector copyright Geoscience Australia

Legend:

- Low Potential
- Moderate Potential
- High / Very High Potential
- Railways
- Roads

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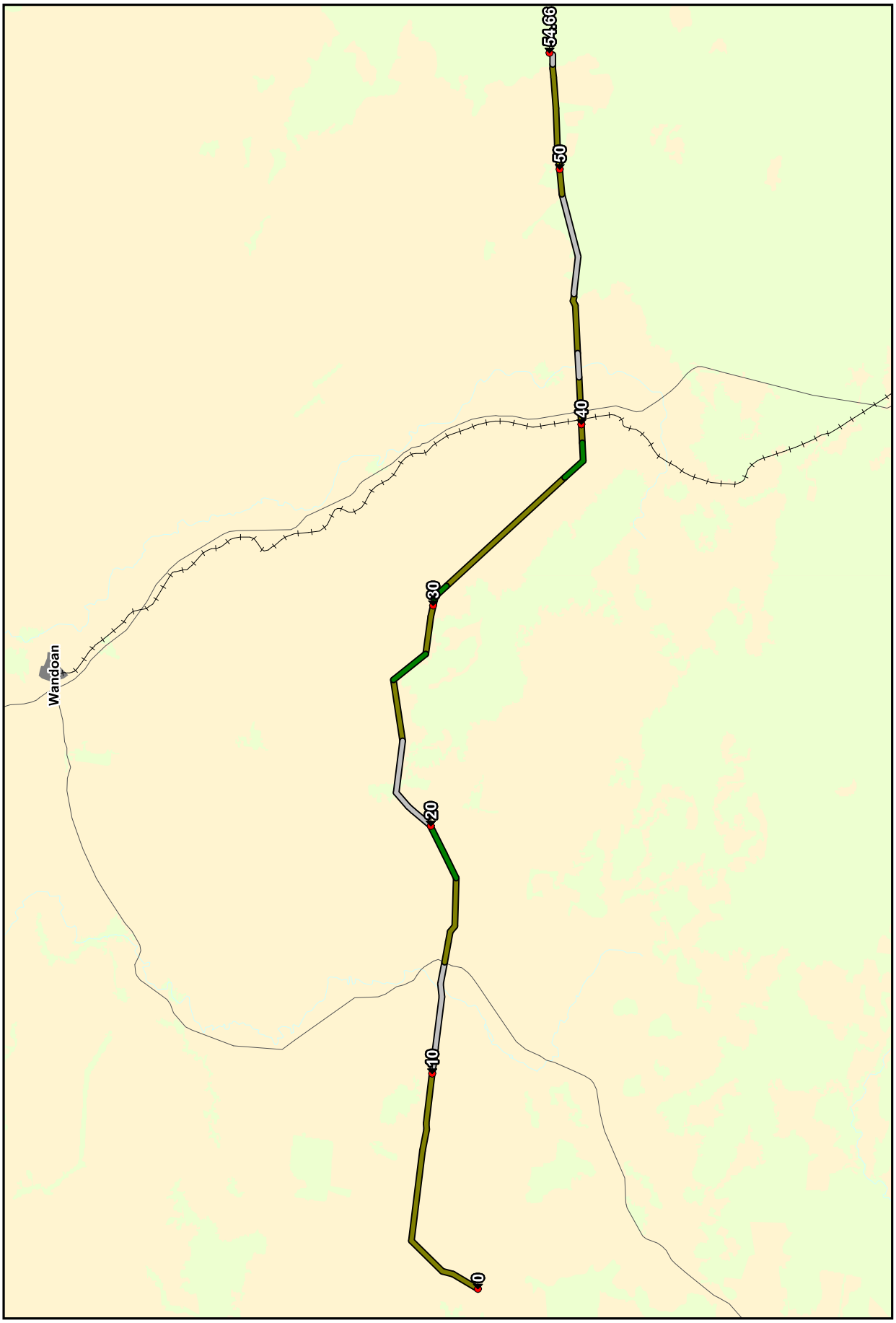
Project	Queensland Curtis LNG Project	Title	**Woleebee Creek Route Erosion Potential**
Client	QGC - A BG Group business		
Drawn	Unidel	**sEIS Volume** 4 **Figure** S4.4.2	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
Approved	CDiP	File No: E05-P-MA-96222	
Date	18.01.2010	Revision Supplementary	



Datum GDA 94

Projection UTM MGA Zone 56

0 3 6 9

Kilometres

N

Source Note:
1:250,000 Topographic vector copyright Geoscience Australia

Legend:

- Class A
- Class B
- Class C
- Railways
- Roads

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

Title **Woleebee Creek Route**
Good Quality Agricultural Land

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Drawn	Unidel	**sEIS Volume** 4 **Figure**	S4.4.3
Approved	CDiP	File No:	E05-P-MA-96223
Date	18.01.2010	Revision	Supplementary

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Table 4.4.3 Woleebee Creek route physical characteristics

KP	Main geological units (interpreted from 1:250k geology sheets)	Terrain/slopes (predominant slope % in brackets)	Land Resource reference* (main soil grouping in italics)	Predominant soil type (typical topsoil depths in brackets) (soil-sample site reference points in italics)	Existing erosion**/ predominant land use	GQAL***	Erosion potential**** / soil dispersibility	Construction excavation*****	Comments / management issues
0-39.0 (excludes alluvium below)	Jmb- Birkhead Formation (calcareous lithic sandstone and shale)	Undulating plains and low rises (2-8%); some steeper rises (up to 12%)	Na,W (3) *2d,e,f,g*	Shallow black earths and grey or brown cracking clays with some shallow brown gradational soils and non-cracking clays; dispersive subsoils; moderately fertile; vertosols/dermosols (20cm)	(1)-(2) mainly improved pastures; minor cultivation	A: 2.5 B: 27 C: 2.5	2; mainly gully erosion; M	Medium; some sandstone/mudstone rock areas	Management issues associated with sodic soils at depth
Various alluvia and stream channels incl Woleebee Creek (KP12) and Conloi Creek (KP20) floodplains	Qa- alluvium	Flat alluvial plains (0-2%)	J (3) *5c,d,e*	Deep black earths and grey clays; fertile; vertosols and dermosols; some deep texture contrast soils (20-50cm)	(1) improved pastures, minor cultivation	A: 2.0 B: 4.0 C: 1.0	1; generally L (some stream bank erosion risk where traversing minor stream channels)	Low; issues with saturated layers (depending on seasonal conditions)	Management issues associated with effects on drainage, possible shallow localised groundwater interception (depending on seasonal conditions); effects on agricultural production (minor)

KP	Main geological units (interpreted from 1:250k geology sheets)	Terrain/slopes (predominant slope % in brackets)	Land Resource reference* (main soil grouping in italics)	Predominant soil type (typical topsoil depths in brackets) (soil-sample site reference points in italics)	Existing erosion**/ predominant land use	GQAL***	Erosion potential**** / soil dispersibility	Construction excavation*****	Comments / management issues
39.0-44.5 49.0-52.5	Jmb- Birkhead Formation (calcareous lithic sandstone and shale); alluvium associated with Juandah Creek	Gently undulating plains and low rises (1%-4%); alluvium on floodplain (1-2%)	W (3) *2d/3d,e*	Deep black earths and grey or brown cracking clays – melonhole common; dispersive subsoils; moderately fertile; deep alluvial clays at Juandah Creek; vertosols/dermosols (15cm)	(1) improved pastures	B: 8.0 C: 1.0	1; generally M	Low; trenching may be difficult	Construction issues with melonhole; will require careful topsoil handling and management especially in gilgai area
44.5-49.0 52.5-54.5	Tertiary sediments, well to poorly sorted quartzose sandstone, some laterite T/Jkk	Gently to steeply undulating to rolling (2-8%); steeply undulating at eastern limits	7a/9b(1) *1a,b,c* *3a*	Shallow sandy and loamy topsoils with rock at shallow depth; some shallow sandy texture contrast soils; rudosols and sodosols; infertile (<5cm)	(2) native pastures and native forest	C: 6.5	3: sheet and gully erosion; H (west) VH (eastern end)	Moderate; sandstone rock at shallow depths; trenching may be difficult	Management issues associated with sodic soils at depth; significant attention to sediment and erosion control for eastern limits

*Land resource mapping is based on the following reports: (1) Murilla and Chinchilla Land Resource Areas; (2) Taroom Shire Land Resource Areas; (3) Land Systems of the Dawson Fitzroy Area CSIRO; (see *Section 2.2.1* of original submission).
Soil groupings in italics have been divided into categories as described in Appendix D of original submission.

**Existing erosion levels: (1) = minor; (2) = moderate; (3) = severe.

***Good quality agricultural land – predominant class only; see *Volume 4, Section 2.6* of draft EIS. Distances are given in KP for each GQAL class. GQAL as per SPP1/92 guidelines and local authority planning provisions.

****Erosion potential**:** 1 = low; 2 = moderate; 3 = high; 4 = very high. Soil dispersion rating: L= low; M = moderate; H = high.

*****Excavation conditions: see original submission, *Section 2.5.6*.

4.3.2 Potential Impacts

There are no significant construction constraints although there are some melonhole (gilgaied) soils near the eastern limits of the route.

Gilgai commonly occur in brigalow country with cracking clay soils. They are usually found on low-lying, poorly drained land with ill-defined drainage in its natural state. Such holes are usually more than 30 cm deep in a broad irregular microrelief and there may be up to 1 m height difference between the mound and depression. The mound is usually light clay that can be stripped although stripping should be no deeper than 15 cm. The depression is usually a heavy, hard clay which should not be stripped and is usually well below strip depth in any case. The subsoil is likely to be stiff with some risk of elevated but very localised salinity levels in exposure. Careful topsoil stripping and handling is required. It may be necessary to import topsoil for rehabilitation purposes.

4.3.3 Mitigation Measures

In addition to the mitigation measures set out in *Volume 4, Chapter 4* of the draft EIS and *Volume 10* the following measures will be applied in gilgaied areas:

- only mounds will be stripped and strip depth will not exceed 15 cm
- the rate of gypsum application will be determined in consultation with the landholder but typically will be 2.5 t/ha
- gypsum should be disc ploughed into the soil after spreading.

4.3.4 Conclusion

QGC expects the impact on soils due to the addition of the Woleebee Creek route will not significantly differ from that described in the draft EIS. Nevertheless, additional measures have been proposed to mitigate any change. QGC will implement the additional mitigations to preserve GQAL productivity.