9 GEOLOGY, MINERAL RESOURCES, OVERBURDEN AND SOILS

9.1 INTRODUCTION

This chapter outlines the geology and soil characteristics of the western coal seam methane (CSM) water supply pipeline (the proposed pipeline) corridor and details the rehabilitation requirements of the site. A detailed geology, mineral resources, overburden and soils technical report is presented in TR 9-1-V3.5: Geology, Mineral Resources, Overburden and Soils Impact Assessment. Note that figures/documents with numbering ending in V3.5, for example, refer to figures/documents contained in Volume 3, Book 5 of the EIS.

9.2 METHODOLOGY OF ASSESSMENT

The assessment was conducted as a desktop soils and land suitability assessment.

9.2.1 EXISTING INFORMATION

Previous investigations that provided information for this report regarding soil and landscape characteristics (topography and geomorphology) include:

- Gray, H.J and Macnish, S.E (1985) Land Management Field Manual Wandoan District
- Forster, B.A (1985). Evaluation of Agricultural Land in Taroom Shire
- Macnish, S.E. (1987) Land Management Field Manual Roma District
- McNee, D.A.K. (1984) Cropping in the Maranoa and Warrego.

9.2.2 OVERBURDEN

No overburden assessment was conducted for this study as no mining activity is proposed within the proposed pipeline corridor.

9.2.3 SOILS

A soils and land suitability assessment comprised a desktop review of available published data to:

- identify anticipated soil types along the corridor
- characterise soil types
- assess land suitability classes
- assess available topsoil types and suggested stripping depths
- assess erosion potential of the topsoil and subsoil materials.

The soil investigation comprised a review of existing geotechnical, geological and soil data, aerial photography and topography. The investigation was conducted in accordance with The Planning Guidelines: the Identification of Good Quality Agricultural Land (DPI & DHLGP 1993).

Soil classification system

The adopted soil classification system is the Australian Soil Classification System (Isbell 1996). Where soil descriptions correlate with soil types in the resources listed in Section 9.2.1, names from these resources have been adopted.

9.2.4 LAND SUITABILITY ASSESSMENT

A land suitability assessment was carried out over the proposed pipeline study area based on the methodology of Attachment 2 of the Land Suitability Assessment Techniques (Department of Mines and Energy 1995). The land in the proposed pipeline corridor was assessed for its suitability for dry-land cropping and cattle grazing on improved pasture.

The findings of the land suitability assessment were then assessed against the Good Quality Agricultural Land (GQAL) mapping under the former Taroom Shire Council Planning Scheme. (Taroom Shire Council, 2006) and Bungil Shire Council Planning Scheme (Bungil Shire Council 2006) to assess the accuracy of the GQAL mapping.

GQAL is defined under State Planning Policy 1/92 Development and conservation of agricultural land. State planning policy 1/92 is based on the principle that land suitable for agricultural purposes is limited in Queensland, and that suitable “good quality” land should be protected for agricultural uses, however the policy makes allowances for developments on high quality agricultural land where the project provides an overriding public benefit and there are no other suitable sites for the purpose.

9.3 EXISTING ENVIRONMENT

9.3.1 TOPOGRAPHY AND GEOMORPHOLOGY

Topography

The topography of the proposed pipeline study area is shown on Figure 9-1-V3.3. Two main landscape units were identified in the proposed pipeline study area:

- alluvial floodplains of Eurombah, Slatehill, Barton, Kangaroo, Canal and Horse Creeks. These northerly flowing creeks are ephemeral and the floodplains vary in width from less than 500 m to about 2 km. The width of creek’s floodplains generally increasing from east to the west. This landscape occurs at a surface level (RL) of between approximately 230 m and 250 m Australian height datum (AHD)
- low undulating hills, with an RL of between 250 m and 295 m AHD make up the majority of the proposed pipeline (West) study area. The undulating hills generally have a greater relief in the west of the study area than in the east.

9.3.2 GEOLOGY

Regional geology

The summary of geology, underlying the proposed pipeline corridor has been referenced to:

- detailed studies of the geology of the Wandoan region including photogeological interpretation (Snodin 2004)
- Roma and Taroom sheets of the Geological Survey of Queensland’s 1:250,000 series.

The geologic units in the wider Wandoan region occur in generally west-north-west to east-south-east trending bands, parallel to the elevated topography of the Great Dividing Range (GDR) which is approximately 50 km south of Wandoan. Soils and the underlying rocks of the Project site are from the following main geological units:

- Quaternary age alluvium (Qa) comprising of sand, silt, mud and gravel in the recent creeks and drainage lines
- Middle to Upper Jurassic age Injune Creek Group (Jsi) on the undulating landform north of the GDR, comprising sandstone and mudstone with coal. The Westbourne Formation and Springbok Sandstone units of this group are anticipated to be present within the study area
- Lower Jurassic age Hutton Sandstone (Jshu) is indicated to occur within on the undulating landform around Spring Gully, comprising quartzose sandstone minor carbonaceous siltstone and shale.

A map illustrating the geology of the proposed pipeline study area is shown on Figure 9-2-V3.3.

9.3.3 GEOMORPHOLOGY

Drainage over the proposed pipeline study area is generally towards the north, with sediment from the Great Dividing Range in the south slowly transported by the creeks via the floodplains towards the Dawson River, located to the north of the Project.

The narrow floodplains, gentle slopes and confined meanders of drainage lines suggest the landscape within the Project area is geologically young. The ephemeral creeks are slowly cutting into and eroding the undulating hills, with lateral erosion of the valleys being the main large-scale landscape altering activity. Temporary deposition of eroded material occurs on the narrow floodplains. Erosion rates are anticipated to be low due to the relatively dry climate and low topographic gradient. Most erosion will occur during infrequent high rainfall events.

9.3.4 MINERAL RESOURCES

According to the Department of Energy and Mine's Interactive Resource and Tenure online maps (http://www.webgis.dem.qld.gov.au accessed on 15 August 2008), A number of petroleum leases (PL), and exploration permit for petroleum (EPP) exist over the proposed pipeline study area (refer Figure 9-3-V3.3). The petroleum leases include the leases from which the CSM water is being sourced. These PL and EPP are summarised below:

- PL204 (granted) held by Origin Energy CSG marketing Pty Limited
- PL195 (granted) held by Origin Energy CSG Limited
- PL203 (granted) held by Origin Energy CSG Limited
- EPP852 (granted), held by Pure Energy Resources Limited
- EPP592 (granted), held by Origin Energy CSG Limited.

A number of exploration permits for Coal also exist along the proposed pipeline corridor.

- EPC1164 (granted) held by Metrocoal Limited
- EPC1275 (application) held by Queensland Thermal Coal Pty Ltd

- EPC1274 (application) held by Queensland Thermal Coal Pty Ltd
- EPC859 (granted) held by Xstrata Coal Queensland Pty Ltd
- EPC1171 (granted) held by Taroom Coal Pty Ltd
- EPC791 (granted) held by Xstrata Coal Queensland Pty Ltd
- EPC787 (granted) held by Xstrata Coal Queensland Pty Ltd
- EPC 650 (granted) held by Taroom Coal Pty Ltd
- EPC789 (granted) held by Xstrata Coal Queensland Pty Ltd
- EPC1143 (granted), held by Xstrata Coal Queensland Pty Ltd.

A number of exploration bores and production bores exist at the western extent of the proposed pipeline, consisting of the Spring Gully gas fields from which the CSM water is being extracted as a byproduct.

9.3.5 OVERBURDEN

Overburden is not relevant to this assessment

9.3.6 SOILS

Land resource areas

Land resource areas (LRAs) are reoccurring landscape units with similar geology, landforms, soils and vegetation associations. They are used to simplify and aid quick field identification of land resource unit mapping and subsequent management. The LRA of the proposed pipeline corridor are presented in Figure 9-4-V3.3.

The LRAs of the proposed pipeline study area are identified and described in the Wandoan District Land Management Field Manual (Gray and Macnish 1985), Evaluation of Agricultural Land in Taroom Shire (Forster 1985) and Cropping in the Maranoa and Warrego (McNee 1984). These studies identified three LRA, which relate to the landscape units identified in Section 9.3.1, being:

- **Brigalow uplands.** Undulating plains with broad ridges and low hills, on sandstones and shales
- **Poplar box alluvia.** Floodplains of generally narrower width than Coolibah LRA; often associated with active secondary stream channels; mixed and sandy alluvia
- **Bymont.** Gently undulating plains to undulating low hills (0-4%) developed predominantly on shales and mudstones, and minor sandstones.

Identified soil types were related to LRA soil profiles in these references. This allowed additional physical and chemical characteristics to be inferred for some soils.

Soil types and descriptions

A number of soils have been identified as occurring within the LRA of the proposed pipeline study area. These soils have the potential to occur along the pipeline corridor and are described below.

Brigalow uplands soils

Brigalow upland soils consist of cracking and non cracking clays and occur on the gently undulating topography. Surface soils are neutral to slightly alkaline, with low salinity and

non-dispersive. Subsoils are generally moderately to strongly alkaline and are dispersive. Soils that occur with the Brigalow Uplands LRA and have the potential to occur in the proposed pipeline corridor are:

- **Rolleston.** These soils occur on mid and lower slopes. The topsoil is dark brown-grey heavy clay with blocky peds. Subsoils are dispersive, and lower sub-soils are strongly acidic or strongly alkaline. Under the Australian Soil Classification this soil is a Brown Dermosol.
- **Teviot.** These soils occur on gently inclined midslopes. The topsoil is brown-grey to dark brown grey clay. Subsoils are grey-yellow-brown clays and are moderately alkaline, moderately saline and dispersive, tending to strongly dispersive with depth. Under the Australian Soil Classification this soil is a brown vertosol.
- **Downfall.** These soils occur on mid to lower slopes on areas of sediment/slopewash accumulation. The topsoil is a shallow brown-grey clay. Lower subsoils are dispersive grey and/or yellow brown heavy clays and are strongly alkaline. Under the Australian Soil Classification this soil is a brown vertosol.
- **Rugby.** These soils occur on ridgetops and are potentially present within the proposed pipeline corridor. The topsoil is a yellow-brown sandy loam to clay loam. The soil has a shallow profile with weathered sedimentary rock generally encountered at less than 0.5 m depth. Under the Australian Soil Classification this soil is a dermosol.
- **Cheshire.** These soils occur on steeper gradient upper slopes (up to 3%). The topsoil consists of dark sandy clay to light clay, tending to be dispersive in the lower topsoil. The subsoil is strongly alkaline, highly saline and dispersive. Under the Australian Soil Classification, this soil is a brown dermosol.
- **Kinnoul.** These soils occur on ridgetops and upper slopes, and are commonly covered by Brigalow regrowth. The topsoil consists of dark sandy clay or light clay with well developed blocky structure. Kinnoul is a shallower version of Cheshire, and often grades into Cheshire on upper slopes. The yellow-brown subsoil encountered in Cheshire is generally absent in Kinnoul. Under the Australian Soil Classification this soil is a brown dermosol.
- **Eumamurrin.** These soils occur on most slope positions on moderately undulating plains. The topsoil is a brown to black medium to heavy clay, with grey to brown subsoil. The subsoil is sodic to strongly sodic by 0.3 m depth. Under the Australian Soil Classification this soil is a brown vertosol.
- **Glenarden.** These soils occur on most slope positions on undulation plains. The topsoil is a brown to grey-brown clay loam. Subsoils are brown-black medium clay, with the soil profile generally less than 0.45 m deep. Under the Australian Soil Classification this soil is a brown Dermosol.
- **Limewood.** These soils occur on most slope positions on gently to moderately sloping plains. The topsoil is a brown-black heavy clay, with yellow-brown heavy clay subsoil. T soil profile is generally less than 0.75 m deep. Subsoils are sodic to strongly sodic below 0.3 m with medium to high salinity below 0.5 m. Under the Australian Soil Classification this soil is a brown vertosol.

Poplar box alluvia soils

Poplar box alluvial soils consist of uniform and texture contrast soils and occur on the floodplains. Soils that occur with the Poplar Box Alluvia LRA and have the potential to occur in the proposed pipeline corridor are:

- **Juandah.** These soils occur on floodplains with less than 1% gradient. The topsoil consists of high plasticity dark brown-grey clay with granular to blocky structure. Subsoils are dispersive with slight to moderately alkaline pH and low to medium salinity. Lower subsoils are yellow-brown, massive alkaline clays. The soil profile is generally greater than 1.5 m deep, and underlain by alluvium. Under the Australian Soil Classification this soil is a brown vertosol.
- **Retro.** These soils occur on the floodplains on slopes less than 0.5%, and are typically uncleared of vegetation. The topsoil consists of dark brown-grey clay-loam, which is non-dispersive, and has neutral pH and low salinity. The subsoils are dark brown heavy clays with medium blocky peds. Subsoils are non-dispersive with alkaline pH. The soil profile is approximately 1 m deep and underlain by weathered sediment or colluvium. Under the Australian Soil Classification this soil is a brown chromosol.
- **Woleebee.** These soils occur on the floodplains of Woleebee and Juandah Creeks. The topsoil consists of a grey silty loam, which is dispersive, has neutral pH and low to medium salinity. The subsoils are dark medium clay, and are strongly alkaline with medium to high salinity from approximately 0.5 m depth. Under the Australian Soil Classification this soil is a brown sodosol.

Bymont soils

Bymont soils consist of uniform to texture contrast soils and occur on undulating plains in the western portion of the proposed pipeline corridor. Soils that occur with the Bymont LRA and have the potential to occur in the proposed pipeline corridor are:

- **Nimitybelle.** These soils occur on gently undulating plains. The topsoil consists of a grey to greyish black heavy clay, underlaid by yellowish grey subsoil. Subsoils are strongly sodic with medium salinity. Under the Australian Soil Classification this soil is a brown vertosol.
- **Pamaroo.** These soils occur on gently undulating plains in brigalow and poplar box areas. The topsoil consists of a brown sandy loam to medium clay and it is underlaid by heavy clay. This texture contrast soil has a sodic B horizon. Under the Australian Soil Classification this is a brown sodosol.

9.3.7 LAND SUITABILITY AND AGRICULTURAL LANDS

Land suitability

The land use suitability assessment was based on the Land Suitability Classification for Cropping and Grazing in the Semi-arid Sub-tropics of Queensland (Department of Mines and Energy 1995). This classification system evaluates whether an area of land can sustain potential agricultural uses regardless of its current use.

All land within the proposed pipeline study area was within one of the following land use classes for either dryland cropping or beef cattle grazing:

- Class 1 – suitable land with negligible limitations and is highly productive requiring only simple management practices
- Class 2 – suitable land with minor limitations which either reduce production or require more than simple management practices to sustain the use
- Class 3 – suitable land with moderate limitations – land which is moderately suited to a proposed use but which requires significant inputs to ensure sustainable use
- Class 4 – marginal land with severe limitations which make it doubtful whether the inputs required to achieve and maintain production outweigh the benefits in the long-term
- Class 5 – unsuitable land with extreme limitations that preclude its use.

Distribution of land suitability classes for rain-fed cropping is provided in Figure 9-5-V3.3, and land suitability for beef cattle grazing is provided in Figure 9-6-V3.3.

The findings of this assessment correlate well with the findings of Grey and Macnish (1985), Forster (1985), and Macnish (1987), with the proposed pipeline study area mainly classified as Class 3 and Class 4 for dry land cropping.

Soils of the Brigalow Uplands LRA are a combination of Class 3 and Class 4 for dry land cropping, with the soils of Cheshire, Glenarden, and Kinnoul, which occur on steeper upper slopes, having been classified as Class 4 due to high erosion potential by surface runoff and the presence of alkaline subsoils that results in low nutrient availability. Soils of Downfall and Rolleston, occurring on the lower slopes, were rated as Class 4 due to high alkalinity within 0.6 m of the soil surface resulting in nutrient deficiency.

Cropping currently occurs within this Class 4 land, however, long term sustainability is limited due to low nutrient and high alkalinity conditions, shallow rooting depth, and heavy application of fertilisers.

Soils of the Poplar Box Alluvia LRA were rated Class 3 for dry land cropping due to the potential of flooding. Small portions of land on the upper margins of the floodplains with alluvial soils, but impacted by flood to a lesser extent, may be Class 2 land for dryland cropping. Soils in the Bymont LRA were rated as Class 4 for dry land cropping due to their susceptibility to erosion.

All land in the proposed pipeline study area is considered class 2 for beef cattle grazing.

Good quality agricultural land

In accordance with Section 2 and Attachment 2 of 'The Planning Guidelines: The Identification of Good Quality Agricultural Land' (Department of Primary Industries and Department of Housing, Local Government and Planning Queensland 1993), agricultural land classes A, B and C are considered GQAL in the area formally known as Taroom and Bungil Shires.

Agricultural land classes A, B and C can respectively be defined as:

- Class A: Crop land – land that is suitable for current and potential cropping with limitations to production which range from none to moderate level

- Class B: Limited crop land – land that is marginal for current and potential cropping due to severe limitations, and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered for cropping
- Class 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.

Under the Taroom and Bungil Planning Schemes almost all land within the proposed pipeline study area, other than along creek lines and near Spring Gully, is classified as Class A agricultural land, as shown in Figure 9-7-V3.3. However, the findings of this land suitability assessment indicate greater than 'moderate' limitations to dryland cropping for areas over the lower slopes of the Brigalow Upland Soils. Consequently, the findings of this assessment suggest a different distribution of GQAL than the Taroom and Bungil Planning Schemes, with Class B agricultural land as a more appropriate classification for the proposed pipeline study area, as represented by Land Suitability Class 3.

9.3.8 SOIL CONSERVATION PLANS

No properties in the proposed pipeline study area are covered by soil conservation plans registered with the Department of Natural Resources and Water.

9.4 DESCRIPTION OF PROPOSED DEVELOPMENT

The proposed pipeline involves the construction and operation of a water pipeline from the Spring Gully coal seam methane wells to the Wandoan Mining Lease Application areas (MLA areas).

The proposed pipeline will be approximately 91 km long and have a nominal diameter of 600 mm. The pipeline will be buried with approximately 0.6 m to 1.0 m cover and will be constructed using a section trench and backfill method.

The width of the proposed construction corridor will be about 20 m. Pre-construction works will include clearing of vegetation (where required), stripping of topsoil and formation of construction access tracks. Trenching would be used to construct the majority of the proposed pipeline and will be prepared ahead of construction. It is expected that a wheel trencher and excavator would be used to dig the trench for the majority of the route, being approximately 1.2 m–1.6 m deep and 0.9 m wide. In some areas, harder rock may be encountered and hydraulic rock breaking equipment may be required. Following placement of the pipeline, the trench will be backfilled, compacted and topsoiled.

All construction activities will be undertaken within the proposed construction corridor.

9.5 POTENTIAL IMPACTS

9.5.1 TOPOGRAPHY AND GEOMORPHOLOGY

The proposed pipeline will have negligible impact on topography as the trench will be fully backfilled and rehabilitated to the original ground surface and landform.

9.5.2 OVERBURDEN

Overburden is not relevant to this assessment.

9.5.3 SOILS

Alkalinity, sodicity and dispersivity

Most soils within the study area (with the exception of Kinnoul) have either sodic or alkaline subsoils. Glenarden, Cheshire, Rolleston, Downfall, Teviot and Juandah, Nimitybelle and Pamaroo are strongly sodic from about 0.3 m depth. Glenarden, Cheshire, Woleebee, Rolleston and Teviot subsoils are strongly dispersive.

Alkaline and sodic soils are generally dispersive, and have high erosion potential if exposed. Sodic, alkaline soils are also poor plant growth mediums due to low nutrient availability, and should not be used as such in rehabilitation of disturbed areas. The topsoil portion of these soils, as shown in Table 9-5-V3.3, is suitable for use in rehabilitation.

Erosion

All soils in the proposed pipeline study area will be subject to erosion if vegetation is removed and rehabilitation is not undertaken within an appropriate timeframe.

Soils most susceptible to wind erosion are soils with sandy or loamy topsoils, which include the soils on the edge of alluvial plains (Retro), and various soils on the undulating hill soils of (Glenarden, Rugby and Pamaroo).

Soils most susceptible to erosion by flowing water are those with dispersive (sodic) topsoil or upper subsoil as discussed in “Alkalinity, sodicity and dispersivity” above. Soils on steep and moderate upper slopes, as occur on the undulating terrain and spoil piles, have higher risk from erosion by water than soils on gentle slopes and floodplain.

Exposure of dispersive subsoils has the potential to cause gully erosion problems, even if only small areas of subsoil are exposed. After initiation of erosion, for example after vegetation removal or ground disturbance, this erosion will continue to expand upslope and expose more dispersive soils.

Soils of Teviot, Pamaroo and Limewood are potentially susceptible to tunnel erosion. Tunnel erosion forms when water infiltrates into dispersive subsoils and flows through cracks and channels. Dispersive clays are then suspended in the water, until the opening in the soil is enlarged and extended to form an outlet. Once a tunnel is initiated, free flowing water can enlarge it further.

Salinity

Soil salinity in the proposed pipeline study area is of limited extent and is not considered a high risk. However, some upper and mid slope soils within the Brigalow Uplands LRA (Cheshire, Teviot and Nimitybelle) and soils on the edge of alluvial plains (Retro) have moderately to highly saline subsoils, and changes to the soil moisture regime due to vegetation removal or other impact may increase near surface soil salinity.

9.5.4 GEOLOGY AND FOSSILS

Uncovering fossil material

Fossil material is not expected to be uncovered during this work.

9.5.5 POST-CONSTRUCTION LAND SUITABILITY AND AGRICULTURAL LANDS

The proposed pipeline is proposed to be buried, and no reduction in land suitability class is expected as a result. Once construction has been completed, existing agricultural land uses will generally be able to continue over the corridor. Limitations to the siting of infrastructure such as sheds or irrigation equipment, and to practices that require excavation or disturbance of the soil may result from installation of the proposed pipeline.

9.6 MITIGATION MEASURES

The following section generally contains mitigation measures related to the construction and operation proposed pipeline. Mitigation measures related to the decommissioning of the proposed pipeline are covered in Chapter 25 Rehabilitation and Decommissioning.

9.6.1 TOPOGRAPHY

The proposed pipeline will have negligible impact on topography, and as such, mitigation measures are not required.

9.6.2 OVERBURDEN

Overburden is not relevant to this assessment.

9.6.3 SOILS

Dispersion and erosion

All soils will have high erosion potential if vegetation is removed and rehabilitation is not undertaken within an appropriate timeframe. Generally wind and water erosion control measures are proposed to be applied to all soils in the proposed pipeline study area, which include:

Site preparation and planning

- An erosion and sediment control plan should be prepared and implemented prior to the commencement of construction, specifying the locations and types of sediment and erosion control measures to be used.
- Vegetation clearing (including grass cover) will be limited to the minimal amount required for Project works.
- Site drainage, erosion and sediment controls will be implemented and in place prior to, or as soon as possible, following the removal of vegetation.
- Traffic will be confined to defined roads and access tracks to minimise soil disturbance
- Infrastructure, parking and laydown areas will be located at sites with minimal slope grade.
- Hardstands will be constructed using erosion resistant material.

Managing water erosion

The following measures are proposed to be implemented to manage water erosion where appropriate:

- erosion and sediment control measures will be installed on disturbed slopes to minimise erosion and sediment released into waterways. This is especially important for soils with dispersive subsoils
- water runoff will be directed around or away from disturbed areas using diversion bunds and catch drains as appropriate
- run-off from exposed subsoil will be directed to sedimentation basins
- exposed soils will be revegetated as soon as practical after works have been completed
- all soil stockpiles will be bunded. Short term stockpiles may be bunded by sediment fencing, while long term stockpiles should have measures such as earthen bunds. Drainage works installed to divert overland flow from upslope of the longterm stockpile areas away from and around the stockpiles. Sediment traps or similar features will need to be installed downslope of stockpiles to present eroded sediment entering waterways
- erosion will be remediated as soon as practicable. This may include levelling the eroded area, capping with non-dispersive topsoil, application of seed and applying erosion control measures to prevent water impacting the site. The longer erosion is allowed to develop, the more costly and difficult it is to remediate
- any soil conservation measures, such as contour banks, that are disturbed during works will be reinstated following construction.

Managing wind erosion

The following measures are proposed to be implemented to manage wind erosion:

- watering trucks will be used during windy conditions for dust suppression
- vegetation clearing (including grass cover) will be limited to the minimal amount required for proposed pipeline works
- long-term (greater than 3 months) stockpiles of topsoil will be planted with vegetation to minimise entrainment of soil particles into the air and minimise erosion through raindrop impact
- exposed soils will be revegetated as soon as practical after works have been completed.

Managing dispersive soils

The following measures are proposed to be implemented to manage dispersive soils:

- exposure of alkaline or sodic subsoils (e.g. Cheshire, Woleebee, Rolleston, Teviot, Limewood, Wondolin, Eumamurrin, Glenarden, Retro, Nimitybelle) should be avoided where possible, and should be limited to the minimal amount of time practicable
- alkaline or sodic subsoils should not be left exposed on the surface, and should be covered with topsoil or other material.

Tunnel erosion control

The following measures are proposed to be implemented to manage tunnel erosion:

- fill around the proposed pipeline will be compacted to at least the density of the surrounding soil material, and the filled trench left slightly higher than the natural landsurface to minimising ponding or infiltration around the pipe
- all dispersive soils along the corridor will be fully capped with at least 0.2 m of topsoil with low erosion potential. Deeper topsoil depths have the potential to store rainwater and reduce infiltration into dispersive subsoils
- the geometry of the final landsurface will be managed to prevent the ponding of water on Teviot, Pamaroo or Limewood soils, to reduce the potential for infiltration into subsoils.

Monitoring

- Regular (e.g. weekly or fortnightly) monitoring for erosion will be conducted during construction, including the trench and water management infrastructure.
- Erosion monitoring will continue until the vegetation cover has become fully established.
- Monitoring for the development of tunnel erosion will be undertaken quarterly for 12 months following the completion of construction.

Salinity

The following measures are proposed to be implemented in relation to soil salinity:

- the topsoil of Teviot is saline and generally will not be used as a topsoil layer in rehabilitation. Where suitable supply of other topsoil is available, this should be used in preference to Teviot, or Teviot soil mixed with this soil. Salt tolerant vegetation species may be required for rehabilitation on Teviot topsoils
- the subsoils of Cheshire, Teviot and Woleebee, Limewood, Wondolin, Glenarden and Pamaroo are saline and where practicable will be buried below the rooting depth plants and crops (i.e. below about 0.6 m depth).

Compaction

The following measures are proposed to be implemented in relation to compaction:

- soils that will be trafficked or compacted during construction will have water control and sediment containment measures installed to minimise potential erosion and sediment entering into waterways
- previously compacted areas that are to be rehabilitated will, where practicable, be remediated by ripping the top layer of soil. Ripping the top layer of soil breaks down the soil structure, and as a result protection of these areas from re-compaction (i.e. vehicles or grazing animals) after ripping is required to allow the soil structure to reform
- compaction of topsoil can be reduced by selection of appropriate earthmoving machinery for these soils (i.e. light weight vehicles with large wheel/track size).

Topsoil reuse

Suggested stripping depths and identified constraints for various encountered soil types are provided in Table 9-1. Topsoil is proposed to be managed as follows:

- topsoil should be stripped separately to lower soil and stockpiled during clearing for reuse in site rehabilitation
- topsoil should be stored in stockpiles no more than 3 m high to retain seed germination potential
- topsoil should be stored for the shortest period practicable, and where possible reused within 6 months of stripping to maximise the retention of the seed bank in the soil
- topsoil should be reused in the general area from which it was stripped
- during site rehabilitation works topsoil should be spread to a depth of approximately 0.2 m
- control measures such as fencing should be installed on newly topsoil areas to exclude vehicle or stock access until a vegetation cover has established.

Table 9-1: Topsoil stripping depths and potential constraints for reuse

Soil type	Surface soil composition	Topsoil stripping depth (m)	Potential constraints
Brigalow Uplands			
Cheshire	Light clay	0.4	▪ highly alkaline and saline subsoil ▪ dispersive subsoil
Kinnoul	Clay	0.3	▪ low nutrient availability in topsoil ▪ dispersive subsoil ▪ shallow soil depth
Downfall	Clay	0.15	▪ shallow topsoil depth ▪ dispersive subsoil
Teviot	Clay	0.2	▪ dispersive subsoil ▪ moderately alkaline and saline
Rolleston	Clay	0.2	▪ alkaline ▪ topsoil may be dispersive ▪ dispersive subsoil
Eumanurrin	clay	0.3	▪ sodic subsoil
Glenarden	clay loam	0.3	▪ dispersive subsoil
Limewood	clay	0.3	▪ sodic subsoil
Rugby	loam	0.4	▪ sodic lower subsoil
Wondolin	clay	0.3	▪ sodic and saline subsoil
Poplar Box Alluvia			
Juandah	Clay	0.1	▪ dispersive A2 horizon ▪ poor workability when wet

Soil type	Surface soil composition	Topsoil stripping depth (m)	Potential constraints
Retro	Clay loam	0.15	▪ shallow topsoil depth ▪ poor workability when wet
Bymont			
Nimitybelle	clay	0.3	▪ strongly sodic subsoil ▪ hardsetting surface
Pamaroo	sandy loam		▪ sodic B horizon

Soil conservation plans

Although no approved soil conservation plans are present in the proposed pipeline study area, the following measures should be applied to soil conservation measures:

- existing soil conservation measures will be retained and maintained where they currently exist
- any soil conservation measures, such as contour banks, that are disturbed during works will be reinstated following construction.

9.6.4 POST CONSTRUCTION LAND USE

To maintain the existing land use and land suitability class after construction, the following measures should be implemented:

- topsoil should be stripped prior to construction and respread over the corridor following construction
- where applicable, the land surface should be left in a smooth even grade suitable for surrounding land use
- sodic or acidic subsoils should not be left on the land surface and should be buried below the rooting depth of crops (i.e. below about 0.6 m depth).

9.7 RESIDUAL IMPACTS

Following mitigation, the residual impacts are anticipated to be as follows:

- a buried pipeline
- some limitations on land use at sites of auxiliary infrastructure elements such as valves and signs
- potential restriction on landuse over the pipeline for farm infrastructure (i.e. sheds or irrigation equipment, etc.) and to practices that require deep excavation or disturbance of the soil.

9.8 REFERENCES

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