HANCOCK PROSPECTING PTY LTD

Alpha Coal Project Environmental Impact Statement

E | Soils and Contamination

CLIENTS | PEOPLE | PERFORMANCE

Hancock Prospecting Pty Ltd

Alpha Coal Project - Environmental Impact Statement

Soils Report

3 August 2010

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Appendices

Abbreviations

APSDA	Abbot Point State Development Area
CLR	Contaminated Land Register
DEEDI	Qld Department of Employment, Economic Development and Innovation
DERM	QLD Department of Environment and Resource Management
DEWHA	Australian Government Department of Environment, Water, Heritage and the Arts
DIP	Department of Infrastructure and Planning
EMR	Environmental Management Register
CH	Chainage
PWHC	Profile Water Holding Capacity
PAWC	Plant Available Water Capacity

1. Introduction

1.1 Project Background

Hancock Prospecting Pty Ltd (HPPL) is proposing to construct a standard gauge, 511 km long railway line for the purposes of transporting processed coal from the Alpha coal mine site to the proposed Port of Abbot Point near Bowen. The proposed railway line is a vital piece of infrastructure that will enable export of 60 Mtpa of quality thermal coal to overseas markets.

In September 2009, GHD was commissioned by HPPL to undertake an Environmental Impact Statement (EIS), for the Alpha Coal Project's proposed rail line (herein referred to as the Project). This report summarises the findings of topography and soils assessments conducted along the proposed rail alignment.

1.2 Study Area

The Project is located between the Alpha coal mine, 38 km northwest of the Alpha township and the Abbot Point coal export terminal, 25 km north of Bowen. The alignment of the Project has been selected on the basis of several factors, primarily environmental, economic and geotechnical grounds. The rail alignment proceeds in a generally north-easterly direction from the Alpha mine, crossing the Belyando River and several of its tributaries in the first 100 km. The railway crosses generally relatively flat lowlands before commencing a gentle climb from near Eaglefield adjacent to the Suttor River, to a point near the existing Newlands mine. This is the highest point on the railway at approximately 300 m above sea level. In the vicinity of the Newlands mine, the railway runs parallel to the Queensland Rail (QR) Northern Missing Link railway for approximately 70 km through a pass in the Leichhardt Range and parallel to the Newlands Railway to a point near the Bowen River. The Railway then travels in a north westerly direction on crossing the Bowen River, down the Bowen River valley through mostly grazing land toward Mount Herbert. West of Mount Herbert, through a pass in the Clarke Range, the railway travels north-easterly crossing the Bogie River and entering Abbot Point on its western boundary.

The railway passes approximately 70 km to the north east of Clermont, 55 km to the north east of Moranbah, 20 km to the west of Collinsville, and enters the Port of Abbot Point 25 km west of Bowen.

2. Topography

2.1 Existing Environment

Information regarding the creeks, hydrology and catchment drainage is provided in the Section 11 of the EIS. A broad overview of the varying topographical features encountered along the rail corridor is provided in this Report. Elevation maps are provided in Appendix A, also referred to in describing the topography were the available land studies (Gunn et al 1967 and Christian et al 1953) which provided additional details on the topographical features likely to be encountered.

From the mine site, the alignment commences within an area of plain and gently undulating slopes with alluvial flats closer to Lagoon Creek, before progressing into undulating country with level to low hilly reliefs, with some rugged country (knolls and breakaways) present to the west. From CH18000 to CH30000 the alignment traverses an area of low rises and ridges, with broad gently undulating country with gentle slopes. Available land systems reports suggest there is an area from CH21000 to CH23000 that may have some localised steep slopes up to 60% on the mesa edges.

From CH30000 the project enters an area of occasional low hills within a lowland area of level to undulating plains before entering the alluvial plains closer to Native Companion Creek. The alignment progresses to an area of flooded alluvial plains before traversing the Belyando River, which is a braided river system; there are also some broad channels throughout the area around the Belyando River.

As the project leaves the alluvial floodplains of the Belyando River area it returns to a lowland area with level to gentle undulations with possible rugged breakaways and depressions interspersed throughout. At CH50000 the project passes through plain country with level to very gently undulating slopes with some more pronounced rises. At CH60000 the alignment crosses Lestree Hill Creek, and re-enters similar country of plains and lowlands, with interspersed depressions and crests of rises and low hills.

The project crosses a small area on the upslope of the alluvial plains at approximately CH64000, before re-entering an area of crests and rises with intermittent plains and shallow depressions. There may be some localised steeper slopes around the rises. From approximately CH72000 the project is within undulating lowlands with some strike ridges and hills, narrow alluvial flats may be interspersed within the natural channels.

A small area after CH80000 is considered to be mostly level to low hilly undulations, with some knolls and breakaways in the more rugged terrain. The project then enters a sustained area of level to very gently undulating slopes with sporadic hills and scarps with incised valleys from CH85000 to CH105000. Within this country there is an area of small lateritic mesas with very low strike ridges at approximately CH90000. Following Laselles Creek the project enters an area of lowlands and plains with shallow depressions. This is consistent until around Gregory Creek at approximately CH118000, whereby the project enters an area of flooded alluvial plains around the creek line.

From CH120000 the alignment enters an area of plains and lowlands with some low local relief, breakaways, depressions and alluvial flats around the drainage areas. There is a possibility of a small area around CH135000 of rocky hills with the occasional strike ridges, before returning to the plains and undulating lowlands with occasional rugged outcrops. The area around Miclere Creek is within alluvial flat country before returning to similar country as previous.

From Gregory Development Road at CH155000 the project enters an area of plains, lowlands and depressions with occasional rises and scarps. Flooded alluvial plains are traversed around Brown and Logan Creek at CH170000. Following the alluvial plains, the alignment returns to gently undulating grassland areas, with some shallow valleys and narrow alluvial flats. There are some local relief areas, prior to entering an area of plains and lowlands at approximately CH186000, the country grades into the alluvial floodplains around Diamond Creek (CH196000) area.

Following Diamond Creek, the project travels along the upper portion of undulating lowland country with some slight rises and shallow depressions. The project then enters an area at CH205000 of small lateritic mesas with small rises, gently to moderately undulating with alluvial flats in some of the lower lying areas. The project progresses through similar terrain until approaching Eaglefield Creek (CH224000) where the land is predominantly plains with some local rises, with flooded alluvial plains confined mostly to around the creek area.

The project remains in relatively plain lowland country with low to moderate undulations, with intermittent crests and rises, following the Eaglefield Creek crossing, until approximately CH255000 when the project enters an area of lowlands with sporadic breakaways and knolls, with depressions and alluvial flats interspersed throughout. This remains until CH260000 whereby level to gently undulating country is traversed with alluvial flats around the Suttor Creek crossing. The terrain rises following this crossing back to undulating country.

From CH270000 onwards the terrain is rolling undulating country with some hills and rises. The Elevation is decreasing heading towards Abbot Point, with the most noticeable change in elevation occurring after CH300000 where the alignment enters the Bowen River Catchment area. The alignment travels through several creek and drainage lines in undulating terrain with some sharper rises and depressions.

The alignment crosses the Bowen River at approximately CH345000 before running parallel with it to approximately CH388000. The terrain around the river is gentle sloping levee country, with the river being the lowest point and the areas either side a mixture of small crests and gentle slopes. The alignment travels west of the river within an area consisting of low gently undulating hills. The alignment travels along the Bowen River traversing both kinds of terrain at various locations.

As the alignment starts to move away from the Bowen River at CH388000 the project travels through gently undulating terrain with some low hills and flatter lower parts. To the east of the alignment at CH390000, CH404000, and CH410000 there are some rugged hills / ranges with steep sloping parts. The alignment generally follows a gently undulating line as it travels around these hills.

The alignment enters an area of nearly flat terrain with some broad shallow depressions as it runs runs parallel to the Bogie River at CH427000 before crossing it at CH435000. Following the river crossing it re-enters an area of undulating to gently undulating terrain. To the east of the alignment from CH442000 to CH448000 is an area of rugged ranges and hills.

As the alignment turns to head east towards Abbot Point at CH45000 it remains within gentle undulating country with relatively flat country around the Sandy Creek and Elliot River areas. The terrain remains relatively flat with some moderate undulations as it enters into Abbot Point. The alignment does travel through a number of small streamlines as it progresses towards Abbot Point which would have localised variations in topography.

The Abbot Point rail loop is in a naturally low lying salt flat area. Two distinct increases in elevation is observed at CH490000 and CH500000 which are considered to be small hilly areas outside of the rail loop which is in an otherwise flat terrain.

2.1.1 Potential Impacts

Areas of steep and long slopes are at risk of erosion and landslides under wet weather conditions. The impacts of erosion are discussed in Section 2.4 of this Report. Erosion in regards to topography is a factor of both the slope gradient and slope length.

The Queensland Department of Main Roads, Road Drainage Manual, 2010, details the erosion risk ratings for slope gradient and length. These are provided in Table 1 below.

Table 1 Erosion Rating for Modal Slope Classes[1]

Class	Percent	Degree	Erosion Rating
Level	<1	0.35	Very Low (1)
Very Gently Inclined	1 to 3	0.35 to 1.45	Low (2)
Gently Inclined	3 to 10	1.45 to 5.45	Moderate (3)
Moderately Inclined	10 to 32	5.45 to 18	High (4)
Steep, Very Steep, Precipitous and Cliffed	32 to >300	18 to >72	Very High

1. Table 13.7.3 of DTMR, Road Drainage Manual, 2010.

The majority of the project alignment is in areas ranging from level to moderate inclination. The project alignment does not appear to traverse through sustained areas regarded as Steep to Cliffed, and as such the highest risk rating of any topographical feature encountered along the alignment is considered to be a maximum of high.

The above assessment of risk in Table 1 is based on modal slope, being the most common slope gradient across a landform.

As mentioned, slope length is the other factor when discussing topography that has an influence on the erosion risk. Slope length determines the capacity of the water runoff to concentrate and detach soil particles, with sustained slope length creating a higher risk of soil displacement. Erosion risk ratings based on Slope Length is provide in Table 2 below.

Table 2 Erosion Rating for Slope Length[1]

Slope Length	Erosion Rating
<5m	Very Low 1
5 to 25m	Low 2

Slope Length	Erosion Rating
25 to 50m	Moderate 3
50m to 100m	High 4
>100m	Very High 5

1. Table 13.7.4 of the DTMR Road Drainage Manual, 2010.

The project alignment is likely to traverse areas of sustained slope length at varying gradients, which will require varying levels of erosion and sediment control management to reduce the risk of erosion and the associated impacts on the receiving environments. There will be slope lengths greater than 100m, and as such the highest erosion rating for slope length will be very high.

The erosion management practices discussed later in Section 3.1 will also aid in reducing loss of valuable topsoil resource and potentially contaminated soils displacing during erosion.

2.1.2 Mitigation Measures

Erosion control techniques need to be implemented within those topographical regions that are considered to be at a higher risk of erosion. Slope length can be reduced by placing in drainage controls across the slope, which effectively reduces the length of the slope and catchment area.

The risk of erosion due to the slope gradient of the various topographical features is difficult to manage as that is a landscape constraint. Employing suitable erosion and sediment control management practices will reduce likelihood of the erosion but not reduce the risk rating of the gradient slope. Construction zones with a slope gradient risk rating of moderate are manageable in terms of reducing erosion, however working within areas of high to very high ratings will require some pre-planning in order to manage the impacts to a satisfactory standard, such planning should include when construction be undertaken, with provision for works to occur in the drier months which will have lower erosion risks.

In general works within topographical features that pose a risk to the environment due to slope length and gradient, are to be avoided during wet weather periods and erosive rainfall events. As water is the main cause of detachment of exposed soils, the other being wind, works are required to be managed to avoid increasing the risk of erosion due to climatic conditions in areas where the topographical features are considered to be most susceptible to erosion.

Erosion and Sediment Control Management Measures are further discussed in Section 3.1, these are the standard principles required to be adopted for the project, in addition, detailed Erosion and Sediment Control Management Plan will be required to be developed in order to manage amongst other things, the risk posed by topographical features likely to be encountered.

2.1.3 Regional Geology

For further details on the Geology and the relationship to soils within the project area, refer to the Section 4 - Geology of this EIS.

2.2 Climate

2.2.1 Existing Environment

For a detailed assessment of Climate refer to the Section 3 - Climate of this EIS. A brief description of the climatic conditions likely to be encountered along the alignment is provided below. Specific details on the erosive force of rainfall and high risk erosion periods are also provided.

The geographic region is strongly influenced by a range of climate extremes including:

- The Australian monsoon consisting of the El Niño and La Niña
- In basic terms the El Niño is associated with lower than average winter / spring rainfall, resulting in drought conditions in the region; and
- In basic terms the La Niña is associated with higher than average winter, spring and early summer rainfall.
- General storm activity;
- Cyclonic events; and
- Severe heat waves.

The key aspect of climate relating to soils is the rainfall events. In particular the erosivity of the rainfall. Due to the Alpha Rail Project being over 450km in length, the climatic conditions and characteristics will change considerably from Alpha to Bowen. In order to provide an overview of the climatic conditions likely to be experienced along the alignment, information from the nearest weather stations is provided below in Table 3.

Table 3 Average Monthly Rainfall and Monthly Rain Days Data[1]

Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Bowen, QLD – Commenced 1987 – Relevant to approximately CH410000 to CH500000													
Mean rainfall (mm)	178	243	76	62	44	24	19	22	7	13	35	135	845
Days of rain	11.7	12.1	9.4	8.2	6	5	3.3	2.7	2.4	3.3	6.3	9.2	79.6
Days of rain ≥ 10 mm	3.7	5.6	2.1	1.5	1	0.6	0.4	0.5	0.2	0.3	1.1	2.9	19.9
Days of rain ≥ 25 mm	2.1	3.4	1	0.7	0.4	0.2	0.2	0.3	0	0	0.3	1.4	10
Erosion Risk Rating based on Monthly Rainfall	**H**	**E**	**M**	**M**	**L**	**L**	**VL**	**VL**	**VL**	**VL**	**L**	**M**	**N/A**
Collinsville, QLD – Commenced 1939 - Relevant to approximately CH230000 to CH410000													
Mean rainfall (mm)	134	165	93	42	32	27	20	17	11	22	51	95	712
Days of rain	10.5	11.4	8.1	4.8	4.1	3.5	2.4	2.1	1.8	2.9	4.8	7.4	63.8
Days of rain ≥ 10 mm	3.9	4.4	2.7	1	0.8	0.7	0.7	0.5	0.4	0.7	1.5	2.7	20

Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days of rain ≥ 25 mm	1.6	2	1.1	0.4	0.3	0.3	0.2	0.2	0.1	0.2	0.6	1.2	8.2
Erosion Risk Rating based on Monthly Rainfall	**H**	**H**	**M**	**L**	**L**	**VL**	**VL**	**VL**	**VL**	**VL**	**M**	**M**	**N/A**
Clermont, QLD – Commenced 1870 - CH230000 to CH410000													
Mean rainfall (mm)	118	116	74	39	35	34	25	19	19	35	57	92	662
Days of rain	8.5	8.1	5.7	3.5	3.5	3.5	2.8	2.3	2.5	4	5.3	7.1	56.8
Days of rain ≥ 10 mm	2.9	2.7	1.7	1	0.8	0.8	0.6	0.5	0.5	1	1.5	2.3	16.3
Days of rain ≥ 25 mm	1.4	1.3	0.7	0.4	0.3	0.3	0.2	0.2	0.1	0.4	0.5	0.9	6.7
Erosion Risk Rating based on Monthly Rainfall	**H**	**H**	**M**	**L**	**L**	**L**	**VL**	**VL**	**VL**	**L**	**M**	**M**	**N/A**
Barcaldine, QLD – Commenced 1981 - Mine Site to CH230000													
Mean rainfall (mm)	86	78	59	37	31	24	23	16	15	29	38	63	500
Days of rain	7.3	6.8	5.0	3.3	2.8	2.7	2.4	2.1	2.5	4.0	5.1	6.5	50.5
Days of rain ≥ 10 mm	2.5	2.1	1.6	1.0	0.9	0.8	0.8	0.5	0.4	1.0	1.1	1.9	14.6
Days of rain ≥ 25 mm	1.1	0.9	0.7	0.4	0.3	0.3	0.3	0.1	0.1	0.2	0.3	0.7	5.4
Erosion Risk Rating based on Monthly Rainfall	**M**	**M**	**M**	**L**	**VL**	**VL**	**VL**	**VL**	**VL**	**VL**	**L**	**M**	**N/A**

Source: Bureau of Meteorology (accessed 27/01/2010).

1 Erosion Risk Ratings derived from IECA Best Practice Erosion and Sediment Control Guidelines 2008, and DTMR Road Drainage Manual (2010).

The erosion risk ratings detailed above are based on average monthly rainfall depth, and not the erosive force of the rainfall. The above data represents the rainfall information for the closest weather stations along the Rail Corridor. The following can be interpreted from the above data:

- The portion of the project nearest to the coast will be subject to a greater number of rainfall events annually with a higher likelihood of a rainfall event exceeding 25mm over a 24 hour period;
- Higher erosion risks are prevalent as the project moves towards Abbot Point from the mine, with the areas nearest to the coastline experiencing the higher erosion risks;
- The number of rainfall days that have in excess of 25 mm of rain generally increases as the project travels towards Abbot Point from the mine;

- The period with lowest erosion risk is from April to October across the whole alignment; and
- The period with the highest erosion risk, based on monthly rainfall levels, is during the summer months from December to March.

Climate information is an integral part in limiting the risk of erosion of exposed soils due to rainfall events.

Relevant land study reports have been referred to for the project area that details the specific climate information and patterns for each of the study areas.

CH410000 to CH500000– Aldrick, J.M, 1988, Soils of the Elliot River, Bowen Area, North Queensland, Department Primary Industries, Queensland Government (DPI, 1988)

Seasonal weather conditions are generally controlled by the conjunctive activity of the subtropical high-pressure belt and equatorial low pressure belt, both of which migrate southwards during summer. The interaction between these movements and the prevailing easterly wind-flows largely accounts for summer rainfall maxima. The area is subject to high frequency cyclonic activity, flooding and prolonged drought (Anonymous 1977). According to the Bureau of Meteorology (1970), rainfall decreases south-westward from Bowen. Rainfall averages along this portion of the coast are the lowest for North Queensland. Rainfall variability, however, is particularly high.

A high proportion of the total rainfall is of high intensity, with some 309 of the annual average rainfall occurring as heavy storms. Probable maximum one” hour rainfalls are cited by the Bureau of Meteorology (1970) as 87 mm once in 10 years and 132 mm once in 100 years. Storm incidence tends to be confined to the December-March period. Prevailing winds in summer are from the east to north-east and in the winter from the east to south-east. Frosts occurring in the region are mostly light, and number from two to three per year. Most occur between July and August.

CH230000 to CH410000 – Shields, P.G, 1984, Land Suitability Study of the Collinsville-Nebo-Moranbah region, Queensland Department Primary Industries (DPI, 1984)

The majority of the region is dominated by dry tropical / sub-tropical weather patterns which have distinct wet (November to April) and dry (May to October) seasons. Rainfall decreases westward across the region, with high rainfall variability due to the sporadic incidence of rainfalll depressions associated with the tropical cyclones and the convective origin of much of the rainfall.

Typically the region experiences hot, humid summer months (December to February) with a winter dry season. Heavy rainfall predominately occurs within the summer months (late December to February) of the year. Cloud cover generally increases in the lead up to the wet season with ‘build up’ thunderstorms starting in late December. Skies are generally clear during the dry season. The wet season occurs between December and March where rainfall occurs between six to nine days per month. The driest months are between May to October when very little rainfall occurs. Rainfall in the area is known to be infrequent with annual rainfall commonly being either well above or well below the annual average rainfall for the region.

The combination of high temperatures and low relative humidity's results in high evaporation rates and low effective rainfall. Annual evaporation in the region is just under three times higher than the annual average rainfall (711 mm).

Mine Site to CH230000 – Gunn, RH, Galloway, R.W, Pedley, L and Fitzpatrick E.A, 1967, *Lands of the Nogoa – Belyando Area, Queensland, Land Research Series No. 18*, CSIRO, Melbourne

Broad transition rather than clearly defined climatic zonation is characteristic within the area. The principal transitions are toward increasing aridity westward and increasing temperature northward. The climate is thus difficult to characterize in any single climatic "type", but it can be described generally as ranging from tropical to subtropical and from subhumid to semi-arid. Approximately three-quarters of the mean annual rainfall occur during the six summer months.

2.2.2 Erosive Rainfall

Erosivity Ratings of the rainfall events have been established for areas along the alignment, these have been developed with reference to the DTMR, Road Drainage Manual (2010). The Erosive potential of rainfall, termed erosivity, is highly correlated with annual rainfall and rainfall intensity, which in turn are dependent upon the number of wet days, number of thunder days, temperature, latitude, and rainfall seasonality. The ability of rainfall to cause erosion is a product of total storm energy (E) and the maximum 30 minute intensity of each storm (I30), which is known as the erosion index (EI) (DTMR, 2010).

The DTMR manual has average annual EI values for selected stations across Queensland. The stations considered most relevant to the Alpha Coal Project (Rail) are listed below:

- Ayr (used in lieu of data for Bowen);
- Milaroo;
- Collinsville;
- Twin Hills;
- Kilmalcolm; and
- Alpha.

These sites each experience different seasonal rainfall, rainfall intensities and other climatic conditions, and are considered a snap shot of the likely climatic conditions expected to be encountered along the project alignment. Table 4 below details the erosivity of rainfall at what are considered the relevant sites along the alignment.

Table 4 Erosivity Rating of Rainfall for Relevant Locations during Construction

Selected Sites	Average Annual Erosion Index (EI) [1]	Highest Monthly EI (as percentage of Average Annual EI) [2]	Rainfall Erosivity Rating [3]
Ayr	481	27.9 (February)	Moderate
Milaroo	590	35.4 (January)	High
Collinsville	277	31.5 (January)	Moderate
Twin Hills	311	29.1 (January)	Moderate

Selected Sites	Average Annual Erosion Index (EI) [1]	Highest Monthly EI (as percentage of Average Annual EI) [2]	Rainfall Erosivity Rating [3]
Kilmalcolm	357	21.1 (December)	Low
Alpha	152	22.8 (December)	Very Low

1. Average annual EI for sites taken from DMR, Road Drainage Design Manual (2002), Table 2.6
2. Highest monthly EI as percentage of average annual taken from DMR, Road Drainage Design Manual (2002), Table 2.7
3. Erosivity ratings established used Table 2.8 of DMR, Road Drainage Design Manual (2002),

From the information presented in Table 4, the most erosive rainfall events occur during the summer months with the erosive force of the rainfall increasing as the alignment travels towards Abbot Point, with the highest erosivity values being recorded around the Collinsville and Milaroo regions.

2.2.3 Potential Impacts

The potential impacts associated with the erosive rainfall is the increased likelihood of erosion and sediment movement, impacting successful rehabilitation of the disturbed areas, and delays to construction and project delivery. DTMR (2010) developed the erosivity ratings assuming the impacted sites are under construction where there has been disturbance to the soil surface, which results in a higher risk of erosion due to the rainfall events. Impacts associated with erosion are detailed in section 2.4 of this Report.

A potential impact arising from the variable climatic conditions experienced along the rail corridor alignment is the delay of works associated with high rainfall periods. Depending on the soil types / slopes and other environmental aspects, a rainfall event of >10 mm over a day period can cause the ground conditions to become a constraint on construction works, which could lead to additional disturbance on soils due to wet and boggy conditions including compaction, soil structure damage and changes to soil permeability.

Works that are required to be undertaken within streams or watercourses will be impacted on by high erosion risk rainfall events and the rainfall erosivity. Several stream / waterways will be required to be traversed as part of this project, some of which are subject to flooding. Any in-stream works that are undertaken during high risk rainfall periods can result in erosion, sedimentation of the waterways, closure of works and potential loss of productivity due to works being stopped.

Poor staging of construction works can lead to works occurring in high risk erosion areas (topography, soils, and sensitive environments) during erosive rainfall periods, leading to increased sedimentation and deposition into the environment. This could also cause ongoing delays; stand down time and remobilisation of plant. Planning construction events around the climatic conditions will be required to limit the impact on the receiving environments as erosion and the associated deposition of sediments in the receiving environments will be reduced.

2.2.4 Mitigation Measures

Construction works are be timed to avoid working in areas of erosive soils, steep slopes, cracking clays and sensitive environments during high risk rainfall and erosive rainfall periods.

Construction staging plans should be developed with consideration given to the climatic conditions in order to avoid the negative impacts of erosion on receiving environment. Works during the summer months should be confined to areas considered to have a low risk of erosion occurring from rainfall events. These areas will have topography and soils not as susceptible to erosion from the erosive rainfall events.

2.3 Soils

2.3.1 Existing Environment

The soil types along the rail corridor vary considerably and consist of the following types.

- Cracking clays;
- Dark brown and grey-brown soils;
- Texture contrast soils;
- Duplex soils;
- Gilgaied deep cracking clays;
- Uniform course textured soils;
- Red and yellow earths; and
- Shallow rock soils.

Soil types have been mapped for the rail corridor using the Atlas of Australian Soils Dataset with the soil maps provided in Appendix A, along with the mapped unit descriptions.

Conversions of the Atlas of Australian Soils Classification (ASC) mapping units to the Australian Soils Classification can be achieved for the relevant mapped units for this project; Appendix B includes an information sheet on the limitations of such conversions. A brief description of those ASC soil types expected to be encountered on the project is also provided in Appendix C.

The soil types identified in the available mapping for the project corridor each have environmental considerations that need managing, and are discussed later in this Report.

The mapping data used to show different soil types along the rail alignment is the Atlas of Australian Soils Mapping (1:2000000 scale); the project corridor has been described in regards to the dominant soil types identified within each mapped unit that is traversed by the project. The map units provide a number of possible soil types, further investigation (field assessments) will be required if a detailed assessment of soil types is required prior to construction. Herein is a general overview of soil types likely to be encountered.

The alignment commencing at the mine site, is within an area mapped as gently undulating or level plains with the dominant soils mapped as being loamy yellow earths with a prominent ironstone nodule horizon at moderate to shallow depths. The alignment progresses into an area with the dominant soil type being sandy or loamy red earths. At CH20000 the project enters an area with the dominant soils mapped as being grey or light grey deep clays with loamy duplex soils throughout.

At CH30000 to after Native Companion Creek the dominant soils are mapped as loamy red earths with some loamy yellow earths; the lower lying areas potentially have a range of loamy duplex soils with the possibility of some occurrences of gilgaied clays.

The area around the Belyando River from CH40000 CH45000 is considered to be alluvial plains with the dominant soils being deep grey clays, it returns to similar soils present prior to the Belyando River, the dominant soils are mapped as being loamy red earths from CH45000 to CH58000.

The alignment progresses into an area with the dominant soils being mapped as brown loamy duplex soils, within undulating terrain, often with a gravelly A horizon. The alignment then returns to the loamy red earths at CH62000. To CH80000, the alignment traverses undulating and low hilly areas with some flat topped benched hills. The soils are moderate to shallow in depth and alternate over short distances consisting of loamy duplex soils, rocky outcrops, deeper loamy duplex soils (confined mainly to the drainage lines) and shallower stony soils in the higher areas.

From CH80000 the dominant soil type is mapped as loamy yellow earths, with areas of hard loamy red earths and loamy duplex soils within the shallow drainage lines. At CH95000 the alignment returns to an area with the dominant soils being loamy red and yellow earths with loamy duplex soils in the lower landscape areas. From CH107000 to CH110000 the dominant soil types are the grey or light grey clays with some loamy duplex soils in the non-gilgaied areas. The alignment then returns back to traversing areas of loamy red and yellow earths.

Mistake Creek is crossed at approximately CH118000 through alluvial flood plains with the dominant soils being the loamy red duplex soils. Following this crossing the alignment re-enters the mapped units with dominant soil types of grey or light grey clays and the red and yellow loamy earths. An area at around CH135000 is mapped as consisting of hilly lands with the dominant soils being very shallow mostly stony loams.

At CH140000, where the project approaches the Miclere Creek crossing and the alluvial plains associated with it, the dominant soils are mapped as being deep grey clays. These deep clays (varying in colour) are mapped up to CH147000 whereby the alignment returns to a more gently undulating area with loamy red earths being the dominant soils. Both the dominant soils and associated soils are described as being strongly nodular at depth.

At CH158000 the project re-enters an area with dominant soils mapped as grey or light grey deep clays with loamy duplex soils within non-gilgaied areas. At CH166000 the dominant soil type is loamy or sandy red earths in the gently undulating plains, the alignment then progresses into area of deep grey clays from CH169000 through to CH176000 which includes the alluvial plains around Logan Creek. Following this, the alignment enters the broadly undulating or level plains with deep brown clays with occasional loamy red duplex soils.

The dominant soil type of deep grey clays is traversed prior to Diamond Creek where the dominant soils then change to deep cracking clays within the level plains. These clays are expected to be slight to moderate gilgaied (1-2 ft). Loamy duplex soils are expected closer to the streamlines within this area. At CH204000 the alignment starts to traverse areas with the dominant soil types mapped as loamy or occasionally sandy red earths within undulating lands.

Where Eaglefield Creek is located at approximately CH220000, within the alluvial flood plains, the dominant soil is loamy duplex soils with some small areas of cracking clays. The alignment re-enters the deep grey clays mapped from Diamond Creek (CH196000) to Suttor Deviation Road (CH250000). To the west of the alignment from CH230000 to CH250000, along the Suttor River area, the dominant soil types are mapped as alkaline yellow and grey bleached duplex deep soils on undulating plains, the soils may have a slightly gravel-strewn surface. In the lower depressions there is potential for grey deep cracking clays to be dominant. Where there are occasional low rises, the soils can change to red or yellow massive loamy earths.

The same soil types are briefly traversed after the Suttor Deviation Road, before progressing into an area of red massive loamy earths between CH256000 and CH260000, where the soils are generally deep and neutral, in lower depression areas the soils may change to loamy alkaline grey or mottled bleached duplex soils with potential for occasional gilgaied deep clays. The dominant soil types return to the alkaline yellow and grey duplex soils mentioned earlier.

At CH264000 the alignment progresses into an area of deep grey and brown clays, then into loamy and sandy duplex soils within undulating terrain. From CH271000 the dominant soil types are slightly acid loamy red earths, with the soils on the scarps and mesas being loamy red earths with shallow stony loams throughout and loamy duplex soils within depressions.

From CH276000 the alignment passes trough an area of deep, slightly acid loamy red earths. At CH287000 the dominant soils change to deep sands on low hilly or strongly undulating lands, the alignment then progresses into an area of shallow mostly stony dark clays.

At CH301000, near Cerito Creek the dominant soil types are grey slopes on the middle and lower slopes of the undulating plains. Deep clay soils are likely to occur within the lower alluvial plain areas. As the terrain gets higher in elevation the soil becomes shallower and is more of a brown to red clay.

At CH315000 the alignment passes through a small area of sandy to loamy mottled duplex soils of shallow to moderate depth within the broad undulating valleys. Areas of brown clays with moderate depth and loamy duplex soils are traversed from CH317000 to CH345000. Also within this zone there are sandy duplex soils around areas of gently undulating plains.

At the Rosella Creek and Bowen River crossings around CH345000, the dominant soil types are mapped as duplex soils with a deep sandy to sandy loam A horizon with a clear horizon change to reddish brown clay or sandy clay. The alignment runs parellel with Bowen River until approximately CH390000. The alignment crosses that same dominant soil type at CH375000. The main soil types traversed from Roselle Creek to CH390000 include loamy duplex soils within the moderate to undulating lands to CH360000, then dark clays within the plains and lower ridges with stony shallow soils within the higher ridges and hills. These dominant soil types are intersected by the alignment up to CH410000. To the west of the alignment from CH390000 to CH410000 are fairly shallow often stony loamy duplex soils within the undulating lands and low hills. Similar dominant soils extend to CH422000.

Where the alignment crosses the Bogie River the soils are mapped as deep alkaline yellow and grey bleached duplex soils. Following this crossing the soils are mapped as changing to sandy or loamy alkaline mottled yellow and grey bleached duplex soils.

From CH440000 where the alignment runs parallel to the west of the high hills / mountainous area, the soils are predicted to be shallow and stony neutral red duplex soils, with rock outcrops common, to the west of the alignment within the valley floor the soils are more of a mottled bleached duplex soils.

As the alignment heads east towards Abbot Point from CH450000, the mapped dominant soil types alternate between the neutral red duplex soils and deep alkaline yellow and grey bleached duplex soils. After the Elliot River crossing the soils change to sandy to loamy and often gritty surface alkaline mottled yellow and grey bleached duplex soils.

Where the alignment meets the Bruce Highway at CH48500 the soils change to dark deep cracking clays, followed by deep alkaline mottled yellow and grey bleached duplex soils with sandy or loamy and often gritty surface, this is then followed by shallow to moderately deep neutral red duplex soils. The rail loop at Abbot Point is mapped as salt pans and salt water couch meadow merging into mangrove swamps, subject to tidal inundation, with the soils being mostly deep yellow-brown mottled saline clays. Associated are a range of grey and dark alkaline bleached duplex soils, particularly within the vegetated areas.

2.3.2 Interpretations of the Mapped Soil Units

The dominant soil type identified within each mapped unit has been further expanded with reference to the CSIRO Soils Division Technical Report 94 / 1992, and Department of Main Roads, Road Design Manual (2010), whereby permeability, water holding capacity, soil texture profile, soil reaction trend, gross nutrient status, soil depth and erodibility risk rating has been allocated for the dominant soil type described within each mapped unit. The technical report is provided in Appendix B, and is to be read in conjunction with this section as it highlights the limitations of the Atlas of Australian Soils Data and limitations of the estimated properties that have been established.

The allocated ratings are crude estimates only and need to be confirmed with site reconnaissance and analysis. Table 5 below details the estimated properties for the dominant soil types, the soil maps provided in Appendix A, show the location of mapped units and the detailed descriptions.

Table 5 Dominant Soil Types and Estimated Properties

Map Unit	Dominant Principle Profile Form	ASC Soil Group [1]	Permeability	Profile Water Holding Capacity	Soil Texture Profile [2]	Soil Reaction Class	Gross Nutrient Status	Soil Depth (m)
AA6	Uc5.11	Tenosols	fast	low	UC	Neutral	Low	Shallow<0.5
BZ9	Uc1.21	Rudosols	fast	very low	UC	Neutral	Low	Deep >1.5
CB7	Ug5.22	Vertosols	slow	low	UCr	Alkaline	Moderate	Mod. 0.5-1
CC29	Ug5.24	Vertosols	slow	low	UCr	Alkaline	Moderate	Deep >1.5
CC33	Ug5.24	Vertosols	slow	low	UCr	Alkaline	Moderate	Deep >1.5
CC35	Ug5.24	Vertosols	slow	low	UCr	Alkaline	Moderate	Deep >1.5
CC39	Ug5.25	Vertosols	slow	low	UCr	Alkaline	Moderate	Deep >1.5
CC40	Ug2.25	Vertosols	slow	low	UCr	Alkaline	Moderate	Deep >1.5
Cd14	Uc2.12	Tenosols	fast	very low	UC	Neutral	Low	Shallow<0.5
Fz18	Um1.41	Rudosols	fast	very low	UC	Strongly Acid	Low	Shallow<0.5
Fz7	Um1.43	Rudosols	fast	very low	UM	Neutral	Low	Shallow<0.5
II11	Ug5.28	Vertosols	slow	low	UCr	Alkaline	Moderate	Deep >1.5
JJ13	Uc4.1	Vertosols	fast	very low	UC	Acid	Low	Shallow<0.5
JK2	Uc4.2	Tenosols	fast	very low	UC	Acid	Low	Shallow<0.5
JK6	Uc4.2	Tenosols	fast	very low	UC	Acid	Low	Shallow<0.5
Jb1	Uf6.62	Hydrosol	slow	low	UF	Neutral	Low	Mod. 0.5-1
Kb11	Ug5.12	Vertosols	slow	low	UCr	Alkaline	Moderate	Mod. 0.5-1

Map Unit	Dominant Principle Profile Form	ASC Soil Group [1]	Permeability	Profile Water Holding Capacity	Soil Texture Profile [2]	Soil Reaction Class	Gross Nutrient Status	Soil Depth (m)
Kb25	Ug5.12	Vertosols	slow	low	UCr	Alkaline	Moderate	Mod. 0.5-1
Ke19	Ug5.12	Vertosols	slow	low	UCr	Alkaline	Moderate	Mod. 0.5-1
Kf13	Ug5.16	Vertosols	slow	moderate	UCr	Neutral	Moderate	Deep >1.5
Lk17	Um4.1	Tenosols	moderate	very low	UM	Acid	Low	Shallow<0.5
MM11	Ug5.34	Vertosols	slow	low	UCr	Alkaline	Moderate	Deep >1.5
MM12	Ug5.34	Vertosols	slow	low	UCr	Alkaline	Moderate	Deep >1.5
MM13	Ug5.33	Vertosols	slow	low	UCr	Alkaline	Moderate	Mod. 0.5-1
MS1	Gn2.22	Kandosols	moderate	low	Gc	Alkaline	Moderate	Mod. 0.5-1
MS2	Gn2.22	Kandosols	moderate	low	Gc	Alkaline	Moderate	Mod. 0.5-1
Mj9	Gn3.14	Dermosols	fast	moderate	G	Acid	Moderate	Shallow<0.5
My19	Gn2.12	Kandosols	fast	moderate	G	Neutral	Low	Deep >1.5
My20	Gn2.12	Kandosols	fast	moderate	G	Neutral	Low	Deep >1.5
My28	Gn2.12	Kandosols	fast	moderate	G	Neutral	Low	Deep >1.5
My34	Gn2.12	Kandosols	fast	moderate	G	Neutral	Low	Deep >1.5
My35	Gn2.12	Kandosols	fast	moderate	G	Neutral	Low	Deep >1.5
My17	GN2.11	Kandosols	fast	moderate	G	Acid	Low	Deep >1.5
Mz18	Gn2.11	Kandosols	fast	moderate	G	Acid	Low	Deep >1.5
Oa9	Dr2.13	Chromosols	moderate	moderate	Du	Alkaline	Moderate	Mod. 0.5-1

Map Unit	Dominant Principle Profile Form	ASC Soil Group [1]	Permeability	Profile Water Holding Capacity	Soil Texture Profile [2]	Soil Reaction Class	Gross Nutrient Status	Soil Depth (m)
Oc29	Dr2.33	Sodosol	slow	low	Du	Alkaline	Moderate	Mod. 0.5-1
Od6	Dr2.43	Sodosol	very slow	low	Du	Alkaline	Low	Mod. 0.5-1
Ok1	Dr3.33	Sodosol	slow	low	Du	Alkaline	Low	Mod. 0.5-1
Qa11	Dr2.12	Chromosols	fast	moderate	Du	Neutral	Moderate	Mod. 0.5-1
Qa12	Dr2.12	Chromosols	fast	moderate	Du	Neutral	Moderate	Mod. 0.5-1
Qa14	Dr2.12	Chromosols	fast	moderate	Du	Neutral	Moderate	Mod. 0.5-1
Qa21	Dr2.11	Chromosols	fast	moderate	Du	Acid	Moderate	Mod. 0.5-1
Qb27	Dr2.22	Chromosols	slow	moderate	Du	Neutral	Moderate	Mod. 0.5-1
Ro5	Db1.33	Sodosol	slow	low	Du	Alkaline	Low	Mod. 0.5-1
Si3	Dy2.33	Sodosol	very slow	very low	Du	Alkaline	Moderate	Mod. 0.5-1
Sl10	Dy2.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Sl11	Dy2.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Sl16	Dy2.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Sl17	Dy2.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Sl21	Dy2.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Sl23	Dy2.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Sl7	Dy2.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Tb119	Dy3.41	Sodosol	very slow	very low	Du	Acid	Low	Mod. 0.5-1

Map Unit	Dominant Principle Profile Form	ASC Soil Group [1]	Permeability	Profile Water Holding Capacity	Soil Texture Profile [2]	Soil Reaction Class	Gross Nutrient Status	Soil Depth (m)
Ub81	Dy3.42	Sodosol	very slow	very low	Du	Neutral	Low	Mod. 0.5-1
Va45	Dy3.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Va49	Dy3.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Va50	Dy3.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Va55	Dy3.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Va56	Dy3.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Va86	Dy3.43	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Vd2	Dy3.33	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Vd4	Dy3.33	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1
Vd5	Dy3.33	Sodosol	very slow	very low	Du	Alkaline	Low	Mod. 0.5-1

1. ASC Soil Group Classification derived from conversion tables discussed in Appendix B.
2. UC – uniform course; UM – uniform medium; UF – uniform fine; UCr – uniform cracking; Gc – gradational calcareous; Du – Duplex; G – gradational

The Australian Government Department of Agriculture, Fisheries and Forestry, Soil Health Knowledge Bank (http://soilhealthknowledge.com.au/) has been referred to in discussing these attributes, impacts and mitigation measures.

Soil permeability refers to the ability of a soil to absorb and transmit water. In this case, the soils with moderate to fast permeability ratings are considered to be well drained soils, which are mainly those soils with a gradational soil texture profile. The duplex soils with very slow permeability ratings are considered most likely to become waterlogged due to the presence of a compacted clay layer below the surface soils which impede drainage. This water logging can lead to rising water tables which may result in encroaching salinity.

Profile water holding capacity (PWHC) refers to the ability of the soil to store water within the rooting depth. Mapped soil units with a PWHC of medium or above (>120 mm), are considered to be most reliable for cropping. The gradational textured soils have the best rating for this aspect, whilst the duplex soils, although having some rated as medium (possibly non-sodic duplex soils), are mostly very low (possibly due to being sodic duplex soils).

Soil texture profile refers to the change in soil texture throughout the profile. The most relevant observation from the above information is that duplex soils have severe limitations in regards to land uses due to the abrupt change in texture between the topsoil and subsoil, affecting drainage and the ability to hold sufficient water within the root zone.

Soil reaction class refers to the pH of the soil type. Acidic soils (<5.5) cause the most issues in regards to establishing vegetation, depending on vegetation type. The pH of the soils disturbed during the construction of this project is particularly relevant when rehabilitation and reinstatement works are to be undertaken.

Gross nutrient status of the dominant soil types was low or medium, meaning there was major responses to N, P and K along with most micronutrients; and responses to N and P with occasional response to some micronutrients, respectively.

Soil depth of the mapped soil units ranged from shallow (<0.5m), moderate (0.5-1.5m) and deep (>1.5m). This is particularly relevant in regards to topsoil resource. The dominant soil types that had gradational textured soils had the deepest soil depth.

2.3.3 Potential Impacts

Soil Permeability can be impacted on by this project in the following way:

- Compaction of clay soils due to repetitious traffic along access routes and pathways of mobilisation around the project corridor, and storage areas including workers camps;
- Deep drainage may occur when deep rooted perennial vegetation is removed, which will be required to occur in various locations along the rail alignment; and
- Diverting overland flow to areas that consist of soils not having the capacity (soil type, lithological characteristics) to drain the increase in water. This may result in water logging of the lower-lying receiving landscape.

Profile water holding capacity is likely to be impacted on when disturbing the top soil and subsoil profiles. Soil texture and structure are two of the factors that will be disturbed during the construction of this project that will cause a change in the PWHC. Replacing the disturbed topsoil in a manner that will promote regrowth and rehabilitation is an important consideration that if not managed can lead to on-going issues, particularly relevant for areas of suitable agricultural land.

Acidic and alkaline soils, if disturbed can lead to impacts on the environment (acidic impacts are discussed in the Acid Sulfate Soil section of this EIS), whereas alkaline soils may have calcium carbonates, high sodicity or presence of toxic compounds like sodium carbonate, which may be harmful to the receiving environment. Issues will also arise during rehabilitation and reinstatement on areas that are acidic or alkaline.

A change in the *gross nutrient status* as a result of soil disturbance, change in drainage, stockpiling and stripping may impact on the ability of the soils to be used for successful vegetation rehabilitation and ongoing use, including agricultural requirements.

Soil depth will be impacted where cut and fill works will be undertaken. Removal of available topsoil resources will cause a reduction in the profile water holding capacity and permeability which will lead to issues when rehabilitating disturbed areas and returning to pre-construction condition.

2.3.4 Mitigation Measures

Soils at risk of becoming waterlogged due to low permeability can be managed by reducing the compaction of such soils by avoiding trafficking during wet weather and selecting access tracks to avoid such areas susceptible to compaction and water logging. Sodic soils, which inhibit internal drainage, can be improved by applying gypsum, which will replace the sodium ions with calcium ions which will improve the soil structure. Similar mitigation measures can be applied to improving and repairing the PWHC of the soils.

Alkaline and acidic soils can be treated by using ameliorants such as lime (to fix acidic soils) and elemental sulphur (to fix alkaline soils). Management of both acidic and alkaline soils will be required to allow for successful rehabilitation of disturbed areas following construction. Soil analysis will be required to ascertain the acidity or alkalinity of the soil in order to select the ameliorant type and quantity required.

Nutrient deficient soils can be improved by first establishing the nutrient status of the soil and then selecting the relevant fertiliser and ameliorants. These will be required to be added at a rate which is developed after laboratory analysis of soil nutrient status is conducted.

Disturbed areas area required to be rehabilitated to pre-construction condition, which will include restoring the topsoil resource. This may require any combination of the above mitigation measures. Topsoil will be required to be replaced at a suitable depth which will allow for possible future land use. These disturbed areas include any area that has been disturbed not associated with the final requirements of the railway, such as access tracks, storage areas, workers camps and any underground infrastructure that is installed.

2.4 Erodible Soils

2.4.1 Existing Environment

Soil erodibility is determined by the rate of infiltration at the surface, permeability of the soil profile, coherence of the soil particles, lack of vegetative cover, loss of soil organic matter and surface sealing (DTMR, 2010).

Table 6 below details the erodibility ratings of the various soil types, included also are the relevant Australian Soil Classification for the soil types, converted from the ATLAS mapped units, and presented in Table 5 above, found along the Rail Corridor. Refer to the Soil Maps provided in the figure in Appendix A, in particular the mapped unit descriptions, which detail the dominant soil type along with associated soil types that may exist within the mapped units.

Table 6 Erodibility of Soil Types Encountered along the Alignment (DTMR, 2010)

Soil Types and ASC group	Description Of Erodibility Characteristics	Erodibility Rating
Uniform sands and sandy loams – ***Rudosols and Tenosols***	Incoherent sand, loamy and sand and clayey sand and coherent sandy loam with single grained massive structure. Coarse textured surface layers are generally either loose or incoherent or firm and weakly coherent. Raindrop splash can easily detach the soil particles. Subsoils are also susceptible to detachment.	Moderate (3)
Uniform loams and clay loams Massive - ***Kandosols*** Structured – ***Rudosols, Tenosols and Dermosols***	Coherent loams, sandy clay loams and clay loams with massive to strong structure. The medium texture results in these soils being moderately permeable regardless of structure. Significant energy is required to detach such soils.	Very Low (1)
Uniform non-cracking Clays - ***Dermosols***	Light to heavy clays with strong structure - fine aggregates – the high clay content is offset by the strong structure and moderate permeability due to the fine aggregates - coarse aggregates – similar erodible characteristics to the uniform cracking clays	Very Low (1) Low (2)
Uniform cracking clays – ***Vertosols***	Light medium to heavy clays that shrink and crack open when dry and swell when wet; Gilgai micro relief common. Moderate to strong structure but generally coarse aggregate below the surface resulting in slow to very slow permeability. Soils are erodible under considerable energy.	Low (1)
Sandy Gradational Soils – ***Kandosols***	Texture gradually increases from a sandy surface to sandy clay loam or sandy light clay with depth; single grain to massive structure. Similar erodible characteristics to the uniform sands and sandy loams.	Moderate (3)
Loamy Gradational Soils – ***Dermosols and Kandosols***	Texture gradually increases from a loamy surface to sandy clay loam or clay with depth; massive to strong structure. These soils have a coherent medium textured surface that grades into clay subsoil. The soils are moderately permeable regardless of subsoil structure and require considerable energy to detach. The high proportion of clay sized particles makes them susceptible to erosion by running water.	Low (2)

Soil Types and ASC group	Description Of Erodibility Characteristics	Erodibility Rating
Texture Contrast Soils (non dispersive) - ***Chromosols***	Sandy or loamy surface abruptly overlying non dispersive and generally friable clay subsoil. The erodibility of the surface and subsurface varies from moderate for the sandy layers to low for the loamy layers. The structure of the clay subsoil varies and profile permeability varies from slow to moderate. The clay particles in the subsoil are not prone to dispersion but their lightweight renders them very susceptible to erosion by running water.	Moderate (3)
Texture Contrast Soils (dispersive) – ***Chromosols and Sodosols***	Sandy or loamy surface abruptly overlying a hard, dispersive clay subsoil	
	- If soil is sodic (ESP 6-14) and/or Ca:Mg <0.5	High (4)
	- If soil is strongly sodic (ESP >15) and/or Ca:MG <0.1	Very High (5)
Waterlogged Soils - ***Hydrosols***	Uniform sands, uniform clays, gradational soils and texture contrast soils that saturated with water for several months of the year. Within saline waterlogged soils, if the soils are drained and leached the removal of soluble salts generally results in sodic profiles and thus increases the erodibility rating to a moderate to high.	Very low (1)

The soil types most susceptible to erosion, are the texture contrast soils (duplex soils), particularly soils that have a high sodic percentage. Information on impacts and management of Sodic Soils is provided in section 2.4.5 of this Report. The management of erosion will vary according to the soil types encountered and the environment in which those soils are located.

The project will result in disturbance of each of those soil types described above, at various locations, with varying environmental constraints, along the alignment. A detailed Erosion and Sediment Control Plan will be developed and implemented during the construction and rehabilitation phases of this project, which will outline practices in preventing or minimising the impacts of erosion on the environment.

2.4.2 Factors Contributing to Soil Erosion

The construction and operation of this project will result in a range of changes to the landscape that will increase the risk of erosion, these include:

- Clearing of vegetative cover;
- Changes in topography, drainage patterns and localized concentration of storm water flows both due to construction of access tracks and rail corridor;
- Excavation and stockpiling of material;
- Construction during high rainfall, particularly erosive rainfall events - Information regarding the rainfall and in particular the erosive nature is provided in section 2.1.3 within this Report;
- Constructing through areas with high soil erodibility risks (Table 6); and
- Constructing in areas of high risk slope gradient and length.

2.4.3 Impacts of Erosion

Sediments that are entrained in water runoff have the potential to result into the surface waters and estuary. The coarser soil particles such as sands and silts will deposit as the velocity of water slows down, whilst the suspended clays will remain in suspension until the water becomes still or mixes with saline waters.

Deposition of elevated levels of coarse and fine sediments can cause adverse effects on aquatic and estuarine ecosystems. Benthic communities can be smothered reducing light transmission through water, resulting lowered ability for aquatic plants to function and negative impacts for organisms that rely these plants for food and shelter. This is discussed in more detail in the Aquatic Ecology assessment component of this EIS.

Loss of topsoil and to a lesser extent subsoil from the construction area is also critical in terms of rehabilitation success. Topsoil is the most valuable resource in relation to rehabilitation and needs to be retained on site and in good condition.

2.4.4 Mitigation Measures

Construction activities for the installation of the railway will take place year round. Erosion risk is highest in the wet season period due to the erosive nature of the rainfall as discussed in section 2.1.3 of this Report. Poor design and/or lack of rehabilitation of disturbed areas may lead to considerable erosion over the life of the construction and operation of the railway. Areas of particular concern are steep slopes, sustained slopes, stream crossings, areas of dispersible and erodible soils, engineered drainage line flow paths, all of which have the potential to become severely eroded.

Design of infrastructure will assist in minimising ongoing erosion risk. Particular attention will need to be paid to:

- Drainage along rail alignment to minimise scouring along drainage lines, avoid concentration of flows, position of drainage and the receiving environment of the new drainage;
- Stabilisation of creek crossings to avoid scouring during wet season flows;
- Avoidance of steep slopes. Where locally steep slopes exist at stream crossings they should be stabilised and drainage controlled; and
- Design of drainage around hard stand and compacted areas to manage accelerated runoff from these areas;

All disturbed areas will be required to be stabilised and reinstated progressively during the rail construction.

A comprehensive drainage, erosion and sediment control plan will be developed and implemented for the construction phase and rehabilitation phase of the project. Core management principles for areas disturbed by the rail corridor will include:

- Drainage controls;
- Erosion controls; and
- Sediment controls.

The Erosion and Sediment Control Management Plan will be prepared with details of catchment description, topography (site specific), soils, hydrology, vegetation, water quality (baseline and discharge quality), selection of control measures; design, installation, maintenance, and removal of control measures, monitoring reporting and auditing, relevant drawings, checklists, and sizings for sediment basins, diversion drains and catch drains. The following provides standard erosion and sediment control management practices which have been sourced from a number of guidelines and documents including IECA 2008, IEAust 1996, URS 2009, and DTMR 2002.

Drainage Controls are required to manage run off on site such that runoff does not cause accelerated erosion. Clean water is to be directed and discharged in a manner that does not cause erosion. Dirty water is to be directed and treated prior to being discharged off-site. The following considerations are required for drainage controls:

- Drainage controls integrated into a total integrated water management plan for the rail corridor;
- Drainage controls for new areas to be installed during the dry season and in place well before predicted wet season onset;
- Divert run-off water from lands upslope around active areas and stockpiles;
- Install site drainage works to convey stormwater safely through and away from the site; and
- Direct water at non erodible velocities. Reduce the erosive energy levels of concentrated water in constructed channels by:
  - Constructing channels/drains with a parabolic or trapezoidal cross-section (rather than V-shaped);
  - Widening the drain invert;
  - Installing check dams;
  - Installing appropriate channel linings;
  - Installing energy dissipaters at outlets; and
  - Outlets from all water conveyance structures should discharge water such that the erosion hazard to down slope lands and waterways is no greater than in the predevelopment condition. This can be achieved through use of water detention basins, waterways that increase the time of concentration, energy dissipaters, level spreaders, etc.

Erosion Controls are required to reduce the velocity of water to prevent scouring and allow coarser sediments to settle. The following considerations are required for erosion controls:

- Protecting the ground surface with a cover of suitable vegetation or gravel. Vegetation should be reinstated in rehabilitated areas as quickly as possible through inclusion of quick growing grass species in seed mixes;
- Reducing the volumes of water flows;
- Rock scour protection should be placed at the discharge of any un-piped stormwater flow to dissipate the flow energy of the discharge; thereby reducing the potential for erosion;
- Placement of topsoil and planting of vegetation on stockpile areas as quickly as possible;
- Retention of buffer vegetation along creeks; and

- Exposed surfaces can be stabilised using chemical stabilisers that are commercially available. These can provide instant protection and are suitable in areas while construction is in progress.

Sediment Control Sediment control devices are recommended to reduce the volume/concentration of suspended solids and other gross pollutants leaving the site. Where possible the intention is to entrap the sediment as close to the source as possible. The following considerations are required for sediment controls:

- Sediment fences and filters downslope of stockpiles and other disturbed areas. Sediment fences should be placed close to areas of disturbance to maximise effectiveness;
- Sediment basins to intercept sediment-laden runoff and retain most sediment and other materials, to protecting downstream waterways. Combined sedimentation and retardation basins are proposed to allow joint function of sediment settlement and collection of water for reuse and control of flows in creeks draining the site;
- Use of flocculants if necessary to accelerate settlement of fine sediments; and
- Sediment fencing is to be used to trap coarse sediments close to their source. The location of sediment fencing will be determined on a needs basis; but in general will be required down hydraulic gradient of stockpiles, battered slopes, disturbed areas, and at locations where sediment laden water has the potential to enter drains or waterways.

With these measures in place, mobilisation of soil and sediment into waterways will be minimised. Some sedimentation can be expected regardless of the effectiveness of drainage, erosion and sediment controls, particularly in large storm events.

Water quality objectives for turbidity levels and suspended solids within the receiving waterways will be set once a full water quality baseline is available and if these are exceeded, corrective actions might include:

- Increasing volume of sedimentation/retardation basins;
- Use of chemical flocculants;
- Additional sediment collection devices at upslope locations; and
- Further stabilisation of stockpiles.

Access Roads and Tracks will be required to construct and maintain the rail corridor. Unmitigated substantial erosion can occur during the construction and operation of the rail due to exposure of bare soil to rainfall and the alteration of the land resulting in areas of concentrated flows. The location of access roads is largely governed by the rail alignment route so there will be little opportunity to avoid areas that would be typically problematic to unformed roads. However, from an erosion and sediment control perspective, the following principles should be considered in the construction of new unformed roads (DECC, 2008[c]):

- The catchment area above the road or track may be reduced by locating the road along a ridge or as high as possible on side slopes;
- Unformed roads and tracks should have at least a slight cross-sectional grade to allow free surface drainage and to avoid excessive ponding in wheel tracks;

- The longitudinal grade of an unformed road or track should ideally be less than 10 degrees (18 %). However, short lengths of steeper grade may be needed subject to topography and geotechnical survey;
- Where grades of unformed roads are between 3% to 20% then easily trafficable diversion banks should be used to prevent scouring. Where higher grades occur then gravelling and more sophisticated road drainage will be required (e.g. turn outs);
- Where table drains need to be established, they will be constructed to a broad dish shape, seeded and fertilised or lined appropriately, to prevent erosion. Table-drains will be slashed periodically to ensure vegetation growth is not restricting drainage flow;
- Approaches on service tracks to gully and creek crossings should be as flat as practicable. The track should be sloped to direct runoff to a table-drain. In some vulnerable areas, it may be necessary to spread and compact coarse aggregate appropriately around / along the approaches to the crossing to provide stable access and to reduce erosion;
- Cut and fill batters associated with service tracks will be formed to a safe slope and stabilised by groundcover vegetation, mulch, stone and rock armouring, or by the use of geo-fabric where appropriate;
- Minimise the number of watercourse and drainage line crossings;
- Avoid areas of riparian vegetation where possible and maintain buffer strips between the road and any watercourse;
- Where provision of access in gullies or creeks causes disturbance of vegetation, re-vegetation and stabilisation work should be undertaken;
- All temporary construction tracks and associated disturbed areas will be stabilised / or revegetated when construction is completed; and
- Minimise disturbance to soil and vegetation.

Stream or Water Crossings will be required as part of the railway construction where the alignment crosses watercourses there is significant potential for environmental degradation:

- Where the railway crosses waterways measures may need to be undertaken to divert water, maintain flow and avoid upstream flooding while the crossings and culverts are being installed. (Note an approval may be required for altering the flow of a waterway);
- Bridge crossings should be designed so that it does not become a channel constriction that may cause backup of flow or washouts during periods of high stream flow or cause any under cutting of structure, bed or bank of creek; and
- Works in and around all streams and waterways should meet all statutory and other requirements of regulatory authorities for works in waterways. Procedures developed for works in waterways should describe methods to minimise erosion, water quality impacts and other impacts.

Soil and Stockpile Management measures to minimise erosion and sediment release should be implemented before stripping or stockpiling of any material. Stockpiles should be:

- Constructed at least 5 m from hazard areas, particularly likely areas of concentrated water flows, e.g. waterways, roads, slopes steeper than 10 %, etc. Where rainfall events within the catchment are likely to cause the waterway to swell then this distance may need to be increased up to 50 m;

- No greater than 2 m high if the stockpile material is topsoil. This is to avoid excessive heat being generated and composting conditions that will degrade soil health;
- Protected from run-on water by installing water diversion structures upslope;
- Formed with sediment fences placed immediately downslope to protect other lands and waterways from pollution
- Stabilised if they are expected to be in-situ for extended periods and receive extended periods of potentially erosive rain they should be stabilised (e.g. sprayed with a chemical stabiliser; covered, grassed, etc); and
- Soil/spoil materials with appreciable fines contents that are windrowed or stockpiled beside near sensitive receptors (e.g. waterways, water bodies, wetlands, etc) and pose a pollution risk following a rainfall event should be stabilised.

If excavated materials potentially contain acid sulfate or other contamination, prevent contamination of the underlying soil by stockpiling the excavated material in an adequately sized bunded area. The bund area should be constructed on a surface of low permeability, or by lining it with HDPE sheeting. Where stockpiles are to be uncovered then bunds should be capable of containing runoff from the stockpile equivalent to a 10-year ARI, 24-hour duration rainfall event. Allow an additional 100 mm freeboard after the displacement of the stockpile has been taken into account.

2.4.5 Aggressive Soils

Aggressive soils are those that have chemical or physical properties that are restrictive to plant growth. Such properties include elevated sodicities, salinities, or acidities (and less commonly high alkalinities). Inversion of these soils during excavation and reinstatement may result in ongoing reinstatement maintenance issues and costs due to the formation of soil surfaces that are restrictive to vegetation establishment and plant growth. Bringing sodic subsoils to the surface may result in highly erodable surfaces with surface crusting and hard setting issues effecting vegetation establishment and growth.

Reinstatement of acidic or saline soils is also likely to be problematic to vegetation establishment and surface stabilisation. Whilst sodic soils and acidic soils may be easily ameliorated (gypsum for sodic soils, and lime for acidic soils) this is costly and resource intensive. Saline soils are much more difficult to ameliorate, and need to generally be capped with non aggressive soil if vegetation establishment is desired.

2.5 Sodic Soils

2.5.1 Existing Environment

A soil is considered sodic when sodium reaches a concentration where it starts to affect soil structure. In Australian soils this is commonly when the exchangeable sodium percentage (ESP) is greater than six per cent (Isbell, *et al* 1983). When sodic soils are wetted the sodium weakens the bonds between soil particles, resulting in clay swelling causing slaking or dispersion. (Rengasamy and Walters, 1994).

Slaking refers to the rapid disintegration of large aggregates (2 to 5 mm diameter) of soil into finer aggregates (i.e. less than 0.25 mm) when wet and is caused primarily by a lack of strong organic particles and micro aggregates. This changes the macroscopic structure of the soil resulting in loss of macropores and alters the porosity and permeability.

Dispersion is a second process of structural breakdown and is caused by either high levels of exchangeable sodium or by excessive mechanical disturbance of a soil, particularly when wet. When dispersive soils are wet aggregates of clay, silt and sand breakdown with individual clay particles going into suspension. Such dispersion may occur in sodic soils without any disturbance at all. The dispersed clay particles can be easily moved by water or wind and can migrate through the soil clogging soil pores and reducing infiltration and drainage and causing higher run-off. This may lead to a range of problems including high erosion rates, water pollution, tunnel formation, reduced workability, difficulty with vegetation establishment, and reduced vegetation growth due to low water holding capacity and root penetration (Raine and Loch, 2003).

The three categories for sodicity corresponding to different ESP's are included in Table 7.

Table 7 Sodicity rating based on ESP

Sodicity Rating	Exchangeable Sodium Percentage
Non-sodic	0-6%
Marginally sodic to sodic	6-14%
Strongly Sodic	>14%

Sourced: Hazelton and Murphy, 2007

The Australian Soil Resource Information System (ASRIS) developed by CSIRO, provided the available soil and land resource information in order to undertake this assessment component. This database was used to assess the presence of the above sodicity ratings of the soils likely to be disturbed on this project. The Exchangeable Sodium Percentage Map provided in Appendix A, shows the ESP levels of the subsoil material (B22 Horizon) across the alignment.

Table 8 below details the area within a 2 km buffer around the rail corridor that is mapped as one of the Sodicity Ratings shown in Table 7. A 2 km buffer was used to allow for possible changes to the rail corridor alignment during the detailed design and planning stages. The ESP figure in Appendix A details the extent of each sodicity class, and should be referred to when discussing alignment changes.

Table 8 Calculated Area for the Different Sodicity Ratings

Sodicity Rating	Hectares
Insufficient Data	62732
Non-sodic	29898
Marginally sodic to sodic	42968
Strongly Sodic	65734

As demonstrated in Table 8, and the associated figures there is a significant portion that could not be mapped due to insufficient data; however there are expansive areas of marginal to strongly sodic soils likely to be encountered along the rail corridor. This is particularly the case in the area from CH125000 to CH250000 and some areas around the Bowen River System. Soils identified as non-sodic are interspersed throughout the project alignment also. The region itself appears to have increasing sodicity levels eastwards towards the coast with larger areas of strongly sodic soils mapped to the east then west.

Laboratory analysis can be performed to verify potential areas of sodic soils by testing for exchangeable cation concentrations, which allows for calculations of cation exchange capacity, exchangeable sodium percentage (ESP), and calcium / magnesium ratios. The results will allow for better management of works within sodic soils, from managing and mitigating erosion and also during rehabilitation to determine any amelioration requirements.

2.5.2 Mitigation Measures

The drainage control, sediment control and erosion control principles detailed in section 2.4 above need to be implemented in areas of dispersive sodic soils. Inversion of deep subsoil material that is sodic nature to near the surface may severely inhibit rehabilitation and surface stabilisation due to poor groundcover establishment resulting in an exposed and erodible surface. Where this occurs consideration to amelioration requirements may need to be required such as gypsum.

2.6 Saline Soils

2.6.1 Existing Environment

Soil salinity refers to the presence of water soluble salts in water or soils. The most common base for salts is sodium; however potassium, calcium, and magnesium can also contribute appreciable quantities. These salts may be present as chlorides, sulfates, or carbonates. Elevated salt levels in soils can hinder vegetation growth, ultimately causing dieback and leaving exposed areas (surface scalds) where vegetation cannot re-establish. Salinity is a natural property of some soils but can be exacerbated by human activities, for example where tree clearing causes groundwater levels to rise, mobilising salt held in soils.

Evaluation of soil salinity on plant growth can be complex and requires consideration to the depth at which the saline zone occurs (e.g. shallow saline layers can have a greater impact on plant growth than saline soil at depth).

Measures of electrical conductivity from a soil / water suspension ($EC_{1:5}$) is a common measure of salinity in soil and water. The relationship between EC and the salinity effect to plant growth is dependant upon the salt tolerance of the plant, and is strongly influenced by soil texture, in particular clay content of the soil. The greater the clay content the higher EC will need to be before it has saline impacts on plant growth because clay soils are made of plates with strong electrical bonds i.e. the EC concentrations that severely inhibit vegetation growth in sandy soils may cause little adverse growth effects on in heavy clay soils.

The majority of the project corridor has been assessed as part of the National Action Plan for Salinity and Water Quality, Burdekin Catchment, 2003. The area has been mapped for Salinity Hazard in regards to the Potential for Salt Mobilisation. The allocation of map ratings is based on the vulnerability of the landscape to salinity due to the inherent characteristics of the various landscapes.

The rail alignment commencing from the mine site is within an area mapped as moderate to high salinity hazard. The corridor remains within moderate to high risk areas until it crosses Mistake Creek where the risk levels reduce to a mostly moderate level. Low to moderate risk areas are mapped north of the Suttor River and North West of Collinsville. The risk level returns to moderate to high nearing the Bogie River crossing and remains elevated as the alignment nears Abbot Point.

2.6.2 Potential Impacts

Removal of vegetation from some environments results in rising of the water table which in turn can lead to accumulation of soluble salts on the soil surface. This process is known as secondary salinisation. Salt accumulation in soils can have a profound and devastating effect on development and catchment health, leading to die back in non salt-tolerant vegetation and result in increased erosion hazard due to loss of groundcover and soil structural decline causing increased levels of runoff. Secondary salinisation can also affect infrastructure causing damage to building foundations, the breaking up of road pavements, and the corrosion of pipes and underground services.

Removal of trees and excavation of the soil is expected to alter the hydrology of the landscape and alter groundwater levels in areas lower in the landscape. Clearing of vegetation acts to increase groundwater levels due to the reduction in uptake; whilst it also may reduce the quantity of water entering the profile and aquifer recharge due to increased surface runoff. The consequence of changes to the hydrology can lead to alterations of stream flows and secondary salinisation. Effects of vegetation clearing and construction activities on groundwater are discussed in the Groundwater section of the EIS.

2.6.3 Mitigation Measures

Avoid clearing of trees and other woody vegetation, or revegetate cleared areas as soon as practicable after construction is complete. This retention of vegetation assists in maintaining groundwater at a lower level reducing secondary salinisation that could result from a rise in groundwater levels. In areas where vegetation has been cleared for grazing or agricultural use, deep drainage may be required to lower the water table below the root zone in order to avoid secondary salinity impacts. Applying excess water on occasions to leach the build up of salts in the plant root zone is another means of combating salt build up throughout the soil profile.

2.6.4 Acid Sulfate Soils

A discussion of location, impacts and mitigation measures for Acid Sulfate Soils is provided in the Section 4 Geology of the EIS.

2.7 Sources of Construction Materials

2.7.1 Existing Environment

It is anticipated that a considerable amount of construction materials will be required in order to construct the railway. Such materials as fill and rail ballast will be of high demand for the duration of the construction. It is likely that fill material will be able to be sourced from some of the cuttings that will be required to be undertaken as part of the project. The suitability of the cuttings for use as fill material is dependant on the geotechnical condition of the cut material and whether it meets the appropriate standards. Ideally only surplus cuttings should be used for fill materials and not be sourced from previously untouched ground where disturbance is not required as part of the project. Fill material will not be sourced from soil types conducive to cropping and beneficial land uses such as GQAL soil types.

Ballast aggregate materials will be most likely sourced from external sources such as quarries. There may be opportunities along the alignment where suitable materials are identified within cuttings and areas where blasting operations may be required in rock material that may suited for use as rail ballast.

Consideration should be given to the transport and handling of fill and ballast materials and the associated impacts on the environment (dust, air emissions, soil compaction etc.) from that.

2.7.2 Potential Impacts

The potential impacts associated with sourcing construction materials for the project can be both on-site and off-site impacts. If the materials are to be sourced externally then quarrying will be required to retrieve the materials (ballast or fill material), which would result in further land degradation / disturbance plus considerable transport and handling costs. Whatever the case additional ground disturbance will be an impact in sourcing rail ballast and fill material (if required).

Alternatively materials can be sourced from within the rail corridor where cuttings and blastings will be undertaken in suitable ground. This would be beneficial in terms of costs, transport and ability to manage impacts within the site without having to manage an off-site area in addition, however if fill material is removed from areas of GQAL or soils suitable for other land uses then this would be regarded as a negative impact. If soil regarded as being good quality is in surplus following construction in particular areas then the soil should be used elsewhere for rehabilitation purposes not as fill material.

If surplus soil material from areas with soil types not conducive to agricultural use meets the geotechnical requirement as fill material, is environmentally sound, then this can be used in areas along the project alignment.

2.7.3 Mitigation Measures

Sourcing ballast material from an off-site source can be achieved through established licensed quarries or alternatively applying for the relevant permits to quarry an area identified as containing material suitable for rail ballast. If the ballast material is sourced from a quarry under the control of the proponent then an appropriate environment management plan specifically for the quarrying activities would need to be developed and implemented to cover the operation of the quarry and rehabilitation of the disturbed land to pre-disturbance condition.

Any surplus material that meets the geotechnical requirements can not be used as fill elsewhere along the alignment if it is of a condition suitable to be used for agricultural purposes or rehabilitation of disturbed areas.

2.8 Contaminated Land

2.8.1 Existing Environment

Contaminated land refers to land that contains hazardous chemical substances referred to as contaminants that pose a significant risk to human health or the environment. Common land uses which may cause contamination include service stations, cattle dips, tanneries, wood treatment sites, landfills, fuel storage and refuse tips. In Queensland, activities that have been identified as likely to cause land contamination are listed as *notifiable activities* and are recorded by the local government authority and DERM and are included on the Qld DERM's Environmental Management Register (EMR). Land that is proven to be contaminated land ('risk' sites) and has the potential to cause serious environmental harm or other adverse public health risks is recorded on the Contaminated Land Register (CLR). The EMR and the CLR are managed by the Qld DERM.

The linear nature of the Alpha Rail Project means that a large number of properties are either traversed by the actual route or within a close proximity. There is a high likelihood that some properties potentially impacted on by the rail corridor have land uses that may have had the potential to contaminate the land. It is therefore prudent for a preliminary assessment be undertaken to determine where potentially contaminated land may exist along the alignment, and whether contaminated land could be a constraint upon the development of the Alpha Rail Project.

2.8.2 Relevant Legislation

The legislative requirements covering contaminated land in Queensland are primarily contained in the Environmental Protection Act 1994 (EP Act) and subordinate policies and regulations. The EP Act is administered by DERM, and includes a list of Notifiable Activities in Schedule 3, which have the potential for contamination impacts, as discussed in above.

Assessments are also based on guidelines and standards. This assessment is based largely on the following Australian guideline publications:

- National Environment Protection (Assessment of Site Contamination) Measure (NEPM); and
- Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland, (Department of Environment [DoE], 1998.

Appendix 9 of the *Draft Guidelines* provides investigation thresholds for contaminated soils in Queensland.

2.8.3 Investigation Scope

The investigation to identify contaminated sites that may be disturbed / traversed as a result of this project included:

- A search of the DERM EMR / CLR database on those properties likely to be impacted on by the construction of this rail corridor; and
- A request for information from DERM for properties listed on the EMR / CLR to ascertain any available information on the contamination status. This includes information on the location of the notifiable activity listed for the property, any contamination assessments, complaints or pollution reports held on file for the property.

2.8.4 Environmental Management Register

A review was undertaken of the DERM EMR / CLR database of the 57 properties that have been identified likely to be impacted on by the rail corridor. A total of 11 properties are registered on the EMR / CLR for a notifiable activity with the potential to contaminate land. The EMR searches for the properties listed on the EMR database is provided in Appendix D.

Table 9 details the properties within the rail corridor that is listed on the EMR as having a notifiable activity registered to the site, also provided is the additional information supplied by DERM regarding those sites. The EMR Listing Figure in Appendix A shows the location and types of notifiable activities for those properties listed on the EMR likely to be traversed by the project.

Table 9 Notifiable Activities of EMR Registered Properties

Lot / Plan Detail	Land Use	Notifiable Activity Listing					Additional information supplied by DERM
		Livestock Dip or Spray Race	Petroleum Product or Oil Storage	Explosives Production or Oil Storage	Waste Storage, Treatment or Disposal	Mineral Processing	
Lot 10 on BL58	Cattle Breeding and Fattening	√	√				There are approximately 6 different livestock dips located within the property (House Yards, Mud Tank Yards, Mistake Paddock, Mt Rolf Holding Paddock, Bottom Blackwood Paddock) An underground fuel storage tank is located within the property, location was not provided.
Lot 2 on CP866147	Cattle Breeding and Fattening	√	√				Above ground fuel storage includes a 10,000L Diesel, 2,500L Unleaded, and 600L Oil
Lot 4 on RU83 (parent site of Lot 2 on SP186058)	Cattle Breeding and Fattening	√					No further information relating to notifiable activity location or quantities was provided.
Lot 5 on RU81	Cattle Breeding and Fattening	√	√				Livestock dip is located at Boggy Yards, approximately 18km from the homestead station yards. Additional information also mentioned the presence of a household dump within the house paddock and another dump facility within the holding paddock. A 200L underground fuel storage tank is located within the property.
Lot 4 on DK264	Unknown		√	√	√	√	The comments provided on the explosives production activities that are registered to the site were that it was for an Imperial Chemical Industries Plant. The petroleum product storage includes

Lot / Plan Detail	Land Use	Notifiable Activity Listing					Additional information supplied by DERM
		Livestock Dip or Spray Race	Petroleum Product or Oil Storage	Explosives Production or Oil Storage	Waste Storage, Treatment or Disposal	Mineral Processing	
							◗ underground bulk storage of diesel / oil; ◗ light vehicle bulk oil storage; ◗ bulk diesel / oil storage; and ◗ 2ML diesel tank. Waste storage includes a chemical dump, location was not provided.
Lot 4 on DC93	Cattle Breeding and Fattening	√					No further information relating to notifiable activity location or quantities was provided.
Lot 3 on RU5	Cattle Breeding and Fattening		√				Above ground 4000L fuel storage.
Lot 3 on DK236	Unknown		√		√	√	Diesel and fuel storage.
Lot 1 on BF51	Cattle Breeding and Fattening		√				Above ground storage of 3,000L petrol and 14,000L diesel tank
Lot 4 on RU83 (parent site of Lot 1 on SP186058)	Cattle Breeding and Fattening	√					No further information relating to notifiable activity location or quantities was provided.
Lot 4 on BL51 (parent site of Lot 4 on SP137517)	Cattle Breeding and Fattening	√					No further information relating to notifiable activity location or quantities was provided.

As shown in the table above, some properties have multiple notifiable activities registered to them which may potentially increases the number of contaminants that may be within the soils and / or groundwater for those sites.

When lots are reconfigured the resultant lots remain on the EMR/CLR until an application to the Qld DERM to have them removed is accepted. On this basis, Lot 4 on SP137517, and Lot 1 and Lot 2 on SP186058 remain on the EMR even though the Notifiable Activity, in this case being a Livestock Dip or Spray Race, may not be located within the actual subdivided parcel.

While sites are listed on the EMR using the lot and plan description, a mining lease may affect only a limited area of the lot. In many instances with large rural properties, only a small area may be potentially affected by the notifiable activities and the majority of the ongoing land use is unaffected, this is the case particularly for the livestock dips / spray races.

Details regarding the Notifiable Activities are provided in Appendix E, which provides an overview of the operations / activities that has resulted in these 11 properties being listed on the EMR.

2.9 Potential Impacts

2.9.1 Potential Impacts from Existing Areas

The following details the potential impacts from contamination from existing areas, being those sites listed on the EMR.

The major impacts that are associated with the existing areas of concern is the excavation of potential contaminants during construction, the mobilisation of contaminants through; earthworks, runoff and gaseous emissions, exposure of contaminants to the workers and public impacting on there health and impacts on surrounding aquatic ecosystems and groundwater dependant ecosystems.

It is difficult to establish the level of impact on the project associated with a potentially contaminated property. In order to accurately evaluate the impacts of each EMR listed site, additional information would be required from the land owner, DERM, local council authority, and person's familiar with the sites. It is most likely that the land parcel would require further investigation in accordance with State and / or National Guidelines. This applies to all potentially contaminated land parcels identified within the rail corridor.

Although a detailed contamination assessment of the project alignment has not been undertaken, there is information to suggest that contamination may be present as a result of the notifiable activities of the sites / properties being impacted on by this project. The potential for other areas within the Alpha Rail Corridor is considered low due to an overall lack of development activity.

In regards to impacts on the delivery of the project and impacts to timeframes the following has been identified.

Land recorded on the EMR usually requires a site investigation and, where necessary, remediation when a development application is made to subdivide the land or change its use (e.g. from industrial to residential use).

Under the Sustainability Planning Act 2009 (formerly the Integrated Planning Act 1997), development applications made for sites listed on the EMR that will be referred to DERM for assessment include for example:

- A material change of use; and / or
- Reconfiguration of lots for land that is listed on the Environmental Management Register/Contaminated Land Register (EMR/CLR) triggered under the Integrated Planning Regulation.

DERM may require contaminated land investigations to be conducted at this time.

DERM recommends that contaminated land issues be addressed as early as possible in the planning stage for a development project. Contaminated land assessment and remediation can be a lengthy process and, where possible, should start prior to the IDAS process. Delays in this process can have impacts on the delivery timeframes for the project.

2.9.2 Potential Impacts from Rail Construction Activities

Activities that will be carried out as part of the construction activity which might result in soil contamination include:

- Hydrocarbon storage, transport, and disposal - Bulk fuel and oil storage will be required to power and maintain all of the vehicles and machinery;
- Refuelling will likely take place at the maintenance area, accommodation camp and along the project alignment through using mobile fuel trucks; and
- Chemicals and Hazardous Substances - the usage of chemicals and hazardous substances is expected to be minor, consisting mostly of chemicals required for water and wastewater treatment, soil treatment ameliorants, and small quantities of commercial cleaning products, solvents, degreasers, and chemicals.

In addition, minor leaks of oils may occur from plant and equipment, particularly if hydraulic hoses are damaged or lost during construction activities.

Spills or leaks could result in contamination of soil, groundwater, and surrounding waters and could cause adverse impacts to terrestrial, aquatic, and estuarine ecosystems if not promptly contained and cleaned up. The following impacts may occur:

- Contamination of surface water / soil / groundwater through hydrocarbon, chemical and industrial waste spills; and
- Contamination of surface water / soil / groundwater through spills associated with storage of fertilizers, soil ameliorants, temporary sewage treatment facility at construction camps etc.

2.9.3 Potential Impacts from Rail Operation

Pesticides are used to control weed growth along rail corridors, depending on the pesticide being used, this could lead to contamination of land and surrounding waterways if there was a spill or a high rainfall event following the use of pesticides. Spills of nutrients and soil ameliorants such as lime and gypsum that may be required during rehabilitation purposes to restore soil properties to a suitable condition for plant growth.

The United States Department of Labor, Occupational Safety and Health Administration provides an occupational health and safety guideline for Coal Dust (<5%SiO2). Exposure to coal dust can occur through inhalation, ingestion and eye contact. Coal dust is not only an issue at the source (coal mines) but also in transport. An extract from this guideline in regards to its impact on humans and animals is provided below:

Effects on Animals: Coal dust is a tumorigenic agent in experimental animals. Coal dusts were shown to be equivocal tumorigenic agents associated with lymphomas and, at the higher dose, adrenal cortex tumors in rats exposed to either 6.6 or 14.9 mg/m(3) for 6 hours/day intermittently for 86 weeks, NIOSH 1991.

Effects on Humans: Coal dust causes pneumoconiosis, bronchitis and emphysema in exposed workers. Coal dust causes coal workers' pneumoconiosis (CWP) [Hathaway et al. 1991]. Coal dust is also recognized as a cause of chronic bronchitis (Rom 1992). Exposure to coal dust is associated with an increased risk of focal emphysema.

The American Conference of Governmental Industrial Hygienists considers the toxicity of coal dust with greater than 5 percent silica to be similar to quartz (ACGIH 1991).

Coal dust impact on the receiving environment is considered to be low due to the relatively inert nature of the coal dust, and the low exposure risks to humans.

It is understood the trains will be diesel powered which may result in accidental spills of fuel /oil / chemicals during the haulage of coal. These spills may result in contamination of the waterways and land.

2.10 Mitigation Measures

2.10.1 Mitigation Measures from Existing Areas

The DERM *Draft Guidelines* provides information on how contaminated site investigations are to be assessed and managed through a staged approach.

Prior to any activities in an EMR listed site that may contain contaminated soil; a preliminary contaminated land assessment needs to be carried out to identify any contaminants and location of such contaminants in relation to the project works. If contaminants appear likely, further investigations and development of a remediation plan should be undertaken. Appropriate disposal methods for contaminated soils and other materials will also need to be developed and may include:

- Obtaining a Disposal Permit from DERM, in order to remove the contaminated material from site by an authorised waste contractor for disposal at another location (this will require permits to move contaminated soil as the site is on the EMR); or
- Disposal on the site in a suitably constructed waste disposal facility.

For all other areas, an inspection should be carried out prior to commencement of vegetation clearing to identify any signs of contamination. This can be carried out concurrently with flora, fauna and cultural heritage clearances of the site by a person trained in signs of soil contamination.

Any dealings with contaminated land need to be done in accordance with the relevant guidelines mentioned earlier.

Provided the below measures are carried out as a minimum, the risk of environmental harm arising from disturbance of contaminated soils is considered low.

- Conduct contaminated soil assessment prior to works in EMR sites;
- Conduct pre-clearing checks for potential soil contamination across the rail corridor;
- Remove and remediate any contaminated soils identified;
- Dispose of contaminated soils to authorised facilities on-site or off-site in accordance with Disposal Permits;
- Contaminated water to be treated until in accordance with relevant water quality objectives prior to disposal;
- Avoid disturbance of known contaminated areas;
- Development of a site management plan limiting the nature of activities that can be carried out on the site, and detail management response if contaminated land is identified;
- Remediate the contaminated area prior to construction activities; and
- Undertake an investigation of EMR listed sites prior to starting the IDAS process for Material Change of Use or Reconfiguration of a Lot.

2.10.2 Mitigation Measures from Rail Construction Activities

Mitigation measures for storage and handing of fuels and chemicals include:

1. Design fuel, oil and chemical storage areas in accordance with Australian Standards;

- Spills to be reported and immediately contained;
- Contaminated soils to be removed, remediated or managed in accordance with an approved site management plan;
- Contaminated waters to be treated to relevant water quality standard prior to disposal;
- All vehicles, plant and machinery to be inspected and maintained to ensure they are not at risk of leaking, or spilling contaminants;
- Develop procedures for handling and using fuels, oils and other chemicals;
- Train workers in proper procedures for handling and use of fuels, oils and other chemicals;
- Incorporate spill response procedures into incident response plan;
- Train personnel in spill response;
- Maintain spill response kits and personal protective equipment in tanker trucks and at all locations where spills may occur. Ensure spill response kits are appropriately sized for the potential spill volumes;
- Transport dangerous goods and potential contaminants in accordance with ADG Code;
- All storage facilities designed to Australian Standards;
- Procedures in place for storage and handling including refuelling;
- Procedures in place for clean up of spills;
- Provide equipment in a location that is readily available for clean up of spills;

- Procedures in place for inspecting and maintaining plant and equipment;
- Any treatment systems to treat contaminated waters or wastewater from construction camps to be maintained to a high standard; and
- Any discharges to the environment off-site to be monitored to ensure contaminants are below EIL values.

With the mitigation measures in place, as a minimum, the likelihood of any spills of any significant volume occurring is low and a prompt clean up will minimise release of contaminants to the environment.

2.10.3 Mitigation Measures from Rail Operation

Development of a weed management program factoring in timing (avoiding undertaken weed spraying during wet weather or high winds), type of pesticide, transport, and application rates will reduce the risk of contamination of waterways associated with weed management programs.

Rehabilitation works following the construction of the project may require the use of soil ameliorants. Management similar to that of the weed control sprays will be required to mitigate the risk of spills and impacts to the environment.

To limit coal dust being blown onto neighbouring properties, whereby it can be inhaled or ingested by the animals and humans, and deposition into waterways, will be negated by the use of covers on the haul trains. Additionally providing a sufficient buffer from sensitive sources such as residential properties, cattle yards and stock yards will also reduce the exposure levels on sensitive receptors.

Develop and implement a maintenance program on the trains used for the transport of coal to prevent any risk of diesel leaks, or fuel leaks associated with faulty equipment.

2.11 Good Quality Agricultural Land / Land Suitability

2.11.1 Existing Environment

Good Quality Agricultural Land (GQAL) refers to land capable of sustainable use for crop or animal production, with a reasonable level of inputs, without causing degradation of land or other natural resources *(QDPI, 1993)*. The State Planning Policy (SPP) 1/92*, Development and the Conservation of Agricultural Land,* sets out principles to guide the protection of GQAL and provides guidance to local authorities on how this issue should be addressed when carrying out their range of planning duties (DHLG&P, 1992).

Australia has a limited supply of good quality agricultural land, with only 1-2% of land supporting highly productive agriculture. Environmental impacts from farming in these lands are easier to manage than in other areas, as the soil, topographic and climatic conditions are more favourable. Like any limited and non-renewable resource, it is important to conserve this land. Thus land that is suitable for agricultural production should be maintained for that purpose.

Good quality agricultural land is the land most suitable for farming. It is essential for:

- Food production, both domestic and international;

- Local and regional economic prosperity;
- Valuable export earnings;
- Preserving the social fabric of rural communities; and
- Growth of secondary industries.

The Department of Environmental and Resource Management (DERM) publishes reports and mapping for areas within Queensland where GQAL or other Land Suitability assessments have been undertaken. The relevant reports and mapping data used to assess GQAL and Land Suitability for the area impacted on by this project includes:

- *Lands of the Nogoa – Belyando Area, Queensland, Land Research Series No. 18,* CSIRO,1967, ***from CH0 to CH260000***;
- *Land suitability study of the Collinsville-Nebo-Moranbah region.* Queensland Department of Primary Industries (DPI, 1984), ***from CH260000 to CH400000***;
- *Soils. Burdekin-Townsville region*. Queensland Resources Series. Department of National Development (DND, 1970), ***from CH415000 to CH450000***; and
- *North Queensland Versatile Cropping Land,* Queensland Department of Environment and Resource Management, 2009, ***from CH400000 to CH4150000 & CH450000 to Abott Point***.

The above studies and the associated data sets allowed for an assessment of GQAL and Land Suitability to be conducted over the entire project alignment. Analysis and allocation of GQAL / Land Suitability ratings was undertaken with reference to the Planning Guidelines: Identification of Good Quality Agricultural Land, 1993. Due to the variable dates in which these land studies were undertaken, field assessments of the findings will be required to establish the relevance and accuracy of these ratings.

The four classes of agricultural land defined in the planning guidelines are detailed in Table 10 below:

Table 10 GQAL Classes

Class	Description
A	Crop land - Land that is suitable for current and potential crops with limitations to production which range from none to moderate levels.
B	Limited crop land - Land that is marginal for current and potential crops due to severe limitations; and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping.
C	Pasture land - Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment.
D	Non-agricultural land - Land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and/or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop or poor drainage.

Appendix E provides supporting information regarding the GQAL / Land Suitability data sets, and the assessment process.

The rail corridor transects each of the GQAL Classes at various areas along the alignment. Table 11 below details the percentage and area (hectares) of GQAL classes within the rail corridor (2 km buffer):

Table 11 Impact on GQAL within a 2 km Buffer around the Rail Corridor Alignment

GQAL Class	Total Area (2km Buffer)	Percentage of Total (%)
A	21730 ha	11
B	14514 ha	7
C	149316 ha	74
Unallocated (Assumed to be Class D)	15073 ha	7
Total	200635 ha	**100.00**

The GQAL / Land Suitability figure is provided in Appendix A.

The major extent of Class A GQAL land is where the alignment approaches the Bowen River crossing, and sporadically to CH400000. The majority of the rail alignment traverses land mapped as Class C.

The rail alignment approaching Abott Point from CH450000, traverses areas mapped as Class A and B. The mapping dataset for this portion uses a different allocation system (detailed in Appendix E); the GQAL Classes have been inferred from that system. The main agricultural production around the Bowen area is sugar cane.

The land uses for the properties likely to be impacted by this project is predominantly cattle grazing, breeding and fattening.

2.11.2 Potential Impacts

The project will preclude any agricultural use within the rail corridor for the life of the railway. The rail corridor will pass through areas that are classed as GQAL resources which could lead to sterilisation of the land for agricultural purposes. This will mainly be caused by fragmentation, and permanent loss of land due to the nature of the infrastructure. Agricultural land may also be impacted on by changes to groundwater and drainage, impacts to stock routes, increased erosion risk and impacts to nutrient levels.

These impacts are not just confined to within the Alpha Rail Project construction footprint but impact on soils outside the area, particularly lower areas within the catchment areas. The following has been identified as potential impacts on GQAL arising from the construction of the Alpha Rail Project.

Sterilisation

As stated in Table 11, approximately 21730 hectare of GQAL Class A land within a 2km buffer around the rail alignment will be impacted on by this project. Unlike a pipeline project where the disturbed GQAL resources can be restored to near pre-existing condition by replacing topsoil, adding ameliorants, reopening the area back to production following installation, a railway is a permanent fixture within the landscape, and the occupied land is no longer usable for agricultural purposes.

Fragmentation

Due to the linear nature of this project, GQAL resources will be fragmented by the rail corridor. This fragmentation may result in a loss of prime agricultural opportunities and the ‘economies of scale’ that sustains some forms of agricultural production (e.g. sugar cane). By fragmenting and rendering GQAL resources within the area unusable it may result in agricultural production being relocated to areas which are more marginal, have a lower GQAL rating and lead to a greater impact on the environment and potential economical impacts.

Fragmentation of grazing paddocks, in particular the important finishing paddocks (Bullock paddocks) which graziers use to fatten cattle before they are sent off to the market, fragmentation will result in a reduced ability for the grazier to move cattle to differing paddocks.

Disruption / loss to cattle yards and purpose built cattle laneways. Landowners use purpose cattle laneways to efficiently move stock from various sections of their properties to central cattle yards. On several of the properties the rail corridor will cross these laneways, potentially impacting on the ability of cattle to be moved efficiently.

Nutrient Decline

Fertility of soil and nutrient levels are intrinsically linked. Disturbing a GQAL resource, will result in a reduction in nutrient content and therefore a reduction in the ability to support plant growth. This may result in a reduced potential for agriculture. This impact can also be an ongoing issue due to erosion from wind and water of areas surrounding the rail corridor. Nutrients are typically stored in the topsoil, which is most susceptible to erosion of the topsoil which will result in reduction in topsoil and hence a reduction in nutrient levels.

The rail alignment will likely have an affect on the drainage of the area, which may result in increased water flow in areas not previously susceptible to such conditions which could result in water logging, structural decline and erosion.

Structural Decline

This refers to a breakdown of the aggregates in which soil particles are held, resulting in a change in the soil particle composition, where prior to disturbance the particles are ordered, loosely packed with high pore space, causing them to become more randomly and closely packed together with little pore space. A decrease in soil permeability, water holding capacity, aeration and microfauna may result from the breakdown of soil aggregates in which soil particles are held. This could cause the soil to be less favourable for plant growth and more prone to high water runoff, with the resulting increased potential for erosion and flooding problems (DLWC, 2000).

Structural decline results from continued compaction under heavy vehicles and machinery, cultivation and turning over of soils. Structural decline is increased during periods where the soil is saturated or during extremes of very low moisture levels (dry). Position of workers camps, access routes, and the construction footprint within GQAL resources will have variable impacts on soil structure and potential agricultural use.

Salinisation

Salinity problems usually arise as a result of alteration to the hydrological regime of a catchment, with greater quantities of water infiltrating into the ground resulting in rising groundwater levels which bring salt to the ground surface. This causes an accumulation of salt in the soil and surface or groundwater, which at high levels is toxic to plants and thus prevent or retard the growth of crops, pasture and other vegetation. The resulting saline scald is highly prone to erosion and consequent sediment transport problems. Salt is also a highly corrosive agent and can cause serious and expensive damage to infrastructure such as building foundations, underground services and roads. Water quality is also adversely affected by high salt levels (DLWC, 2000).

The impacts on GQAL resources identified during the construction phase of the project are largely manageable. The impact that is most difficult to manage is the fragmentation and associated sterilisation of GQAL resources.

2.11.3 Mitigation Measures

Sterilisation

Areas such as construction camps and storage areas that are located within a GQAL resource can be restored to pre-existing conditions following completion of the project and removal of the camps and storage facilities. Topsoil can be placed back over the disturbed area, and with the addition of ameliorants, can be restored to productive agricultural land.

Fragmentation

It is difficult to not fragment GQAL resources with a linear project. Consultation with affected landowners will be required to be undertaken to limit the impact of the project by locating the alignment in suitable locations away from GQAL resources, stock routes etc. and managing the construction and operations on the activities carried out on the land.

Nutrient Decline

The following have been identified as mitigation measures for the aforementioned impacts on nutrient levels within the soils;

- Retention of vegetation and vegetative wastes following clearing;
- Replenish nutrients of GQAL resources that are disturbed during construction and are not within the rail corridor, such as construction camps, temporary access tracks, and storage areas. Chemical analysis will be required to ascertain the nutrient deficiencies of these soils prior to addition of fertilisers;
- Establish vegetation over disturbed areas that serve to replenish soil nitrogen levels; and
- Establish plant species that have low nutrient requirements within vulnerable GQAL resource areas.

Structural Decline

The following mitigation measures may be implemented to reduce the impacts on structural characteristics of the GQAL resources:

- Restricting the travel paths and movement of heavy vehicles and equipment over GQAL resources, including restricting movement during periods of sustained wet weather, particularly over cracking clays;
- Stockpile stripped topsoil into low, broad mounds and use as soon as possible to prevent excessive compaction and help with the retention of soil fauna;
- Add organic matter to soil that has been stored for a long period of time to improve soil structure, biological activity, water holding capacity and fertility; and
- Establish vegetation with deep, fibrous roots instead of shallow simple rooting systems.

Overall the following mitigation measures are required to be adopted during pre-planning, construction and rehabilitation of the project.

- Avoid good quality agricultural land (GQAL) by re-locating infrastructure off such land where practicable. Some loss of GQAL is unavoidable;
- Retain vegetation, add soil fertilisers, establish nutrient replenishing vegetation, establish low nutrient requiring species during rehabilitation;
- Control movement of vehicles and position temporary access tracks in consultation with landholders;
- Follow the erosion mitigation principles detailed in the erosion and sediment control section of this Report;
- Work with affected landholders to limit disruption to their use of the land; and
- Areas of construction that are temporary in nature, replace and ameliorate topsoil to pre construction standards in order to return the affected land to near as possible to pre-construction condition.

2.11.4 Change to Landform

A permanent change to landform will be an unavoidable result of this project. In order to construction the railway, there will be significant requirements to fill and cut within the current landscape. While the rail corridor will be confined to a corridor (~30m) in width, the nature of the project will result in the final contours after construction to differ from the original landform.

Landform, hydrology and hydrogeological conditions are closely connected which will be affected to varying degrees along the alignment. There is a high likelihood that drainage, including groundwater infiltration, sheet flow and creeks / streams will be altered to varying degrees as a result of this project. This may result in significant impacts on downstream ecosystems due to increases or decreases in runoff and redirection of drainage lines.

Hydrological impacts of the project have been assessed and reported in detail in Section 4 of this EIS, whilst the hydrogeological (groundwater) impacts are detailed in the groundwater section. Avoiding impacts due to landform change can be in the form of maintaining natural drainage flows and patterns to that of what was in place prior to the project being constructed.

Restoring the landforms in a way that will not alter the overall catchment behaviour is an important part in reducing the impacts on the change to landform. The following matters need to be addressed to ensure this aspect is managed appropriately:

- Restore the drainage flows and pathways into the various catchments that will be affected by this project;
- Avoid steep slopes and significant changes to landform; and
- Replacing the topsoil resources to nearest to pre-disturbance condition, which may require the addition of ameliorants to achieve that.

Restore the overall catchment gradients to that of pre-disturbance condition

Avoiding areas of steep slopes and areas that require significant landform change

Restore the disturbed areas to pre-existing conditions where possible, including restoration of topsoil resources

2.11.5 Rehabilitation

An undertaking like the Alpha Coal Rail Project includes both temporary and permanent changes to the land. There are some opportunities for returning disturbed land such as the access tracks, storage areas and construction camps to a condition that poses no liabilities to future land uses and to the surrounding environment. The rehabilitation goals aim to create a site that is safe to humans and wildlife; non-polluting; stable; and able to sustain an agreed land use after the disturbance and rehabilitation works are undertaken (Qld EPA, 2007).

Rehabilitation is intended to progressively occur following installation of the ralline. Areas at high risk of erosion such as the banks of drainage lines / creeks / streams and rivers, areas of steep and / or sustained slops and areas of high erosive soils are required to be stabilised and rehabilitated as soon as practical following construction in those areas.

The final landform of the rail corridor will be in done to ensure the surface water runoff is managed and the areas other then the ralline itself are restored to a condition that resembles the pre-disturbance landscape as close as possible.

Revegetation

Revegetation is to commence in a progressive manner as soon as practical following the construction of the ralline in any given area. Where topsoil has been stripped it is to be placed back over the disturbed area and ameliorated if required to a standard that will allow for successful revegetation.

Decommissioning

As the project construction phase approaches completion, temporary storage construction camps will be decommissioned and rehabilitate. All unnecessary buildings and workshops will be removed. Haul roads and unnecessary access tracks will be rehabilitated. If any of the sediment basins constructed along the rail corridor for sediment treatment may be given permanent status if landowners request they stay as small water reservoirs. If this is requested and agreed with by the relevant stakeholders, additional stabilisation works may be required to ensure the sediment basins remain structurally sound.

Rehabilitation Criteria

The following rehabilitation criteria are prescribed for the revegetation of disturbed areas:

- Local indigenous people shall be involved in all phases of site rehabilitation, from the initial surveys through, removal of vegetation, rehabilitation works to the monitoring of rehabilitated areas;
- Flora and fauna will be surveyed prior to disturbance, to establish any species of concern (weeds, threatened, rare etc.) and to provide a species list for rehabilitation purposes;
- Rare and threatened species, and articles and places of cultural significance shall be conserved and protected, and will be identified prior to construction;
- Rehabilitation of disturbed areas will be done progressively during construction;
- Rehabilitation of disturbed areas will be done with consideration of climatic conditions, particularly erosive rainfall and high erosion potential periods. Rehabilitation will occur prior to the wet season periods along the alignment;
- Clearing, like rehabilitation, will be done progressively, in order to retain as much stabilising vegetation at any given time along the alignment corridor. High risk areas (erodible soils, steep / sustained slopes, streams and creeks) will not be cleared until such time that the construction is scheduled to start for those given areas;
- Preference shall be given to placing topsoil on land to be rehabilitated immediately after it is removed stripped from areas due to be constructed within. The topsoil however must be made suitable for plant growth and land use for the disturbed area;
- All topsoil stockpiled shall be placed in uncompacted windrows not more than 2 metre high with a base width not exceeding 3 metres;
- All surfaces will be prepared to ensure successful rehabilitation; this may include ripping to reverse compaction and addition of ameliorants if required;
- Topsoil replacement will involve placing it in layers consistent with its natural profile;
- All areas which are rehabilitated shall be monitored using Ecosystem Function Analysis as the primary broadscale;
- Monitoring shall include flora, fauna, surface conditions, soil condition and surface runoff;
- Rehabilitation techniques shall be improved through the findings of monitoring and research; and
- Site monitoring shall continue until such time that government agencies and traditional owners are confident that the disturbed areas have returned to an approved natural state.

Details on species selection and maintenance requirements are detailed in the flora assessment component of this EIS.

3. Conclusion

The project is approximately 500 km in length and will traverse numerous soil types, topographical features and will be impacted on by varying climatic conditions.

The types of soils vary from dispersive sodic soils to soils suitable for cropping. Each soil type will require varying levels of management to limit the impact on the environment and soil resource. Of particular concern in regards to impact to the environment are the erodible soils, potentially contaminated soils, sodic soils, acid sulfate soils, areas of high salinity risk and areas of Good Quality Agricultural Land.

A number of potential impacts on the soil resources may arise from this project.

- Secondary salinisation;
- Loss of productive cropping land;
- Disturbance of acid sulphate soils at Abbot Point;
- Disturbance and possible migration of contaminants;
- Contamination of soil from spills;
- Erosion of valuable topsoil resources during the construction and operation phase; and
- Alteration to the topography and landforms resulting in a change in catchment characteristics.

Environmental impacts are unavoidable from a project of this type. The mitigation measures and management practices that have been detailed in this report will however reduce the impact on the environment and soil resources. The impacts requiring management and mitigation are the disturbance and fragmentation of GQAL resources, erosion, exposure of and to contaminated soils, sourcing of the construction materials and the rehabilitation post construction. Specific management plans will need to be developed and implemented to ensure that all impacts have mitigation and management options. Management plans may include but is not limited to Erosion and Sediment Control, Acid Sulfate Soil, Rehabilitation and Site Management Plan for Contaminated Lands.

4. Bibliography

Aldrick, J.M, 1988, Soils of the Elliot River, Bowen Area, North Queensland, Department Primary Industries, Queensland Government (DPI, 1988)

Australian Government, Department of Agriculture and Fisheries and Forestry, Soil Health Knowledge Bank, retrieved May 20, 2010, from http://soilhealthknowledge.com.au/.

Christian, CS, Paterson, SJ, Perry, RA, Slatyer, RO, Stewart, GA and Traves, DM, 1950, *Survey of the Townsville – Bowen Region, North Queensland,* Land Research Series No. 2, CSIRIO, Melbourne.

Department of Land and Water Conservation 2000, *Soil and Landscape Issues in Environmental Impact Assessment*, Technical Report No. 34, 2nd edition, NSW Department of Land and Water Conservation, Sydney.

Department of Transport and Main Roads, 2010, *Road Drainage Manual,* QLD

DNRM, 2004. *Soil Conservation Measures – Design Manual for Queensland.* Department of Natural Resources and Mines, Brisbane

Department of Natural Resources and Water, 2003, *National Action Plan for Salinity and Water Quality, Burdekin Catchment - Salinity Hazard (Potential for Salt Mobilization)*

Department of Environment and Resource Management, 1998, *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland*

Gunn, RH, Galloway, R.W, Pedley, L and Fitzpatrick E.A, 1967, *Lands of the Bogoa – Belyando Area, Queensland, Land Research Series No. 18*, CSIRO, Melbourne.

IECA 2008, *Best Practice Erosion and Sediment Control*. International Erosion Control Association (Australasia), Picton NSW.

Institution of Engineers Australia (IEAust), Queensland Division, 1996, *Soil Erosion and Sediment Control, Engineering Guidelines for Queensland Construction Sites*

Isbell, R, 1983. *Salt and sodicity.* In Soils and Australian Viewpoint. CSIRO Melbourne

Isbell, R. 1996. The Australian Soil Classification System. CSIRO, Vic

Isbell, RF and Murtha, GG, 1970, *Burdekin Townsville Region, Queensland, Resource Series, Soils*. Department of National Development, Canberra.

McKenzie, N and Hook, J, 1992, Interpretation of the Atlas of Australian Soils, Consulting Report to the Environmental Resources Information Network, CSIRO Division of Soils, Canberra.

North Queensland Versatile Cropping Land, Queensland Department of Environment and Resource Management, 2009

National Environment Protection (Assessment of Site Contamination) Measure 1999

Queensland Department of Main Roads, 2002, *'Site Assessment', Road Drainage Manual,* Queensland

Raine, SR. and Loch, RJ. (2003). *what is a sodic soil? Identification and management options for construction sites and disturbed lands.* Roads, Structures and Soils in Rural Queensland. 29-30 July, Toowoomba. Queensland Department of Main Roads, Brisbane.

Rengasamy, P and Walters, L. 1994. *Introduction to soil sodicity*. Cooperative Research Centre for Soil and Land Management. Adelaide

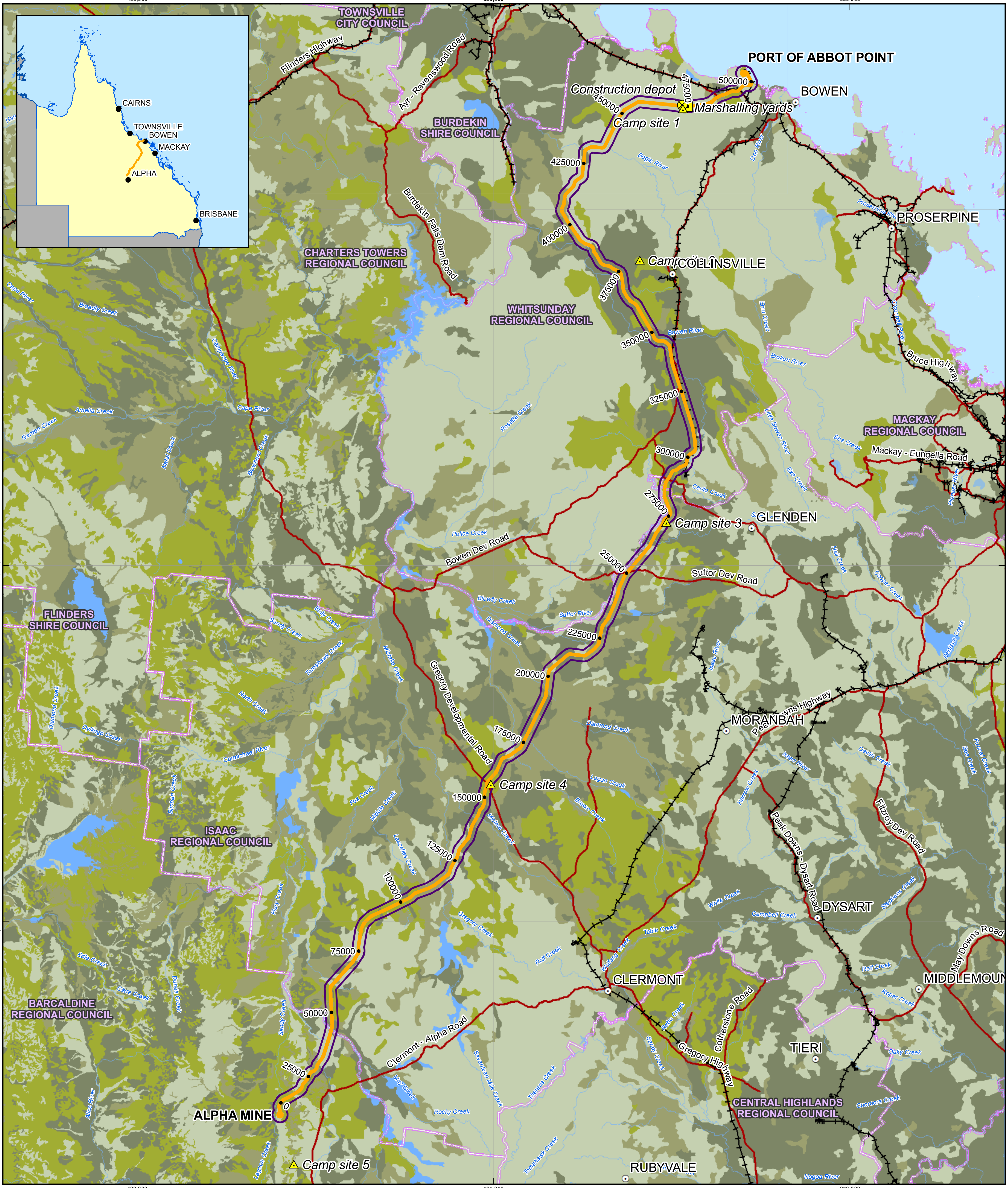
Shields, PG, 1984*, Land Suitability Study of the Collinsville – Nebo – Moranbah Region*, Queensland Department of Primary Industries, Brisbane.

SSSA, 1984. *Glossary of Soil Science Terms*. Soil Science Society of America (SSSA) Wisconsin.

URS. 2009. *GLNG Environmental Impact Statement*. Prepared for GLNG

Appendix A

Figures



LEGEND

- Town
- Camp
- Marshalling Yards
- Depot
- Alignment
- State Road
- Existing Railway
- Watercourse
- 2km Alignment Corridor
- Waterbody

Exchangeable Sodium Percentage

- No Data
- 0 - 6% (Non-Sodic)
- 6 - 14% (Marginally Sodic to Sodic)
- >14% (Strongly Sodic)

Source: See Copyright Details below and for full disclosure please read Section 18.2 - References in the EIS

1:1,250,000 (at A3)

0 5 10 20 30 40 50

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

HANCOCK PROSPECTING PTY LTD

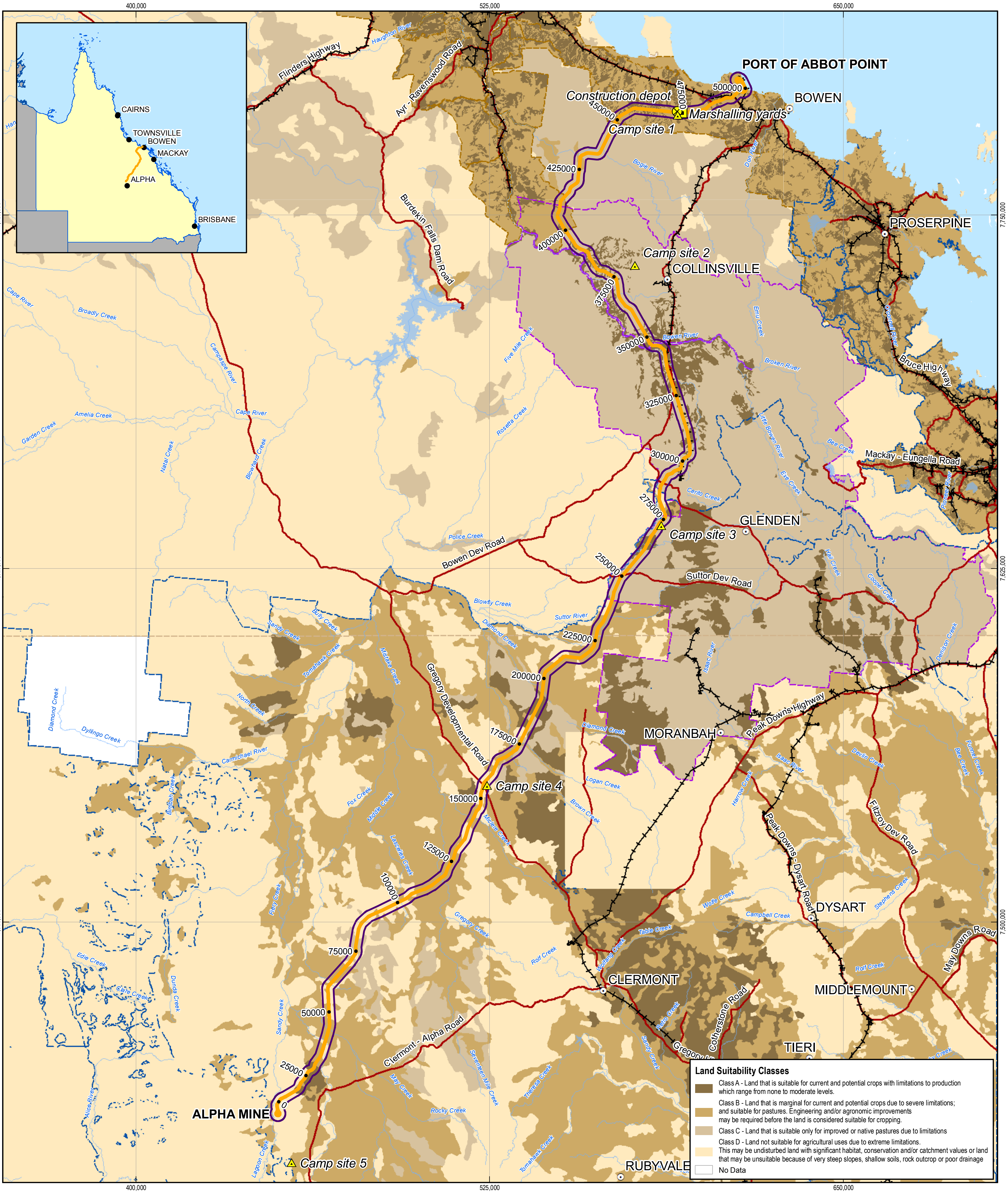
Alpha Coal Project
Environmental Impact Statement

Job Number	41-22090
Revision	A
Date	03-08-2010

EXCHANGEABLE SODIUM PERCENTAGE

Figure: 3

G:\41\22090\GIS\MAPS\MXD\300_Soils_Contamination\41-22090_314_rev_a.mxd



LEGEND

- Town
- Camp
- Marshalling Yards
- Depot
- Proposed Alignment
- State Road
- Existing Railway
- Watercourse
- 2km Alignment Corridor
- Waterbody
- Burdekin Townsville Region
- Lands of the Nagoa Belyando
- Collinsville-Nebo-Moranbah Land Suitability Study Area
- North Queensland Versatile Cropping Land

Source: See Copyright Details below and for full disclosure please read Section 18.2 - References in the EIS

1:1,250,000 (at A3)

0 5 10 20 30 40 50
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Environmental Impact Statement

Job Number	41-22090
Revision	A
Date	03-08-2010

LAND SUITABILITY

Figure: 5

G:\41\22090\GIS\MAPS\MXD\300_Soils_Contamination\41-22090_305_rev_a.mxd

Appendix B

Limitations of ATLAS of Australian Soils Data

TECHNICAL REPORT 94/1992

INTERPRETATIONS OF THE ATLAS OF AUSTRALIAN SOILS

Consulting Report to the Environmental Resources Information Network (ERIN)

N. McKenzie and John Hook

TECHNICAL REPORT 94/1992

INTERPRETATIONS OF THE ATLAS OF AUSTRALIAN SOILS

Consulting Report to the Environmental Resources Information Network (ERIN)

Neil McKenzie
John Hook

CSIRO Division of Soils, Canberra.

INTERPRETATIONS OF THE ATLAS OF AUSTRALIAN SOILS

Consulting Report to the Environmental Resources Information Network (ERIN)

Neil McKenzie
John Hook

INTRODUCTION

The Environmental Resources Information Network (ERIN) contracted the CSIRO Division to provide interpretations of soil types found in the Atlas of Australian Soils. The Division of Soils agreed to undertake the following tasks.

1. Ensure the consistency of soil type descriptions as supplied by the ERIN Unit (derived from the Atlas of Australian Soils Explanatory Notes).

2. Interpret the dominant soil attributes for each Principal Profile Form (PPF) specified in the Atlas of Australian Soils Explanatory Notes and provide estimates of:

- profile permeability;
- profile water holding capacity;
- soil texture profile;
- soil reaction trend (pH);
- gross nutrient status; and
- soil depth

3. Provide broad estimates of the reliability (mean and range) of the interpretations for each polygon.

4. Provide for each soil landscape unit, digital tables of the data in an interchange format agreed between ERIN and CSIRO Division of Soils (e.g. Ingres or Oracle running under Unix).

METHOD

The Atlas of Australian Soils Explanatory Notes provide descriptions of soils for the 3,060 map units defined by the legend of the Atlas Map. Soils are described using the Factual Key of Northcote (1979) at several levels. Most of the 725 profile classes are at the level of Principal Profile Form although a substantial number are at a more generalized level (e.g. Class, Section, Subdivision and in some instances, Division). Fewer interpretations can be made at the more generalized levels. The rating system used for estimating permeability, profile available water capacity, soil texture profile, soil reaction trend, nutrient status and depth for each taxonomic class is presented in Table 1.

In many cases, the taxonomic distinctions made by the Factual Key do not provide a reasonable basis for interpretation. For example, many of the Uc soils vary in depth from less than 0.5m to greater than 1.5m. Interpretations for Depth and Profile Water Holding Capacity are not therefore possible (the latter is strongly determined by depth). A missing value has been recorded wherever reasonable interpretations cannot be made. A missing value has also been recorded when there was insufficient information.
The primary sources of information for the ratings were Northcote *et al.* (1975) and Stace *et al.* (1968). Interpretations of permeability and profile water holding capacity have drawn from Williams (1983), Talsma (unpub. 1980), Talsma (1983), Talsma and Hallam (1981). The ratings for each of the taxa used in the Atlas of Australian Soils Explanatory Notes are presented in Appendix One.

The interpreted values for each class (Appendix One) were used to generate interpretations for each of the mapping units in the Atlas of Australian Soils. The interpreted value of the dominant soil was taken as the interpreted value for the map unit. The range of interpreted values for each mapping unit was generated using the range of the five most common soils in the map unit. The details of the procedure and the tables generated using the Ingres database are described below. The tables and transfer files are available from the authors at the CSIRO Division of Soils, Canberra.

The table *ppfinterp*, with 725 records, was created to hold values listed in Appendix One and the fields are listed in Table 2.

A record was created for each soil type listed in the ERIN table *map_unit_soil*, enabling attribute values to be associated with map units by joining *ppfinterp* to *map_unit_soil* on the soil_type field.

Table 1: Rating system used for interpreting classes from the Factual Key (Northcote 1979)

Permeability

Four classes to provide a crude estimate of saturated hydraulic conductivity of the least permeable horizon in the upper 0.5m. In some duplex soils with deep A horizons, the estimate applies to the top of the B horizon.

1	<5mm day^{-1}	(0.2mm hr^{-1})	Very Slow
2	5-50mm day^{-1}	(0.2-2mm hr^{-1})	Slow
3	50-500mm day^{-1}	(2-21mm hr^{-1})	Moderate
4	>500mm day^{-1}	(>21mm hr^{-1})	Fast

Profile Water Holding Capacity

1	<50 mm	Very Low
2	50-150mm	Low
3	150-250mm	Medium
4	250-350mm	High
5	>350mm	Very High

Soil Texture Profile

1	Uniform Coarse
2	Uniform Medium
3	Uniform Fine
4	Uniform Cracking
5	Gradational calcareous
6	Gradational
7	Duplex

Soil Reaction Class

1	Strongly acid
2	Acid
3	Neutral
4	Alkaline

Gross Nutrient Status

1	Low	Major responses to N, P and K along with most micronutrients
2	Moderate	Responses to N and P with occasional response to some micronutrients
3	High	Responses to N and P uncommon except after intensive farming

Soil Depth

1	<0.5 m	Shallow
2	0.5 - 1.5m	Moderate
3	>1.5m	Deep

Table 2: *ppfinterp* schema.

column name	column datatype	column length
soil_type	CHAR	10
ks	INTEGER	1
pwhc	INTEGER	1
texture	INTEGER	1
srt	INTEGER	1
nutr	INTEGER	1
depth	INTEGER	1

The generation of dominant and range values for each map unit required the original data to be further condensed. In the Atlas, a variety of soils are listed for each mapping unit and codominants rather than dominants are often indicated. The ERIN data recorded this information in two ways:

- with a sequence number corresponding to the order in which soils are mentioned in the Atlas (earlier mention and lower numbers generally indicated greater dominance);
- with a dominant soil type flag marking all soil types described as being the chief soils of the unit.

The averaging of interpreted values for co-dominant soils is not often meaningful and a single dominant value was obtained using the following principles:

- Where the unit was described under the heading of a specific soil type (in the Explanatory Notes and on the Atlas Legend), that type was accorded dominance;
- Where the grouping of mapping units was at a more general taxanomic level (e.g. Gn2 rather than Gn2.11) but under a heading for which an individual record had been or could be defined in the *ppfinterp* table, the more general category was added to the list of types in that unit, and accorded dominance. In many cases this required a re-ordering of the original ERIN data.
- In the few cases left unresolved by the above, the unit description was examined and a dominant type more or less arbitrarily assigned.

The range values were calculated from the first five soil types described in the Atlas. An upper limit of five was selected to counter the tendency for further variation to depend more on the detail of the description than on the actual nature of the unit. To implement this restriction, the ERIN numbers were revised into an ordered sequence from 1 to 5, and these are retained in the final table.

For all attributes except texture, the range has been calculated as a simple difference between maximum and minimum attribute values for the first five types. For texture, in which the numbers identified classes rather than a numeric progression, the range shows the number of distinct texture classes in addition to that of the dominant soil type.

In the course of this analysis, a number of the classifications supplied in the original ERIN data were amended For example, in several instances the first-mentioned soil type was not the dominant soil but instead was at the top of a catenary sequence with the dominant soil occurring in the mid-slope position. In other cases there were sequence number anomalies such as two zero values.

From this information, a table (*erin_final*) showing dominant and range attribute values was created by the application of relational joins and aggregate operators to the basic table. The data are supplied as an ASCII file with character data enclosed in double quotes, and the fields separated by commas. Null values are shown ,, and there is no comma before the first or after the last field. The schema of *erin_final* is presented in Table 3.

Table 3: *erin_final* schema (transfer file: *erin_final.tfr*)

column name	column datatype	column length
map_unit	CHAR	5
soil_type	CHAR	10
ks	INTEGER	1
r_ks	INTEGER	1
pwhc	INTEGER	1
r_pwhc	INTEGER	1
texture	INTEGER	1
r_texture	INTEGER	1
srt	INTEGER	1
r_srt	INTEGER	1
nutr	INTEGER	1
r_nutr	INTEGER	1
depth	INTEGER	1
r_depth	INTEGER	1

Additional tables supplied are as follows:

Revised equivalent to the erin table *map_unit_soil*

In this table all sequence numbers have been condensed, and soil types originally flagged as dominant but for which this classification has been removed, are identified with the upper-case letter O (for original) in the *dominant_soil_type_flag* field (Table 4).

Table 4: *munitsoil* schema (Transfer file: *munitsoil.tfr*)

column_name	column_datatype	column_length
map_unit	CHAR	5
soil_type	CHAR	10
soil_type_seq_nbr	INTEGER	2
dominant_soil_type_flag	CHAR	1

Table of interpretations for each soil type (ppfinterp)

Table 5: *ppfinterp* schema (Transfer file: *ppfinterp.tfr*)

column_name	column_datatype	column_length
soil_type	CHAR	10
ks	INTEGER	1
pwhc	INTEGER	1
texture	INTEGER	1
srt	INTEGER	1
nutr	INTEGER	1
depth	INTEGER	1

Table of references to each map unit in the guidebooks to the Atlas of Australian Soils.

This information greatly facilitates access to all printed references in the Explanatory Notes to any given map unit (Table 6).

Table 6: *atlasref* schema (Transfer file: *atlasref.tfr*)

column_name	column_datatype	column_length
map_unit	CHAR	5
sheet	INTEGER	1
page	INTEGER	2

REFERENCES

Northcote, K. H., Hubble, G. D., Isbell, R. F., Thompson, C. H. and Bettenay, E. (1975). A description of Australian Soils. (CSIRO: Melbourne)

Stace, H. C. T., Hubble, G. D., Brewer, R., Northcote, K. H., Sleeman, J. R., Mulcahy, M. J. and Hallsworth, E. G. (1968). "A Handbook of Australian Soils.", (Rellim: Glenside, S.A.).

Talsma, T. (1983). Soils of the Cotter Catchment Area, A.C.T.: distribution, chemical and physical properties. Aust. J. Soil Res. 21, 241-255.

Talsma, T. and Hallam, P. M. (1980). Hydraulic conductivity measurement of forest catchments. Aust. J. Soil Res. 30, 139-148.

Williams, J. (1983). Physical properties and water relations. In "Soils: an Australian viewpoint." Division of Soils, CSIRO (CSIRO: Melbourne/Academic Press:London)

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
O	-1	-1	-1	-1	-1	-1
Uc1.1	4	-1	1	4	1	-1
Uc1.11	4	-1	1	4	1	-1
Uc1.12	4	-1	1	4	1	-1
Uc1.13	4	-1	1	4	1	-1
Uc1.14	4	-1	1	4	1	-1
Uc1.2	4	-1	1	3	1	3
Uc1.21	4	-1	1	3	1	3
Uc1.22	4	-1	1	3	1	3
Uc1.23	4	-1	1	3	1	3
Uc1.3	4	-1	1	4	1	-1
Uc1.31	4	-1	1	4	1	-1
Uc1.4	4	1	1	-1	1	1
Uc1.41	4	1	1	-1	1	1
Uc1.42	4	1	1	-1	1	1
Uc1.43	4	1	1	-1	1	1
Uc2.1	4	1	1	-1	1	1
Uc2.11	4	1	1	4	1	1
Uc2.12	4	1	1	3	1	1
Uc2.2	4	2	1	2	1	3
Uc2.20	4	2	1	2	1	3
Uc2.21	4	2	1	2	1	3
Uc2.22	4	2	1	2	1	3
Uc2.23	4	2	1	2	1	3
Uc2.3	4	2	1	2	1	3
Uc2.31	4	2	1	2	1	3
Uc2.32	4	2	1	2	1	3
Uc2.33	4	2	1	2	1	3
Uc2.34	4	2	1	2	1	3
Uc2.35	4	2	1	2	1	3
Uc2.36	4	2	1	2	1	3
Uc3.12	3	1	1	3	1	2
Uc3.2	3	-1	1	-1	1	-1
Uc3.21	3	-1	1	-1	1	-1
Uc3.3	3	-1	1	-1	1	-1
Uc3.31	3	-1	1	-1	1	-1
Uc3.32	3	-1	1	-1	1	-1
Uc3.33	3	-1	1	-1	1	-1
Uc4.1	4	1	1	2	1	1
Uc4.11	4	1	1	2	1	1
Uc4.12	4	1	1	2	1	1
Uc4.2	4	1	1	2	1	1
Uc4.21	4	1	1	2	1	1
Uc4.22	4	1	1	2	1	1
Uc4.23	4	1	1	2	1	1
Uc4.24	4	1	1	2	1	1
Uc4.3	4	1	1	2	1	1
Uc4.31	4	1	1	2	1	1
Uc4.32	4	1	1	2	1	1
Uc4.33	4	1	1	2	1	1
Uc5.1	-1	2	1	-1	1	-1
Uc5.11	4	2	1	3	1	-1
Uc5.12	3	2	1	4	1	-1
Uc5.13	3	2	1	3	1	-1
Uc5.2	4	-1	1	-1	1	-1
Uc5.21	4	-1	1	-1	1	-1
Uc5.22	4	-1	1	-1	1	-1
Uc5.23	4	-1	1	-1	1	-1

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
Uc5.3	4	-1	1	-1	1	-1
Uc5.31	4	-1	1	-1	1	-1
Uc5.32	4	-1	1	-1	1	-1
Uc5.4	-1	-1	-1	-1	-1	-1
Uc6.11	4	2	1	3	1	1
Uc6.12	4	2	1	4	1	1
Uc6.13	4	2	1	4	2	1
Uc6.14	4	2	1	3	1	3
Um1.2	4	1	2	4	1	1
Um1.21	4	1	2	-1	1	1
Um1.23	4	1	2	-1	1	1
Um1.3	4	2	2	4	1	1
Um1.32	4	2	2	4	1	1
Um1.4	4	1	2	3	1	1
Um1.41	4	1	2	3	1	1
Um1.42	4	1	2	3	1	1
Um1.43	4	1	2	3	1	1
Um2.12	3	1	2	2	1	1
Um2.2	3	1	2	-1	1	2
Um2.21	3	1	2	2	1	2
Um2.22	3	1	2	-1	1	2
Um2.23	3	1	2	3	1	2
Um2.3	3	1	2	-1	1	-1
Um2.32	3	1	2	3	1	2
Um3.12	3	1	2	4	1	1
Um3.2	3	2	2	3	1	3
Um3.21	3	2	2	3	1	3
Um4.1	3	1	2	2	1	1
Um4.11	3	1	2	2	1	1
Um4.12	3	1	2	2	1	1
Um4.2	3	2	2	2	2	2
Um4.21	3	2	2	2	2	2
Um4.22	3	2	2	2	2	2
Um4.23	3	2	2	2	2	2
Um4.3	3	4	2	3	3	2
Um4.31	3	4	2	3	3	2
Um4.4	4	3	2	2	2	2
Um4.41	4	3	2	2	2	2
Um4.43	4	3	2	2	2	2
Um5.1	3	-1	2	4	1	-1
Um5.11	3	2	2	4	1	1
Um5.12	3	3	2	4	1	2
Um5.2	3	3	2	4	2	2
Um5.22	3	3	2	4	2	2
Um5.3	3	1	2	2	1	1
Um5.31	3	1	2	2	1	1
Um5.4	3	-1	2	3	1	-1
Um5.41	3	1	2	3	1	1
Um5.42	3	2	2	3	1	2
Um5.5	3	-1	2	3	-1	-1
Um5.51	3	1	2	3	1	2
Um5.52	3	3	2	3	2	1
Um5.61	3	1	2	4	1	1

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
Um6	3	-1	2	-1	-1	-1
Um6.1	3	3	2	-1	-1	2
Um6.11	3	3	2	4	3	2
Um6.12	3	3	2	2	2	2
Um6.13	3	3	2	2	2	2
Um6.14	3	3	2	2	2	2
Um6.2	-1	2	2	2	2	1
Um6.21	4	2	2	2	2	1
Um6.22	3	2	2	2	2	1
Um6.23	3	2	2	2	2	1
Um6.24	3	2	2	2	2	1
Um6.3	3	3	2	2	2	2
Um6.31	3	3	2	2	2	2
Um6.32	3	3	2	2	2	2
Um6.33	3	3	2	2	2	2
Um6.34	3	3	2	2	2	2
Um6.4	4	2	2	2	2	1
Um6.41	4	2	2	2	2	1
Um6.42	4	2	2	2	2	1
Um6.43	4	2	2	2	2	1
Um7.11	4	4	2	2	1	3
Um7.12	4	4	2	2	1	2
Uf1.13	2	2	3	4	2	2
Uf1.23	2	2	3	3	2	2
Uf1.3	-1	-1	3	4	-1	-1
Uf1.41	2	1	3	3	1	3
Uf1.42	2	2	3	3	1	1
Uf1.43	2	2	3	3	1	1
Uf4.41	4	3	3	2	1	3
Uf4.43	4	3	3	2	1	3
Uf5	4	-1	3	-1	-1	-1
Uf5.11	4	3	3	-1	-1	3
Uf5.12	4	3	3	-1	-1	3
Uf5.21	4	4	3	2	2	3
Uf5.22	4	4	3	2	3	3
Uf5.23	4	-1	3	2	2	-1
Uf5.31	4	3	3	3	3	2
Uf6	-1	-1	3	-1	-1	-1
Uf6.11	3	2	3	3	2	1
Uf6.12	3	2	3	3	2	1
Uf6.13	3	2	3	3	2	1
Uf6.2	3	-1	3	-1	2	-1
Uf6.21	3	-1	3	3	2	-1
Uf6.22	3	-1	3	2	2	-1
Uf6.23	3	-1	3	3	2	-1
Uf6.3	3	2	3	-1	2	2
Uf6.31	3	2	3	4	2	2
Uf6.32	3	2	3	3	2	2
Uf6.33	3	2	3	3	2	2
Uf6.34	3	2	3	3	2	2
Uf6.4	2	3	3	2	2	3
Uf6.41	2	3	3	2	2	3
Uf6.42	2	3	3	2	2	3
Uf6.5	2	1	3	4	1	2
Uf6.51	2	1	3	4	1	2
Uf6.6	2	2	3	3	1	2
Uf6.61	2	2	3	3	1	2
Uf6.62	2	2	3	3	1	2
Uf6.71	3	2	3	3	1	2

Ug3.2	-1	-1	4	-1	-1	-1
Ug5.1	2	-1	4	-1	2	-1
Ug5.11	2	2	4	4	2	2
Ug5.12	2	2	4	4	2	2
Ug5.13	2	3	4	4	2	2
Ug5.14	2	3	4	4	2	2
Ug5.15	2	3	4	4	2	3
Ug5.16	2	3	4	3	2	3
Ug5.17	2	3	4	4	2	3
Ug5.2	2	2	4	4	2	-1
Ug5.22	2	2	4	4	2	2
Ug5.23	2	2	4	4	2	2
Ug5.24	2	2	4	4	2	3
Ug5.25	2	2	4	4	2	3
Ug5.26	2	2	4	4	2	2
Ug5.27	2	2	4	4	2	2
Ug5.28	2	2	4	4	2	3
Ug5.29	2	2	4	4	2	3
Ug5.3	2	2	4	4	2	-1
Ug5.32	2	2	4	4	2	2
Ug5.33	2	2	4	4	2	2
Ug5.34	2	2	4	4	2	3
Ug5.35	2	2	4	4	2	3
Ug5.37	2	2	4	4	2	2
Ug5.38	2	2	4	4	2	3
Ug5.39	2	2	4	4	2	3
Ug5.4	1	2	4	4	2	3
Ug5.5	1	2	4	4	2	3
Ug5.6	1	2	4	4	2	3
Ug6.1	2	2	4	4	2	3
Ug6.2	2	2	4	4	2	3
Ug6.4	1	2	4	4	2	3
Ug6.5	1	2	4	4	2	3
Gc	-1	2	5	4	-1	2
Gc1	-1	2	5	4	1	2
Gc1.1	2	2	5	4	1	2
Gc1.11	2	2	5	4	1	2
Gc1.12	2	2	5	4	1	2
Gc1.2	3	2	5	4	2	2
Gc1.21	3	2	5	4	2	2
Gc1.22	3	2	5	4	2	2
Gc2.11	3	2	5	4	1	2
Gc2.12	3	2	5	4	1	2
Gc2.21	3	2	5	4	2	2
Gc2.22	3	2	5	4	2	2
Gn1.12	3	2	6	3	1	2
Gn1.13	3	2	6	4	1	2
Gn1.19	-1	-1	6	4	-1	-1
Gn1.83	-1	-1	6	4	-1	-1
Gn1.84	-1	-1	6	2	-1	-1

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
Gn2.1	-1	-1	6	-1	1	3
Gn2.11	4	3	6	2	1	3
Gn2.12	4	3	6	3	1	3
Gn2.13	4	2	6	4	1	3
Gn2.14	3	3	6	2	1	3
Gn2.15	3	3	6	3	1	3
Gn2.16	3	2	6	4	1	3
Gn2.17	3	2	6	2	1	3
Gn2.18	3	2	6	3	1	3
Gn2.19	3	2	6	4	1	3
Gn2.2	3	2	6	-1	1	2
Gn2.21	3	2	6	2	1	2
Gn2.22	3	2	6	3	1	2
Gn2.23	3	2	6	4	1	2
Gn2.24	3	2	6	2	1	2
Gn2.25	3	2	6	3	1	2
Gn2.3	3	2	6	-1	1	2
Gn2.31	3	2	6	2	1	2
Gn2.32	3	2	6	3	1	2
Gn2.34	3	2	6	2	1	2
Gn2.35	3	2	6	3	1	2
Gn2.4	3	2	6	-1	-1	2
Gn2.41	3	2	6	2	1	2
Gn2.42	3	2	6	3	2	2
Gn2.43	3	2	6	4	2	2
Gn2.44	3	2	6	2	1	2
Gn2.45	3	2	6	3	1	2
Gn2.46	3	2	6	4	1	2
Gn2.51	3	2	6	2	1	2
Gn2.52	3	2	6	3	1	2
Gn2.53	3	2	6	4	1	2
Gn2.54	3	2	6	3	1	2
Gn2.55	3	2	6	4	1	2
Gn2.6	3	2	6	-1	1	2
Gn2.61	3	2	6	2	1	2
Gn2.62	3	2	6	3	1	2
Gn2.63	3	2	6	4	1	2
Gn2.64	3	2	6	2	1	2
Gn2.65	3	2	6	3	1	2
Gn2.7	4	2	6	-1	1	2
Gn2.71	4	2	6	2	1	2
Gn2.72	4	2	6	3	1	2
Gn2.74	4	2	6	2	1	2
Gn2.75	4	2	6	3	1	2
Gn2.8	3	2	6	-1	1	-1
Gn2.81	3	2	6	2	1	-1
Gn2.82	3	2	6	3	1	-1
Gn2.83	3	2	6	4	1	-1
Gn2.84	3	2	6	2	1	-1
Gn2.85	3	2	6	3	1	-1
Gn2.9	3	2	6	-1	1	-1
Gn2.91	3	2	6	2	1	-1
Gn2.92	3	2	6	3	1	-1
Gn2.93	3	2	6	4	1	-1
Gn2.94	3	2	6	2	1	-1
Gn2.95	3	2	6	3	1	-1
Gn2.96	3	2	6	4	1	-1

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
Gn3.0	-1	2	6	-1	1	2
Gn3.01	3	2	6	2	1	2
Gn3.02	3	2	6	3	1	2
Gn3.03	3	2	6	4	1	2
Gn3.04	2	2	6	2	1	2
Gn3.05	2	2	6	3	1	2
Gn3.06	2	2	6	4	1	2
Gn3.1	4	-1	6	-1	-1	-1
Gn3.10	4	4	6	1	3	3
Gn3.11	4	4	6	2	3	3
Gn3.12	4	4	6	3	2	3
Gn3.13	4	3	6	4	2	3
Gn3.14	4	3	6	2	2	-1
Gn3.15	4	3	6	3	2	-1
Gn3.16	4	3	6	4	2	-1
Gn3.2	3	2	6	-1	2	2
Gn3.21	3	2	6	2	2	2
Gn3.22	3	2	6	3	2	2
Gn3.23	3	2	6	4	2	2
Gn3.24	3	2	6	2	2	2
Gn3.25	3	2	6	3	2	2
Gn3.32	3	2	6	3	2	2
Gn3.34	3	2	6	2	2	2
Gn3.4	3	2	6	-1	-1	2
Gn3.41	3	2	6	2	3	2
Gn3.42	3	2	6	3	3	2
Gn3.43	3	2	6	4	3	2
Gn3.45	3	2	6	3	2	2
Gn3.46	3	2	6	4	2	2
Gn3.49	3	2	6	4	2	2
Gn3.5	4	2	6	-1	2	2
Gn3.51	4	2	6	2	2	2
Gn3.52	4	2	6	3	2	2
Gn3.53	4	2	6	4	2	2
Gn3.54	4	2	6	2	2	2
Gn3.56	4	2	6	4	2	2
Gn3.6	3	2	6	2	2	2
Gn3.61	3	2	6	2	2	2
Gn3.64	3	2	6	2	2	2
Gn3.7	4	2	6	-1	2	2
Gn3.71	4	2	6	2	2	2
Gn3.72	4	2	6	3	2	2
Gn3.73	4	2	6	4	2	2
Gn3.74	4	2	6	2	2	2
Gn3.75	4	2	6	3	2	2
Gn3.8	3	2	6	-1	1	3
Gn3.81	3	2	6	2	1	3
Gn3.82	3	2	6	3	1	3
Gn3.83	3	2	6	4	1	3
Gn3.84	3	2	6	2	1	3
Gn3.85	3	2	6	3	1	3
Gn3.9	-1	2	6	-1	2	2
Gn3.90	4	2	6	1	2	2
Gn3.91	4	2	6	2	2	2
Gn3.92	4	2	6	3	2	2
Gn3.93	4	2	6	4	2	2
Gn3.94	3	2	6	2	2	2
Gn3.95	3	2	6	3	2	2
Gn3.96	3	2	6	4	2	2

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
Gn4.1	4	-1	6	-1	2	-1
Gn4.11	4	3	6	2	2	3
Gn4.12	4	3	6	3	2	3
Gn4.13	4	1	6	4	2	1
Gn4.14	4	3	6	2	2	3
Gn4.3	4	-1	6	-1	2	-1
Gn4.31	4	3	6	2	2	3
Gn4.32	4	3	6	3	2	3
Gn4.33	4	1	6	4	2	1
Gn4.34	4	3	6	2	2	3
Gn4.4	4	2	6	-1	3	2
Gn4.41	4	2	6	2	3	2
Gn4.42	4	2	6	3	3	2
Gn4.5	3	-1	6	-1	2	-1
Gn4.51	3	-1	6	2	2	-1
Gn4.52	3	-1	6	3	2	-1
Gn4.54	3	-1	6	2	2	-1
Gn4.64	3	-1	6	2	2	-1
Dr	-1	-1	7	-1	-1	2
Dr1	-1	2	7	-1	2	2
Dr1.12	2	2	7	3	2	2
Dr1.13	2	2	7	4	2	2
Dr1.16	2	2	7	4	2	2
Dr1.3	3	2	7	-1	2	2
Dr1.31	3	2	7	2	2	2
Dr1.32	3	2	7	3	2	2
Dr1.33	3	2	7	4	2	2
Dr1.42	3	2	7	3	2	2
Dr1.43	2	2	7	4	2	2
Dr1.73	2	2	7	4	2	2
Dr1.82	2	2	7	3	2	2
Dr1.83	2	2	7	4	2	2
Dr2.1	-1	3	7	-1	2	2
Dr2.11	4	3	7	2	2	2
Dr2.12	4	3	7	3	2	2
Dr2.13	3	3	7	4	2	2
Dr2.2	-1	-1	7	-1	2	2
Dr2.21	3	3	7	2	2	2
Dr2.22	2	3	7	3	2	2
Dr2.23	2	2	7	4	2	2
Dr2.31	3	3	7	2	2	2
Dr2.32	3	2	7	3	2	2
Dr2.33	2	2	7	4	2	2
Dr2.4	-1	-1	7	-1	-1	2
Dr2.41	2	3	7	2	2	2
Dr2.42	2	2	7	3	2	2
Dr2.43	1	2	7	4	1	2
Dr2.51	3	2	7	2	2	2
Dr2.52	3	2	7	3	2	2
Dr2.53	3	2	7	4	2	2
Dr2.61	3	2	7	2	2	2
Dr2.62	3	2	7	3	2	2
Dr2.63	2	2	7	4	2	2
Dr2.71	3	2	7	2	2	2
Dr2.72	3	2	7	3	2	2
Dr2.73	2	2	7	4	2	2

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
Dr2.81	3	2	7	2	2	2
Dr2.82	2	2	7	3	2	2
Dr2.83	2	1	7	4	1	2
Dr3	-1	-1	7	-1	-1	2
Dr3.11	3	2	7	2	2	2
Dr3.12	3	2	7	3	2	2
Dr3.13	2	2	7	4	2	2
Dr3.21	3	2	7	2	2	2
Dr3.22	3	2	7	3	2	2
Dr3.23	2	2	7	4	2	2
Dr3.3	-1	2	7	-1	-1	2
Dr3.31	3	2	7	2	2	2
Dr3.32	2	2	7	3	2	2
Dr3.33	2	2	7	4	1	2
Dr3.4	2	-1	7	-1	-1	2
Dr3.41	2	2	7	2	2	2
Dr3.42	2	2	7	3	2	2
Dr3.43	2	1	7	4	1	2
Dr3.51	-1	-1	7	2	-1	2
Dr3.61	-1	-1	7	2	-1	2
Dr3.62	-1	-1	7	3	-1	2
Dr3.71	-1	-1	7	2	-1	2
Dr3.72	-1	-1	7	3	-1	2
Dr3.73	-1	-1	7	4	-1	2
Dr3.81	-1	-1	7	2	-1	2
Dr3.83	-1	-1	7	4	-1	2
Dr4.1	4	3	7	-1	3	2
Dr4.11	4	3	7	2	3	2
Dr4.12	4	3	7	3	3	2
Dr4.13	4	3	7	4	3	2
Dr4.2	4	3	7	-1	2	2
Dr4.21	4	3	7	2	2	2
Dr4.22	4	3	7	3	2	2
Dr4.23	4	3	7	4	2	2
Dr4.33	4	3	7	4	2	2
Dr4.41	4	2	7	2	2	2
Dr4.42	4	2	7	3	2	2
Dr4.43	4	2	7	4	2	2
Dr4.53	4	3	7	4	2	2
Dr4.61	4	3	7	2	2	2
Dr4.63	4	3	7	4	2	2
Dr4.72	4	3	7	3	2	2
Dr4.73	4	3	7	4	2	2
Dr4.81	4	3	7	2	2	2
Dr4.82	4	3	7	3	2	2
Dr5.11	4	2	7	2	2	2
Dr5.12	4	2	7	3	2	2
Dr5.21	3	2	7	2	2	2
Dr5.23	3	2	7	4	2	2
Dr5.32	3	2	7	3	2	2
Dr5.33	3	2	7	4	2	2
Dr5.41	3	2	7	2	2	2
Dr5.42	3	2	7	3	2	2
Dr5.43	3	2	7	4	2	2
Dr5.62	3	2	7	3	2	2
Dr5.8	-1	2	7	-1	2	2
Dr5.81	3	2	7	2	2	2

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
Db1.1	1	2	7	-1	1	2
Db1.11	3	2	7	2	1	2
Db1.12	3	2	7	3	1	2
Db1.13	3	2	7	4	1	2
Db1.2	3	3	7	-1	2	2
Db1.21	3	3	7	2	2	2
Db1.22	3	3	7	3	2	2
Db1.23	3	3	7	4	2	2
Db1.3	2	2	7	-1	1	2
Db1.31	2	2	7	2	1	2
Db1.32	2	2	7	3	1	2
Db1.33	2	2	7	4	1	2
Db1.4	-1	2	7	-1	1	2
Db1.41	2	2	7	2	1	2
Db1.42	2	2	7	3	1	2
Db1.43	1	2	7	4	1	2
Db1.52	2	2	7	3	1	2
Db1.61	2	2	7	2	1	2
Db1.62	2	2	7	3	1	2
Db1.81	1	2	7	2	1	2
Db2.1	-1	2	7	-1	2	2
Db2.12	3	2	7	3	2	2
Db2.13	2	2	7	4	2	2
Db2.2	2	2	7	-1	2	2
Db2.21	2	2	7	2	2	2
Db2.22	2	2	7	3	2	2
Db2.31	2	2	7	2	1	2
Db2.32	2	2	7	3	1	2
Db2.33	1	2	7	4	1	2
Db2.4	-1	2	7	-1	1	2
Db2.41	2	2	7	2	1	2
Db2.42	1	2	7	3	1	2
Db2.43	1	2	7	4	1	2
Db3.1	4	2	7	-1	2	2
Db3.11	4	2	7	2	2	2
Db3.12	4	2	7	3	2	2
Db3.13	4	2	7	4	2	2
Db3.2	4	2	7	-1	2	2
Db3.21	4	2	7	2	2	2
Db3.22	4	2	7	3	2	2
Db3.23	4	2	7	4	2	2
Db3.32	3	2	7	3	2	2
Db3.41	3	2	7	2	2	2
Db3.43	3	2	7	4	2	2
Db4.1	3	2	7	-1	2	2
Db4.11	3	2	7	2	2	2
Db4.13	3	2	7	4	2	2
Db4.21	3	2	7	2	2	2
Db0.33	1	2	7	4	1	2
Db0.43	1	2	7	4	1	2
Dy1.13	2	2	7	4	2	2
Dy1.32	2	2	7	3	2	2
Dy1.33	1	1	7	4	1	2
Dy1.43	1	1	7	4	1	2
Dy1.63	2	2	7	4	1	2

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
Dy2.1	-1	2	7	-1	2	2
Dy2.11	3	2	7	2	2	2
Dy2.12	3	2	7	3	2	2
Dy2.13	2	2	7	4	2	2
Dy2.2	2	2	7	-1	2	2
Dy2.21	2	2	7	2	2	2
Dy2.22	2	2	7	3	2	2
Dy2.23	2	2	7	4	2	2
Dy2.3	-1	-1	7	-1	-1	2
Dy2.31	2	2	7	2	1	2
Dy2.32	1	2	7	3	2	2
Dy2.33	1	1	7	4	2	2
Dy2.4	-1	-1	7	-1	1	2
Dy2.41	2	2	7	2	1	2
Dy2.42	1	2	7	3	1	2
Dy2.43	1	1	7	4	1	2
Dy2.5	3	2	7	-1	1	3
Dy2.51	3	2	7	2	1	3
Dy2.52	3	2	7	3	1	3
Dy2.61	2	2	7	2	1	3
Dy2.62	2	2	7	3	1	3
Dy2.71	2	2	7	2	1	3
Dy2.73	1	2	7	4	1	3
Dy2.8	-1	-1	7	-1	1	-1
Dy2.81	2	2	7	2	1	3
Dy2.82	2	2	7	3	1	3
Dy2.83	1	1	7	4	1	3
Dy2.84	2	1	7	2	1	2
Dy3.1	-1	2	7	-1	2	2
Dy3.11	3	2	7	2	2	2
Dy3.12	3	2	7	3	2	2
Dy3.13	2	2	7	4	2	2
Dy3.2	-1	2	7	-1	2	2
Dy3.21	3	2	7	2	2	2
Dy3.22	3	2	7	3	2	2
Dy3.23	2	2	7	4	2	2
Dy3.3	-1	-1	7	-1	1	2
Dy3.31	2	2	7	2	1	2
Dy3.32	2	2	7	3	1	2
Dy3.33	1	1	7	4	1	2
Dy3.4	1	1	7	-1	1	2
Dy3.41	1	1	7	2	1	2
Dy3.42	1	1	7	3	1	2
Dy3.43	1	1	7	4	1	2
Dy3.53	3	2	7	4	1	2
Dy3.6	2	2	7	-1	1	2
Dy3.61	2	2	7	2	1	2
Dy3.62	2	2	7	3	1	2
Dy3.63	2	2	7	4	1	2
Dy3.71	2	2	7	2	1	2
Dy3.73	2	2	7	4	1	2
Dy3.8	-1	-1	7	-1	1	2
Dy3.81	2	2	7	2	1	2
Dy3.82	2	2	7	3	1	2
Dy3.83	1	2	7	4	1	2
Dy3.84	2	1	7	2	1	2
Dy3.85	1	1	7	3	1	2

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
Dy4.1	3	2	7	-1	2	2
Dy4.11	3	2	7	2	2	2
Dy4.12	3	2	7	3	2	2
Dy4.13	3	2	7	4	2	2
Dy4.21	3	2	7	2	2	2
Dy4.22	3	2	7	3	2	2
Dy4.23	2	2	7	4	2	2
Dy4.32	2	2	7	3	2	2
Dy4.33	2	2	7	4	2	2
Dy4.41	2	2	7	2	2	2
Dy4.42	2	2	7	3	2	2
Dy4.43	2	2	7	4	2	2
Dy4.51	2	2	7	2	2	2
Dy4.61	2	2	7	2	2	2
Dy4.81	2	1	7	2	1	2
Dy4.83	1	1	7	4	1	2
Dy5.1	3	2	7	-1	2	2
Dy5.11	3	2	7	2	2	2
Dy5.12	3	2	7	3	2	2
Dy5.2	-1	2	7	-1	2	2
Dy5.21	2	2	7	2	2	2
Dy5.22	3	2	7	3	2	2
Dy5.23	2	2	7	4	2	2
Dy5.3	-1	-1	7	-1	1	2
Dy5.31	2	2	7	2	1	2
Dy5.32	1	2	7	3	1	2
Dy5.33	1	1	7	4	1	2
Dy5.4	1	-1	7	-1	1	2
Dy5.41	1	2	7	2	1	2
Dy5.42	1	2	7	3	1	2
Dy5.43	1	1	7	4	1	2
Dy5.51	3	2	7	2	1	2
Dy5.6	2	2	7	-1	1	2
Dy5.61	2	2	7	2	1	2
Dy5.62	2	2	7	3	1	2
Dy5.63	2	2	7	4	1	2
Dy5.71	2	2	7	2	1	2
Dy5.8	-1	2	7	-1	1	3
Dy5.81	3	2	7	2	1	3
Dy5.82	2	2	7	3	1	3
Dy5.83	2	2	7	4	1	3
Dy5.84	2	2	7	2	1	3
Dy5.91	-1	-1	-1	-1	-1	-1
Dd.1.1	-1	2	7	-1	2	2
Dd1.11	3	2	7	2	2	2
Dd1.12	3	2	7	3	2	2
Dd1.13	2	2	7	4	2	2
Dd1.2	2	2	7	-1	2	2
Dd1.21	2	2	7	2	2	2
Dd1.22	2	2	7	3	2	2
Dd1.23	2	2	7	4	2	2
Dd1.3	-1	2	7	-1	1	2
Dd1.31	2	2	7	2	1	2
Dd1.32	2	2	7	3	1	2
Dd1.33	1	2	7	4	1	2

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth
Dd1.4	-1	-1	7	-1	1	2
Dd1.41	2	2	7	2	1	2
Dd1.42	1	2	7	3	1	2
Dd1.43	1	1	7	4	1	2
Dd1.52	2	2	7	3	2	2
Dd1.81	2	2	7	2	1	2
Dd2.11	2	2	7	2	2	2
Dd2.12	2	2	7	3	2	2
Dd2.13	2	2	7	4	2	2
Dd2.2	2	2	7	-1	-1	2
Dd2.22	2	2	7	3	2	2
Dd2.31	2	2	7	2	1	2
Dd2.32	2	2	7	3	1	2
Dd2.33	1	2	7	4	1	2
Dd2.41	2	2	7	2	1	2
Dd2.42	2	2	7	3	1	2
Dd2.43	1	1	7	4	1	2
Dd3.1	-1	2	7	-1	2	2
Dd3.11	3	2	7	2	2	2
Dd3.12	3	2	7	3	2	2
Dd3.13	2	2	7	4	2	2
Dd3.21	2	2	7	2	2	2
Dd3.32	2	2	7	3	1	2
Dd3.33	1	2	7	4	1	2
Dd3.42	1	2	7	3	1	2
Dd3.43	1	1	7	4	1	2
Dd3.51	3	2	7	2	2	2
Dd4.13	2	2	7	4	2	2
Dd4.23	2	2	7	4	2	2
Dd4.43	1	1	7	4	1	2
Dd4.63	2	2	7	4	1	2
Dg1.41	2	2	7	2	1	3
Dg1.43	1	2	7	4	1	3
Dg1.81	2	2	7	2	1	3
Dg2.21	2	2	7	2	1	3
Dg2.31	2	2	7	2	1	3
Dg2.41	2	2	7	2	1	3
Dg2.42	2	2	7	3	1	3
Dg2.43	1	2	7	4	1	3
Dg2.63	1	2	7	4	1	3
Dg2.81	2	2	7	2	1	3
Dg2.82	2	2	7	3	1	3
Dg2.83	1	2	7	4	1	3
Dg3.43	1	2	7	4	1	3
Dg3.81	2	2	7	2	1	3
Dg4.11	2	2	7	2	1	3
Dg4.13	1	2	7	4	1	3
Dg4.21	2	2	7	2	1	3
Dg4.31	2	2	7	2	1	3
Dg4.41	2	2	7	2	1	3
Dg4.42	2	2	7	3	1	3
Dg4.43	1	2	7	4	1	3
Dg4.8	2	2	7	2	1	2
Dg4.81	2	2	7	2	1	2

PPF	Ks	PWHC	Texture	SRT	Nutr.	Depth	
K-Dy2.21	3	1	7	2	1	2	
K-Gn2.1	-1	-1	6	-1	1	3	
K-Gn2.11	4	2	6	2	1	3	
K-Gn2.12	4	2	6	3	1	3	
K-Uc1	4	-1	1	-1	1	-1	
K-Uc1.21	4	-1	1	3	1	3	
K-Uc1.22	4	-1	1	3	1	3	
K-Uc1.23	4	-1	1	3	1	3	
K-Uc1.4	4	1	1	-1	1	1	
K-Uc1.43	4	1	1	-1	1	1	
K-Uc4.1	4	1	1	2	1	1	
K-Uc4.2	4	1	1	2	1	1	
K-Uc4.22	4	1	1	2	1	1	
K-Uc5.11	4	1	1	3	1	-1	
K-Uc5.21	4	-1	1	-1	1	-1	
K-Um	-1	-1	2	-1	-1	-1	
K-Um1.4	4	1	2	3	1	1	
K-Um1.42	4	1	2	3	1	1	
K-Um1.43	4	1	2	3	1	1	
K-Um4.2	3	1	2	2	1	2	
K-Um5.51	3	1	2	3	1	2	
K-Um6.24	3	1	2	2	1	1	
KS-Dr2.62	3	1	7	3	1	2	
KS-Dr5.81	3	1	7	2	1	2	
KS-Dy2.62	2	1	7	3	1	3	
KS-Dy3.62	2	1	7	3	1	2	
KS-Dy5.81	3	1	7	2	1	3	
KS-Gn2.1	-1	-1	6	-1	1	3	
KS-Gn2.11	4	2	6	2	1	3	
KS-Gn2.12	4	2	6	3	1	3	
KS-Gn2.21	3	1	6	2	1	2	
KS-Gn2.22	3	1	6	3	1	2	
KS-Gn2.24	3	1	6	2	1	2	
KS-Gn2.42	3	1	6	3	1	2	
KS-Gn3.12	4	2	6	3	1	3	
KS-Uc	4	-1	1	-1	1	-1	
KS-Uc1.2	4	-1	1	3	1	3	
KS-Uc1.23	4	-1	1	3	1	3	
KS-Uc1.4	4	1	1	-1	1	1	
KS-Uc1.41	4	1	1	-1	1	1	
KS-Uc1.43	4	1	1	-1	1	1	
KS-Uc2.12	4	1	1	3	1	1	
KS-Uc2.2	4	1	1	2	1	3	
KS-Uc4	4	1	1	2	1	1	
KS-Uc4.1	4	1	1	2	1	1	
KS-Uc4.11	4	1	1	2	1	1	
KS-Uc4.12	4	1	1	2	1	1	
KS-Uc4.2	4	1	1	2	1	1	
KS-Uc5.21	4	-1	1	-1	1	-1	
KS-Uc5.22	4	-1	1	-1	1	-1	
KS-Um5.51		3	1	2	4	1	1

SOME LIMITATIONS OF THE ATLAS OF AUSTRALIAN SOILS AND ITS ASSOCIATED INTERPRETATIONS

NOTES COMPILED BY NEIL MCKENZIE: December 4, 1992

The Division of Soils has prepared a database table to be used with the Digital Atlas of Australian Soils. The table provides simple interpretations of the permeability, water holding capacity, soil texture profile, soil reaction trend, gross nutrient status and soil depth for each Atlas mapping unit. A range and dominant value is presented for each unit. Details of the rating scheme are presented in an unpublished Technical Report (McKenzie and Hook 1992).

These notes have been prepared to encourage sensible use of the data and to describe some of the inherent limitations of the Atlas.

1. The quality of the Atlas mapping varies substantially and an indication of reliability is provided with the original explanatory notes published during the 1960s: it should be heeded.

2. The dominant soil for each unit may occupy a very limited area (perhaps 20%) within that unit. Any analysis based on an interpretation of the dominant soil is therefore of restricted value.

3. It is normal for there to be a very large variation within each map unit. Some units have up to 20 soils listed. It is common for the within unit variation to be as great as the between unit variation - this is an inescapable problem with reconnaissance scale soil mapping.

4. As a consequence, it is essential to use the *range* of soils and their interpreted values when making judgements on soil character and behaviour for any area. Many ranges are presented as missing or null values because reasonable interpretations cannot be made.

5. Many landscape processes (e.g. erosion, salinization etc) do not correlate in a simple way (if at all) with the Atlas units because the description of soils is based on profile morphology. Profile morphology may have a poor or complex relationship with soil processes. Furthermore, landscape processes require far more information before even synoptic predictions can be made.

6. The spatial arrangement of soils within a landscape may have an overriding impact on landscape processes (e.g. erodible soils along streambanks). The Digital Atlas and its associated tables provide no information on spatial arrangement.

7. The interpretations have been prepared using published information supported by limited first hand experience. The interpretations will be revised in the near future. In the interim, they should be treated with an appropriate level of scepticism.

Neil McKenzie.

CONVERSION OF THE ATLAS OF AUSTRALIAN SOILS TO THE AUSTRALIAN SOIL CLASSIFICATION

Linda Ashton, Neil McKenzie
CSIRO Land & Water, GPO Box 1666, Canberra, ACT
May 2001

Introduction

The Atlas of Australian Soils (Northcote et. al. 1968) was produced between 1960 and 1968. There are 3060 unique mapping units, describing 22 560 polygons, which are defined on the basis of soil, landform, parent material and vegetation. Within each unit, dominant and subdominant soil types have been presented, using the Northcote Principal Profile Form (PPF). Some units have as many as 28 PPF's recorded. McKenzie and Hook (1992) used the descriptions to identify a dominant PPF for each of the Atlas mapping units. This has enabled interpretative information (eg. soil texture) to be linked to the Atlas to produce broad scale spatial estimates across Australia. A provisional correlation table between Atlas Mapping Units and Soil Orders in the Australian Soil Classification has been prepared recently.

The ASC Look Up Table (LUT) was developed in conjunction with Concepts and Rationale of the Australian Soil Classification (Isbell et al 1996). The purpose of the table was to enable plots of the distributions of the ASC orders to be created with an estimate of the area of each order, and used to enhance descriptions of the "General Occurrence and Environment" of each Order.

Method

In 1994, Graham Murtha and Warwick McDonald (CSIRO Division of Soils) began the development of a translation of the Principal Profile Forms (PPF) listed as dominant in the Atlas, to the new Australian Soil Classification (ASC). The translation and subsequent LUT attempted to identify the ASC, down to the suborder level, with an estimate of the accuracy based on the number of PPF's listed for each map unit. This table formed the basis for the Isbell et al (1996) ASC table, which has developed further, to rely more on the full descriptions and personal experience within some areas.

Ray Isbell used plots created from the Murtha/McDonald table, at a scale of 1:23 000 000, to locate areas where, from his personal experience, there was some doubt in the translation. Using the original Atlas maps (1:2 000 000), Isbell identified the mapping units in question and referred back to the full unit descriptions. In some cases, the PPF designated as dominant did not appear appropriate, was not defined clearly enough or was too ambiguous to make a translation (eg. Red Duplex soils (Dr) span several orders). Previous experience and the unit descriptions allowed an acceptable estimate to be made. Many iterations of this process were carried out during 1995/96, before final distribution plots were accepted and used as an aid to describing the occurrence of the new soil classification orders (Isbell et al 1996).

Limitations

Knowledge of the methods used to create the Atlas of Australian Soils is necessary to appreciate limitations of the new coverage predicting the dominant ASC Order. The accuracy of the conversion of the dominant PPF's in the Atlas to the ASC is further constrained by the following.

- The accuracy of the conversion varies spatially and depends on the quality of published information in each region and personal experience of contributing authors (primarily Ray Isbell).

- Plots at a scale of 1:23 million were used to verify the accuracy of the table. Application of the ASC LUT at larger scales will not be reliable.

- The table is based on the assumption that each PPF thought to be dominant in an Atlas polygon can be readily equated with a particular ASC order. This is a false premise in a number of instances and other assumptions have to be made – for example, sodicity (ESP) is not used in the Factual Key (and hence not in the Atlas) so the identification of Sodosols has to be based on morphological criteria – in this case a useful guide is the presence of a strongly bleached A2 horizon overlying a clay subsoil B horizon.

- PPF's listed for each of the mapping units in the ASC LUT do not necessarily agree with those previously identified as being dominant (eg. in McKenzie & Hook 1991)

- The quality of the original Atlas mapping varies substantially and an indication of reliability is provided with the original explanatory notes published during the 1960's: it should be heeded.

- The dominant soil for each map unit may occupy a very limited area (perhaps 20%) within that unit. Any analysis based on an interpretation of the dominant soil is therefore of restricted value.

- It is normal for there to be a very large variation within each map unit. Some units have up to 20 soils listed. It is common for the within unit variation to be as great as the between unit variation – this is an inescapable problem with reconnaissance scale soil mapping.

SOME LIMITATIONS OF THE ATLAS OF AUSTRALIAN SOILS AND ITS ASSOCIATED INTERPRETATIONS

NOTES COMPILED BY NEIL MCKENZIE: DECEMBER 4, 1992

The Division of Soils has prepared a database table to be used with the Digital Atlas of Australian Soils. The table provides simple interpretations of the permeability, water holding capacity, soil texture profile, soil reaction trend, gross nutrient status and soil depth for each Atlas mapping unit. A range and dominant value is presented for each unit. Details of the rating scheme are presented in an unpublished Technical Report (McKenzie and Hook 1992).

These notes have been prepared to encourage sensible use of the data and to describe some of the inherent limitations of the Atlas.

1. The quality of the Atlas mapping varies substantially and an indication of liveability is provided with the original explanatory notes published during the 1960's: it should be heeded.

2. The dominant soil fro each unit may occupy a very limited area (perhaps 20%) within that unit. Any analysis based on an interpretation of the dominant soil is therefore of restricted value.

3. It is normal for there to be a very large variation within each map unit. Some units have up to 20 soils listed. It is common for the within unit variation to be as great as the between unit variation - this is an inescapable problem with reconnaissance scale soil mapping.

4. As a consequence, it is essential to use the range of soils and their interpreted values when making judgements on soil character and behaviour for any area. Many ranges are presented as missing or null values because reasonable interpretations cannot be made.

5. Many landscape processes (e.g. erosion, salinization etc.) don not correlate in a simple way (if at all) with the Atlas units because the description of soils is based on profile morphology. Profile morphology may have a poor or complex relationship with soil processes. Furthermore, landscape processes required far more information before even synoptic predictions can be made.

6. The spatial arrangement of soils within a landscape may have an overriding impact on landscape processes (e.g. erodible soils along stream banks). The Digital Atlas and its associated tables provide no information on spatial arrangement.

7. The interpretations have been prepared using published information supported by limited first hand experience. The interpretations will be revised in the near future. In the interim, they should be treated with an appropriated level of scepticism.

Neil McKenzie.

Appendix C

Australian Soil Classification Descriptions

ASC Soil Groups and Descriptions

Australian Soil Classification	Brief Description
Dermosol	The Dermosols lack a strong texture contrast between the A and B horizons, but they do have moderately to strongly structured B2 horizons. The profiles have less than five percent free ferric oxide and are not calcareous throughout, thereby distinguishing them from Ferrosols and Calcareous, respectively.
Hydrosol	Saturated for 2-3 months or more due to the site conditions or tidal influence
Sodosol	Sod sols are characterized by a strong texture contrast between the A horizon and B horizon. Invariably the A2 horizon is bleached and the B horizon is sodic (an ESP of 6 or greater) and often mottled, indicating a major change in permeability between the A2 and B2 horizons, caused primarily by the dispersive nature of the sodic clay.
Chromosol	The dominant feature of Chromosols is the strong texture contrast between the topsoil (A horizon) and subsoil (B horizon). If thick topsoils are present, the lower portion may be bleached (an A_2 horizon) and the degree of bleaching relates directly to the difference in permeability between the A and B horizons. The B horizon can be neutral to alkaline (pH >5.5) but the upper B horizon must not be sodic (Exchangeable Sodium Percentage, ESP <6).
Rudosols	The Rudosols are distinguished from other soils by the complete lack of horizon development, other than the accumulation of organic matter in the A1 horizon. The soils are so young, or conditions have been such, that soil-forming factors have not significantly modified the colour, texture, or structure of the parent material. If the profile is calcareous it is because the parent material is calcareous, not because pedogenesis has concentrated carbonate in any specific horizons.
Tenosols	Tenosols have poor water retention which means they have a low fertility, and occur in regions with low or erratic rainfall. They are mainly used for the grazing of native pastures
Kandosols	Kandosols lack a strong texture contrast between horizons, usually showing gradual increases in texture in gradational-textured profiles, and have massive or only weakly structured B horizons with a clay content exceeding 15 percent. They do not have tenic (well-defined) B horizons and are not calcareous throughout. The mineralogy is dominated by quartz, kaolin, and iron oxides and hydroxides, and the natural fertility
Vertosols	The Vertosols have several clearly developed features, they have a uniform clay texture throughout the profile, shrink-swell properties that cause the soil to shrink and develop large cracks when dry, but swell and close up to form a tight impermeable mass when wet and slickenside's (smooth surfaces on the faces of 'peds' or soil aggregates indicating that blocks of soil have moved past one another) and large lenticular structures at depth that provide evidence of the shrink-swell process.

Appendix D

EMR Listed Properties Search Receipts

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1219881 EMR Site Id: 39475 19 April 2010
This response relates to a search request received for the site:
Lot: 4 Plan: SP137517

EMR RESULT

The above site IS included on the Environmental Management Register.
The site you have searched has been subdivided from the following site, which is included on the EMR. Subdivided new parcels will remain on the EMR unless it can be shown that they are not located near the contaminating activity.

Lot: 4 Plan: BL51
Address: "AMAROO" - GOLDEN DOWNS ROAD
CLERMONT 4721

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
LIVESTOCK DIP OR SPRAY RACE - operating a livestock dip or spray race facility.

For the majority of rural properties only a small area may be affected by the chemicals used in livestock dips and spray races. The EPA may hold further information relating to the location of the dip site within this property.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1219903 EMR Site Id: 14851 19 April 2010
This response relates to a search request received for the site:
Lot: 4 Plan: DK264

EMR RESULT

The above site IS included on the Environmental Management Register.
Lot: 4 Plan: DK264
Address: COLLINSVILLE-NEBO ROAD
NEBO 4804

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
MINERAL PROCESSING - chemically or physically extracting or processing metalliferous ores.

While sites are listed on the EMR using the lot and plan description, a mining lease may affect only a limited area of the lot. In many instances with rural properties, only a small area may be potentially affected by the mining activities and the ongoing landuse is unaffected. More detailed information relating to the location of the mining activities may be held by the EPA or the Department of Natural Resources and Mines.

EXPLOSIVES PRODUCTION OR STORAGE - operating a factory under the *Explosives Act 1952.*
PETROLEUM PRODUCT OR OIL STORAGE - storing petroleum products or oil -
(a) in underground tanks with more than 200L capacity; or
(b) in above ground tanks with -
for petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code - more than 2, 500L capacity; or
for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code - more than 5, 000L capacity; or
for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia - more than 25, 000L capacity.
WASTE STORAGE, TREATMENT OR DISPOSAL - storing, treating, reprocessing or disposing of regulated waste (other than at the place it is generated), including operating a nightsoil disposal site or sewage treatment plant where the site or plant has a design capacity that is more than the equivalent of 50, 000 persons having sludge drying beds or on-site disposal facilities.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1219889 EMR Site Id: 24828 19 April 2010
This response relates to a search request received for the site:
Lot: 4 Plan: DC93

EMR RESULT

The above site IS included on the Environmental Management Register.
Lot: 4 Plan: DC93
Address: DIAMOND DOWNS EAGLE FIELD ROAD
BELYANDO 4721

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
LIVESTOCK DIP OR SPRAY RACE - operating a livestock dip or spray race facility.

For the majority of rural properties only a small area may be affected by the chemicals used in livestock dips and spray races. The EPA may hold further information relating to the location of the dip site within this property.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1220100 EMR Site Id: 25464 19 April 2010
This response relates to a search request received for the site:
Lot: 3 Plan: RU5

EMR RESULT

The above site IS included on the Environmental Management Register.
Lot: 3 Plan: RU5
Address: 76KM WEST OF CLERMONT TOWER
CLERMONT 4721

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
PETROLEUM PRODUCT OR OIL STORAGE - storing petroleum products or oil -
(a) in underground tanks with more than 200L capacity; or
(b) in above ground tanks with -
for petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code - more than 2, 500L capacity; or
for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code - more than 5, 000L capacity; or
for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia - more than 25, 000L capacity.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1219902 EMR Site Id: 14850 19 April 2010
This response relates to a search request received for the site:
Lot: 3 Plan: DK236

EMR RESULT

The above site IS included on the Environmental Management Register.
Lot: 3 Plan: DK236
Address: COLLINSVILLE-NEBO ROAD
NEBO 4804

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
MINERAL PROCESSING - chemically or physically extracting or processing metalliferous ores.

While sites are listed on the EMR using the lot and plan description, a mining lease may affect only a limited area of the lot. In many instances with rural properties, only a small area may be potentially affected by the mining activities and the ongoing landuse is unaffected. More detailed information relating to the location of the mining activities may be held by the EPA or the Department of Natural Resources and Mines.

PETROLEUM PRODUCT OR OIL STORAGE - storing petroleum products or oil -
(a) in underground tanks with more than 200L capacity; or
(b) in above ground tanks with -
for petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code - more than 2, 500L capacity; or
for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code - more than 5, 000L capacity; or
for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia - more than 25, 000L capacity.
WASTE STORAGE, TREATMENT OR DISPOSAL - storing, treating, reprocessing or disposing of regulated waste (other than at the place it is generated), including operating a nightsoil disposal site or sewage treatment plant where the site or plant has a design capacity that is more than the equivalent of 50, 000 persons having sludge drying beds or on-site disposal facilities.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1219865 EMR Site Id: 64472 19 April 2010
This response relates to a search request received for the site:
Lot: 2 Plan: SP186058

EMR RESULT

The above site IS included on the Environmental Management Register.
The site you have searched has been subdivided from the following site, which is included on the EMR. Subdivided new parcels will remain on the EMR unless it can be shown that they are not located near the contaminating activity.

Lot: 4 Plan: RU83
Address: "SPRINGVALE"
CLERMONT 4721

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
LIVESTOCK DIP OR SPRAY RACE - operating a livestock dip or spray race facility.

For the majority of rural properties only a small area may be affected by the chemicals used in livestock dips and spray races. The EPA may hold further information relating to the location of the dip site within this property.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1219904 EMR Site Id: 26239 19 April 2010
This response relates to a search request received for the site:
Lot: 2 Plan: CP866147

EMR RESULT

The above site IS included on the Environmental Management Register.
Lot: 2 Plan: CP866147
Address: COLLINSVILLE NEBO ROAD
WESTERN GRAZING 4804

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
LIVESTOCK DIP OR SPRAY RACE - operating a livestock dip or spray race facility.

For the majority of rural properties only a small area may be affected by the chemicals used in livestock dips and spray races. The EPA may hold further information relating to the location of the dip site within this property.
PETROLEUM PRODUCT OR OIL STORAGE - storing petroleum products or oil -
(a) in underground tanks with more than 200L capacity; or
(b) in above ground tanks with -
for petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code - more than 2, 500L capacity; or
for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code - more than 5, 000L capacity; or
for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia - more than 25, 000L capacity.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1219876 EMR Site Id: 25545 19 April 2010
This response relates to a search request received for the site:
Lot: 10 Plan: BL58

EMR RESULT

The above site IS included on the Environmental Management Register.
Lot: 10 Plan: BL58
Address: GREGORY DEVELOPMENTAL ROAD
CLERMONT 4721

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
LIVESTOCK DIP OR SPRAY RACE - operating a livestock dip or spray race facility.

For the majority of rural properties only a small area may be affected by the chemicals used in livestock dips and spray races. The EPA may hold further information relating to the location of the dip site within this property.
PETROLEUM PRODUCT OR OIL STORAGE - storing petroleum products or oil -
(a) in underground tanks with more than 200L capacity; or
(b) in above ground tanks with -
for petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code - more than 2, 500L capacity; or
for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code - more than 5, 000L capacity; or
for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia - more than 25, 000L capacity.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1219866 EMR Site Id: 64471 19 April 2010
This response relates to a search request received for the site:
Lot: 1 Plan: SP186058

EMR RESULT

The above site IS included on the Environmental Management Register.
The site you have searched has been subdivided from the following site, which is included on the EMR. Subdivided new parcels will remain on the EMR unless it can be shown that they are not located near the contaminating activity.

Lot: 4 Plan: RU83
Address: "SPRINGVALE"
CLERMONT 4721

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
LIVESTOCK DIP OR SPRAY RACE - operating a livestock dip or spray race facility.

For the majority of rural properties only a small area may be affected by the chemicals used in livestock dips and spray races. The EPA may hold further information relating to the location of the dip site within this property.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1219863 EMR Site Id: 25523 19 April 2010
This response relates to a search request received for the site:
Lot: 1 Plan: BF51

EMR RESULT

The above site IS included on the Environmental Management Register.
Lot: 1 Plan: BF51
Address: ALPHA-CLERMONT ROAD
ALPHA 4724

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
PETROLEUM PRODUCT OR OIL STORAGE - storing petroleum products or oil -
(a) in underground tanks with more than 200L capacity; or
(b) in above ground tanks with -
for petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code - more than 2, 500L capacity; or
for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code - more than 5, 000L capacity; or
for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia - more than 25, 000L capacity.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

QLD ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Transaction ID: 1219870 EMR Site Id: 25537 19 April 2010
This response relates to a search request received for the site:
Lot: 5 Plan: RU81

EMR RESULT

The above site IS included on the Environmental Management Register.
Lot: 5 Plan: RU81
Address: LAGLAN ROAD
CLERMONT 4721

The site has been subject to the following Notifiable Activity pursuant to section 374 of the *Environmental Protection Act 1994.*
LIVESTOCK DIP OR SPRAY RACE - operating a livestock dip or spray race facility.

For the majority of rural properties only a small area may be affected by the chemicals used in livestock dips and spray races. The EPA may hold further information relating to the location of the dip site within this property.
PETROLEUM PRODUCT OR OIL STORAGE - storing petroleum products or oil -
(a) in underground tanks with more than 200L capacity; or
(b) in above ground tanks with -
for petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code - more than 2, 500L capacity; or
for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code - more than 5, 000L capacity; or
for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia - more than 25, 000L capacity.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

EMR/CLR Searches may be conducted online through the State Government Website www.smartservice.qld.gov.au or Citec Confirm www.confirm.com.au.

If you have any queries in relation to this search please phone (07) 3330 5687.

Lindi Bowen
Registrar, Contaminated Land Unit

Appendix E

Relevant Notifiable Activities

Details on Notifiable Activities

Notifiable Activity	Details
Petroleum Product or Oil Storage	Storing petroleum products or oil - (a) in underground tanks with more than 200 L capacity; or (b) in above ground tanks with: for petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code - more than 2500 L capacity; or for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code - more than 5000 L capacity; or for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia - more than 25000 L capacity.
Livestock Dip or Spray Race	Operating a livestock dip or spray race facility.
Mineral Processing	Chemically or physically extracting or processing metalliferous ores.
Explosives Production or Storage	Operating a factory under the *Explosives Act 1952*
Waste Storage, Treatment or Disposal	Storing, treating, reprocessing or disposing of regulated waste (other than at the place it is generated), including operating a nightsoil disposal site or sewage treatment plant where the site or plant has a design capacity that is more than the equivalent of 50,000 persons having sludge drying beds or on-site disposal facilities.

Appendix F

GQAL / Land Suitability Assessment Process and Background Information

The different data sets used to establish GQAL / Land Suitability along the rail corridor do not all map units according to the GQAL Classes listed above; however correlative relationships between the mapped units of the various soil and land studies to the GQAL classes can be achieved by referring to the planning guidelines and by reviewing the information presented in the studies. Summaries of the findings of the different soil and land studies and their respective data sets are provided below:

***Land suitability study of the Collinsville-Nebo-Moranbah region,* Queensland Department of Primary Industries (DPI, 1984)**

The Land suitability study of the Collinsville-Nebo-Moranbah region (DPI, 1984) was undertaken to determine the cropping potential of the region. The major crops grown in Central Queensland include grain sorghum and sunflower during the summer and safflower and wheat during the winter.

Rainfed broad-acre raingrown cropping in the region is restricted to soils with a high plant available water capacity (PAWC). The majority of the rainfall (70 %) occurs in the summer months when sorghum and sunflower are grown, however, rainfall variability is so high during this period that PAWC is a critical factor for successful cropping. In the winter months rainfall is negligible so any cropping of wheat and sunflower must rely almost entirely on stored soil moisture.

The only soils that were identified as having some potential for raingrown cropping were the cracking clay Vertosols soils. Cracking clays on sedimentary rocks must be deeper than 60 cm to be suitable for cropping in the Collinsville-Nebo area. The Vertosols with heavy clay subsoils below the self-mulching layer may be susceptible to hardpan development. Hardpans that develop immediately below the plough layer may severely restrict root and water penetration.

Gilgaied Vertosols clays with deep (40 to 100 mm) melonhole microrelief severely hinders cultivation and land levelling will bring the saline subsoils to the surface resulting in poor crop growth. They are unsuitable for raingrown cropping.

Vertsosols occur on gently undulating plains and rises. They are moderately to highly erodible and where present on slopes greater than one per cent, soil conservation measures would be required to minimise soil losses.

The Sodosols are unsuitable for raingrown cropping due to low PAWC and deep hard setting surface soils; however they are suitable for grazing. The sodic nature of the subsoils results in the soils having a high erodability potential, as discussed in the Sodic Soils of this Report. Relatively flat areas with slopes less than two per cent are suitable for pasture improvement, but slopes greater than this are unsuitable for cultivation and should be grazed for native pastures only.

The Dermosol rocks have a low PAWC, very low fertility and are unsuitable for rainfed cropping. They tend to support eucalypt woodlands that would be expensive to clear and prone to woody regrowth and are more suited to native pasture grazing.

The accompanying map to this study provided an overview of the land suitability allocating either a rating of Arable (suitable for rain grown agriculture or improved pastures) or Non-Arable (suitable for improved pasture, or suitable for grazing of native pastures and catchment protection), these ratings have been correlated to GQAL classes in accordance with the planning guidelines, shown in Table 1.

***Soils of the Burdekin-Townsville Region*, Queensland Resources Series, Department of National Development (DND, 1970)**

The study of the soils in the Burdekin – Townsville region was undertaken to assess the soil resources within the study area and provide an assessment of the soils potential productivity. The assessment involved a review of; climatic conditions, management factors, soil moisture, nutrient status, soil parent material and available soil profile information and investigations.

The following is a summary of the soil groups that are mapped within the rail corridor and there potential for agricultural uses.

Soils with texture contrast (duplex) profiles have the widest distribution and diversity within the study area. They are characterised by having a lighter texture surface soils overlying heavy clay subsoils. Generally the clayey subsoil causes sever impedance of internal drainage and the hard setting loamy surface soils leads to excessive runoff losses from high intensity rainfalls.

The neutral red duplex soils generally have a shallow sandy loam to sandy clay loam soil surface with an abrupt change to a strongly structured clay material at 10 – 20cm. The soils are generally used for beef cattle grazing on fair suited to some cultivation. Their nutrient status is generally low but they do have a fairly high potential for pasture development.

The alkaline bleached duplex soils are fairly widespread, and occur on a range of parent materials, and range from shallow and stony to deep and stone free. Most of these soils are used for beef cattle grazing of generally poor quality native pastures.

Mottled soils have a coarsely structures, very dense and tough clay subsoils which severely impedes internal drainage and root penetration. The nutrient status is low with deficiencies in phosphorus, nitrogen, molybdenum and sulphur. There is some scope in areas for improved grass and legume pastures after clearing and fertilising.

Deep earthy sands have low to very low nutrient status and land use is restricted to sparse cattle grazing with some native hardwood production. Some of these soils are ideally suited to pastures but productivity will be variable as many of these soils have very low water holding capacity.

Dark cracking clays, occupy only a small area within the rail corridor. The soils have moderate to high nutrient status and high water holding capacity, but often have a stony nature which limits the potential. These soils between Home Hill and Bowen have areas of deep stone free dark clays with low phosphorus levels. The major use for the dark cracking clay soils is beef cattle grazing on native pastures.

Land of the Nogoa – Belyando Area, Queensland, Land Research Series No. 18, CSIRO, 1967;

The survey covered an area of 35000 square miles known as the Nogoa – Belyando Area. Assessments were undertaken on landforms, soils and vegetation in order to map the varying land systems within the region. The area was mapped in terms of 43 different land systems. The land systems are described in relation to the three main characteristics, land form, soils and vegetation. An estimated land capability class is also provided for each of the land systems. A summary of the land systems that are within the Alpha Rail Project include the following:

Alpha (Al) – Alluvial plains with box and texture contrast soils in non-basaltic alluvium;

Avon (Av) – Gently undulating grassland with cracking clay soils on alkaline clays deposited within the tertiary wetland;

Blackwater (Bl) - Brigalow plains with cracking clays on acid clay exposed within the tertiary zone;

Borilla (Bo) – Rocky hills with ironbark and shallow, rocky soils cut below the Tertiary weathered zone on volcanics;

Carborough (Ca) – Mountains and hills with narrow leaved ironbark and lancewood, shallow rocky soils formed on quartz sandstone mainly below the tertiary weathered zone;

Comet (Ct) – Flooded alluvial plains with brigalow and cracking clay soils;

Disney (D) – small lateritic mesas with ironbark and red and yellow earths on tertiary sandstone; surrounding lowlands with box and brigalow and texture-contrast soils on weathered Drummond Basin sediments;

Funnel (Fu) – Flooded alluvial plains with coolabah and cracking clay soils;

Hope (Ho) – Low stony hills and lowlands with narrow leaved ironbark and texture contrast soils on Drummond basin sediments below the tertiary weathered zone;

Humboldt (Hu) – Lowlands and plains with Blackbutt and brigalow with texture contrast soils formed on acid clay exposed within the tertiary weathered zone;

Islay (I) – Gidgee plains with gilgaied clay soils on acid clay exposed within the Tertiary weathered zone;

Kinsale (K) – Brigalow scrub on rolling basalt country with cracking clay soils within the Tertiary weathered zone;

Lennox (Le) – Plains and lowlands with silver – leaved ironbark and yellow and red earths on intact tertiary land surface;

Monteagle (Mo) – Lowlands with box on texture-contrast soils on slightly stripped Tertiary land surface;

Moray (My) – Plains and lowlands with gidgee and cracking clay soils on Alkaline clay deposited within the tertiary weathered zone;

Rutland (Ru) – Lowlands and low hills with groved brigalow and ironbark and texture contrast soils on both weathered and fresh Drummond basin sediments;

Somerby (So) – Gilgaied plains with brigalow and cracking clay soils on acid clay exposed within tertiary weathered zone;

Tichbourne (Ti) – Undulating country with silver-leaved ironbark or melaleuca and red and yellow earths on partially stripped Tertiary land surface; and,

Ulcanbah (U) – Clay plains with gidgee and cracking clay soils on shales and acid clay exposed within the tertiary weathered zone.

The planning guideline provides correlative relationships between the different land systems and the GQAL classes and is provided in Table 1.

***North Queensland Versatile Cropping Land,* Queensland Department of Environment and Resource Management, 2009;**

Versatile Cropping Land (VCL) is a product of the DERM review of policy SPP 1/92 to protect the more 'versatile' agricultural land from inappropriate development and move away from the use of the established GQAL (Good Quality Agricultural Land) principle for the States Regional Planning process. VCL is represented by the values 'Y' or 'N'.

◗ • Y being yes, meaning suitable land uses for a mapped unit being 4 or more

◗ • N being no, is where the mapped unit has less than 4 suitable land uses

This data is used to identify the VCL (Versatile Cropping Land) for planning purposes for both irrigated and non-irrigated land uses. Correlative relationships are not established within the planning guidelines, but estimated GQAL ratings have been provided, but will be required to be assessed in the field to determine appropriate ratings were allocated.

Allocation of GQAL Rating

As mentioned previously the Planning Guidelines for the Identification of GQAL provides correlations between varying studies, assessments and maps to the different GQAL classes. The table below details the correlative / relationships between the mapped units within the four different studies and their respective data sets to the GQAL ratings.

Table 1 Soil and Land Suitability Mapped Units Correlation to GQAL

Report Title	Map Title	Map Units of Good Quality Agricultural Land
Land Suitability Study of the Collinsville – Nebo – Moranbah Region, 1984	Land Suitability Map	A: Arable C: Non-arable (improved pastures)
Lands of the Nogoa-Belyando Area, Queensland (1967)	Land Systems Map	A: K, Ma, My, O, W B: Al, By, Bl, Ct, Cu, D, Fu, Hi, Hu, I, Mo, Pv, Ph, S, So, U, Wa, Wh C: Av, Cn, Fu, Ru, Wi
Soils. Burdekin-Townsville Region. (1970) –	Soils Map	B: Dark Deep Cracking Clays (Cf 17) C: Neutral Red Duplex (RC12, 13, 15), Alkaline Duplex (YD11, YE13, YE16, GG4, GH27), Deep Earthy Sands (Sg1).
Versatile Cropping Land, 2009	Versatile Cropping	A – Yes B – No

No correlative relationships are established for GQAL Class D soils. For the purpose of this assessment, mapped units without a GQAL correlation of A, B or C, are regarded as land unsuitable for agricultural use (Class D).

GHD

201 Charlotte Street Brisbane QLD 4000
GPO Box 668 Brisbane QLD 4001
T: (07) 3316 3000   F: (07) 3316 3333   E: bnemail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	David Doolan	J. Keane, Simon Buchanan		Julie Keane		3.08.2010