4 GEOLOGY AND SOILS

4.1 RESPONSE TO SUBMISSIONS ON DRAFT EIS

Responses to submissions relating to the Queensland Curtis LNG (QCLNG) Project LNG Component Geology and Soils, as described and assessed in the draft environmental impact statement (EIS), are summarised in *Table 5.4.1* below. In particular, the table outlines responses to submissions on draft EIS *Volume 5, Chapter 4: Geology and Soils*, *Appendix 5.1 – LNG Facility and Associated Infrastructure – Geology, Geomorphology, Topography and Soils* and *Appendix 5.2 – LNG Facility and Associated Infrastructure – Acid Sulfate Soils Investigation, Friend Point and Curtis Island, Gladstone, QLD*.

It should be noted that many of the queries addressed in *Table 5.4.1* relate to the detailed technical classification of near surface soils on the LNG Facility site. Notwithstanding this technical discussion, as pointed out in *Volume 5, Chapter 5* of the draft EIS, the location of the LNG Facility accords with the designation of the site as part of the Gladstone State Development Area (GSDA) Curtis Island Industry Precinct, and the selection of the precinct location is understood to have taken, *among other things,* soil characteristics into account.

Table 5.4.1 Response to Submissions on Draft EIS

Issue Raised	QCLNG Response	Relevant Submission(s)
Appendix 5.1 Geology, Geomorphology, Topography and Soils; *Section 6 Soil Sampling and Analysis.* The data in the Australian Soil Resource Information System (ASRIS) is very coarse scale and not relevant to the scale needed for the EIS assessment.	The ASRIS database was accessed to provide preliminary data for the Targinie Road – Phillipie's Landing section of the pipeline. Further geotechnical assessment of the pipeline approach to Phillipie's Landing is ongoing as part of the detailed design of The Narrows crossing. The ASRIS database was not used for the soil assessment and characterisation of the Curtis Island LNG site. Data detailing the soil quality for this part of the LNG Component was assessed based on actual field sampling and analysis.	32
The depth of soil examination and sampling over the LNG Facility site is not sufficient to adequately characterise the erosion potential of the site, and the agricultural land evaluation remains subjective.	The soil data presented in the draft EIS was derived from samples collected to a depth of 60 cm, with most being from a depth of 10 to 40 cm. The sampling procedure was by hand auger. Given the characteristics of the site, such as: extensive development of soils containing up to 40% rock fragments, which consisted of indurated mudstone;	32

Issue Raised	QCLNG Response	Relevant Submission(s)
	and the coverage of the site, which prevented the use of mechanical means to collect soil borings, it was not practicable to collect information to the depth of 2m. At the time of sampling, the soil was dry and hard in many areas, and combined with the extensive presence of rock fragments up to 5 cm in size, severely limited the ability to obtain samples from greater depths (B horizon) necessary to fully characterise the soil profile. The assessment of the agricultural quality of the land was based on the criteria specified in *The Identification of Good Quality Agricultural Land (1993)*. This document provides guidance of a subjective nature, and does not provide specific soil chemistry information against which to make a quantitative assessment of land use quality. Further, the rocky nature of the soil encountered during the field sampling at the majority of locations would suggest that the soils would not be considered to be good quality agricultural land.	
There are a number of anomalies in the soils information provided in the draft EIS, including: The moderate to high Cation Exchange Capacity (CEC) average value of 22 milliequivalents (meq) per 100 g of the soils (Section 7.4 Cation Exchange Capacity (CEC)) would indicate high nutrient retention characteristics, and hence moderate to high fertility.	For consistency*, Appendix 5.1* of the draft EIS has been re-issued (refer *Appendix 5.1* of this sEIS) with clarifications per the items below: The CEC of the soils across the proposed LNG Facility site varied quite markedly, both in total CEC and individual components. The total CEC ranged from low (6-12 meq/100 mg) to high (40-100 meq/100 mg). The results indicated variable CEC across the site, and hence moderate to high soil fertility, the distribution of rock fragments and slope of the land on the eastern, southern and northern boundaries of the site would restrict the potential for extensive, broad-acre agriculture. The CEC results were also restricted to the upper 10 to 40cm of the soil profile in most locations, limiting the ability to make an assessment of the overall agricultural quality of the land.	32

Issue Raised	QCLNG Response	Relevant Submission(s)
It is most unusual for every soil horizon of the 45 sampled sites to have exactly the same soil texture considering variation in topographic position and parent material as indicated in *Annex B Detailed Soil Descriptions*.	The texture identified for the soils was predominantly silty clay loam, with light to medium clay soils also present. The differences between the samples were not appreciable, and as such the description was given as silty clay loam to light clay. However, this represents a technical clarification and does not alter the conclusions of the report. The parent material for the soils was predominantly the indurated mudstone of the Wandilla Formation, which underlies the QCLNG site. This unit outcrops across the site as blocky fragments to 1 m in size or more commonly as fragments 2 cm to 20 cm in size.	
Assuming the full profile description is given for the sampled sites; the soils are uniform in profile form, and would not be classified as chromosols or sodosols.	The soils varied in the relative proportion of the rock/sand/silt and clay components. The majority of the samples were light grey brown in colour, and based on the underlying geology of the site (Wandilla Formation), it would be expected that the soil classification would be similar. The classification of several soils as sodosols was based on the sodicity of the samples which reported exchangeable sodium percentage (ESP) greater than 6%. This value has generally been used to ascribe soils as sodic (Northcote and Skene 1972)[1]. However, this represents a technical clarification, and does not alter the key conclusions of the report.	
There is a major discrepancy between CEC and exchangeable cations for most of the sites sampled.	The CEC and exchangeable cations data for calcium, magnesium, potassium and sodium was based on analyses reported as received from the National Association of Testing Authorities (NATA) accredited laboratory. Laboratory results were included as an Annexure to *Appendix 5.1* in the draft EIS. The variation in the CEC to exchangeable cations may be a result of the variable organic content of the soils. The organic carbon content of the soils was not determined as part of the laboratory analysis	

1 Northcote KH, and Skene JKM. 1972, Australian Soils with Saline and Sodic Properties, Soil Publication No. 27, CSIRO, Australia

Issue Raised	QCLNG Response	Relevant Submission(s)
The soils and land suitability information provided in the draft EIS should be revised and the identified problems corrected.	The report submitted as *Appendix 5.1* of the draft EIS has been amended to reflect the responses above, and is included as *Appendix 5.1* to this sEIS.	
With regard *Appendix 5.2 Acid Sulfate Soils Investigation, Friend Point and Curtis Island, Gladstone, QLD*, no detail is provided on the proposed disturbances of acid sulfate soils (ASS), for example volume, depth and specific location. A geotechnical investigation should be undertaken to determine the feasibility of location of proposed infrastructure in or over marine sediments.	Detailed design of the LNG Facility and the Pipeline (including construction methodology across Friend Point, Laird Point and The Narrows) is ongoing. The detailed design and construction methodology is being undertaken with reference to identified ASS issues on these sites, with potential changes to location and layout of structures, detailed foundation design, and detailed construction methodology under consideration to avoid ASS or potential acid sulfate soils (PASS) and avoid or minimise disturbance where praticable. A general Project Acid Sulfate Soils management framework has been developed. Detailed site specific Acid Sulphate Soils Management Plans, which will address volumes of ASS disturbed, depths, and detailed site-specific management methods, will be developed for approval by DERM before the start of construction on each of these sites.	32

4.2 AMENDMENTS TO BASELINE AND UPDATE OF IMPACTS

The description of Geology and Soils on the LNG Facility and Curtis Island pipeline route as described in *Volume 5, Chapter 4* of the draft EIS remains valid, apart from the clarifications outlined in *Table 5.4.1* above.