CHAPTER 17
SOIL AND LAND QUALITY

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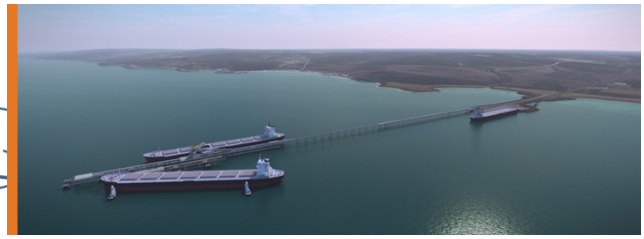

17 Soil and Land Quality

The region surrounding the proposed CEIP Infrastructure supports ongoing agricultural activity including mixed crops and grazing. The region forms part of the Western, Eastern and Lower Eyre Peninsula Agricultural Districts; responsible for a combined total crop production of 2,764,630 t in the 2013/14 season (PIRSA 2014). Soils in the Eyre Peninsula are generally nutrient poor; however when managed appropriately can be improved to provide significant economic returns (Soil Quality 2014).

This chapter provides an overview of the existing environmental values relevant to soil and land quality, including a review of known or suspected areas of site contamination and acid sulfate soils (ASS), soil characteristics and salinity. Soil disturbance during construction and operation has the potential to affect existing environmental values by reducing land quality and compromising the ability of the proposed CEIP Infrastructure site and adjoining areas to support ongoing agricultural activity. The scale of effect on existing environmental values is discussed, and where relevant, management and/or mitigation measures that would minimise impacts and risks are identified.

17.1 Applicable Legislation and Standards

The *Environment Protection Act 1993* (together with the *Environment Protection Regulations 2009*) is the key legislation relevant to land quality at the CEIP Infrastructure site. The Regulations outline activities that have the potential to result in site contamination. Additional legislation relevant to land quality is as follows:

- *Natural Resource Management Act 2004*
- *Development Act 1993*
- *Explosives Act 1936*

Further information regarding the requirements and relevance of the legislation is provided in Chapter 5. Specifically, the following standards provide a range of criteria relevant to land quality:

- *National Environment Protection (Assessment of Site Contamination) Measure 1999*
- *Environment Protection (Water Quality) Policy*
- Site contamination – acid sulfate soil materials (EPA 2007)
- Bunding and spill management guideline (EPA 2012)
- AS 1940-2004: The storage and handling of flammable and combustible liquids
- AS 1692-2006: Steel tanks for flammable and combustible liquids
- AS 2187.2-2006: Explosives: Storage and use – Use of explosives

The *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM) is established to provide a nationally consistent approach to identifying and managing site contamination. The NEPM refers to three different types of investigation levels: Ecologically-based Investigation Levels (EILs), Health-based Investigation Levels (HILs) and Groundwater Investigation Levels (GILs) which provide criteria (concentrations of contaminants) to guide assessment of risks to human health and the environment. This approach ensures sound environmental management practices are adopted by all stakeholders when managing site contamination.

The *Environment Protection (Water Quality) Policy* provides a framework to achieve the sustainable management of waters, utilising the ANZECC Guidelines for Fresh and Marine Water Quality (2000) as water quality trigger values, establishing discharge limits for particular activities. The discharge limits for metal, inorganic, organic and microbiological pollutants are outlined by the policy and must not be exceeded. Additional obligations are also placed on specific activities relevant to the CEIP, such as concrete batching and extractive industries, which require careful management of discharges and the handling of contaminated materials.

The EPA guidelines relating to bunding and spill management provide a framework for the storage and handling of chemicals and hazardous materials. Similarly, the acid sulfate soil materials guidelines outline measures for the identification of ASS materials, and practices for the management of such materials should they be encountered. The measures outlined in each of the guidelines will be incorporated into the design and control measures utilised during construction and operation of the CEIP Infrastructure.

The nominated Australian Standards each specify specific design criteria that will be incorporated into the design of the CEIP Infrastructure to protect the key environmental and stakeholder values relevant to land quality.

17.2 Assessment Method

A desktop environmental site history review and ASS desktop review (Jacobs 2014a, Jacobs 2014b and Jacobs 2014c) was undertaken to determine the potential risk of site contamination or ASS at the site of the proposed CEIP Infrastructure based on current and historical land uses.

The ASS desktop assessment was undertaken with reference to available information sourced from Soil of South Australia's Agricultural Lands (DWLBC, 2002). Soil characteristics were identified through existing geological maps and preliminary topsoil management planning for the CEIP (Jacobs 2014b). Soil characteristics identified in desktop investigations were confirmed during on-site geotechnical investigations and soil sampling.

17.3 Existing Environment

The following section provides an overview of the existing environment surrounding the proposed CEIP Infrastructure sites in relation to soils and land quality. Soil characteristics are identified, as well as any areas of existing site contamination or ASS.

17.3.1 Topsoil and Subsoil

The site of the proposed CEIP Infrastructure (Plate 17-1) is typically located within undulating sand plains, with inliers of hard basement rock protruding from the surface. The sand comprises older, eroded and partly consolidated carbonate sands of the Bridgewater Formation in the western half of the project area, with younger overlying quartz sands in the north and east (e.g. Moornaba Sand). Calcrete in sheet, rubble, nodular and powder forms is present to varying degrees in both of these geological units. In general, the older the host rock the more indurated the calcrete (Jacobs 2014a; 2014b; 2014c).

The most common soils in the region are Calcarosols (soils containing calcium carbonate). These soils are widespread in the pastoral districts of South Australia and the drier margins of the agricultural districts. Calcarosols are characterised by their calcium carbonate content, which ranges from 0-10% in surface soils, and up to 60% in the subsoils (Jacobs 2014d).

Two types of Calcarosols are predominant; calcareous earths and shallow sands over calcrete. Calcareous earths are easy to cultivate and their productivity for cereals in the agricultural regions of the Eyre Peninsula has been greatly enhanced through the application of fertilisers, insecticides and pesticides.

Typical characteristics of the calcareous earth in the Eyre Peninsula are depicted in Figure 17-1 and include:

- Surface soils neutral to alkaline
- Surface soils prone to water repellence and erosion
- Shallow depth (10-60 cm) and effective rooting depth
- Low water retention
- Subsoils high in salinity, alkalinity and boron toxicity
- Nutrients unavailable to plants
- Low to moderate fertility

Shallow sands over calcrete are common on the dunes, plains and low hills of aeolianite (wind-blown deposits) and dune limestone. They typically reach 60 cm in depth and are permeable. Typical characteristics of shallow sand over calcrete in the Eyre Peninsula include:

- Slightly acid to slightly alkaline
- Surface soils prone to water repellence and erosion
- Shallow depth and effective rooting depth
- Low water retention
- Boron in the subsoil
- Nutrients unavailable to plants
- Low inherent fertility
- Subsoils high in salinity

The CEIP Infrastructure site forms part of the Western, Eastern and Lower Eyre Peninsula Agricultural Districts which were responsible for a combined total crop production of 2,764,630 t in the 2013/14 season. Overall, the Eyre Peninsula region contributed approximately one third of the total State crop production (8,546,480 t) in the 2013/14 season (PIRSA 2014). Significant crop production occurs despite soils within the Peninsula being generally nutrient poor. Through the application of fertilisers and appropriate management, soils have been improved to provide significant economic returns (Soil Quality 2014). The soils also support remnant vegetation throughout the Peninsula, as discussed in Chapter 13.

Northern Infrastructure Corridor, April 2014

Northern Infrastructure Corridor, October 2011

Near Rudall, April 2014

Near Rudall, August 2011

Port Site, April 2014

Port Site, September 2013

Plate 17-1 Landscapes Throughout the CEIP Infrastructure

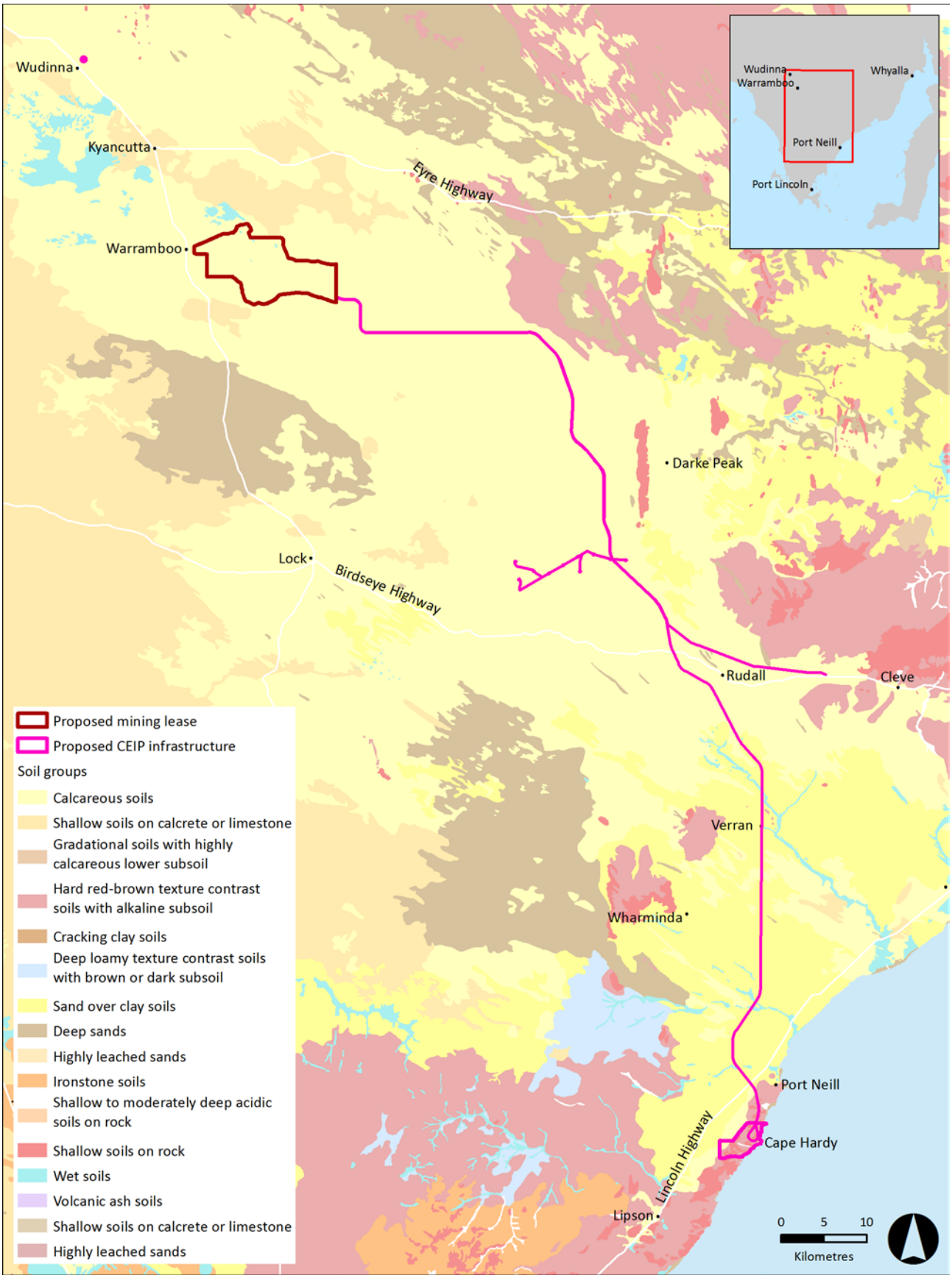

Figure 17-1 Soil Characteristics across the Project Area

17.3.2 Acid Sulfate Soils

Acid sulfate soils are naturally occurring and form in waterlogged areas with the presence of iron, sulphide and organic material. If exposed to air as a result of excavation or drainage, acid sulfate soils can react with oxygen to form sulfuric acid. Sulfuric acid can be toxic to flora and fauna, contaminate water supplies, or damage man-made structures (EPA 2014).

Acid sulfate soil potential across the proposed CEIP Infrastructure site and surrounding areas was determined based on available data (DWLBC, 2002), taking into account information with regard to the following:

- Groundwater conditions
- Site setting (i.e. topography, land clearance, low lying areas, floodplains, site area)
- Watercourses and surface water features, where present

Small, isolated portions of the proposed infrastructure corridor between Rudall and Verran, and between Verran and Cape Hardy were identified as being of medium to high risk for the potential presence of ASS (i.e. having greater than 30% potential for ASS). Figure 17-2 depicts the ASS potential throughout the proposed infrastructure corridor and surrounding areas. It is noted that the medium to high risk areas coincide with hydrologic features that are intersected by the proposed CEIP Infrastructure, namely the Driver River and Dutton River (refer Chapter 15 for more information on surface water features). No part of the port site or long-term employee village has been identified as at risk of ASS.

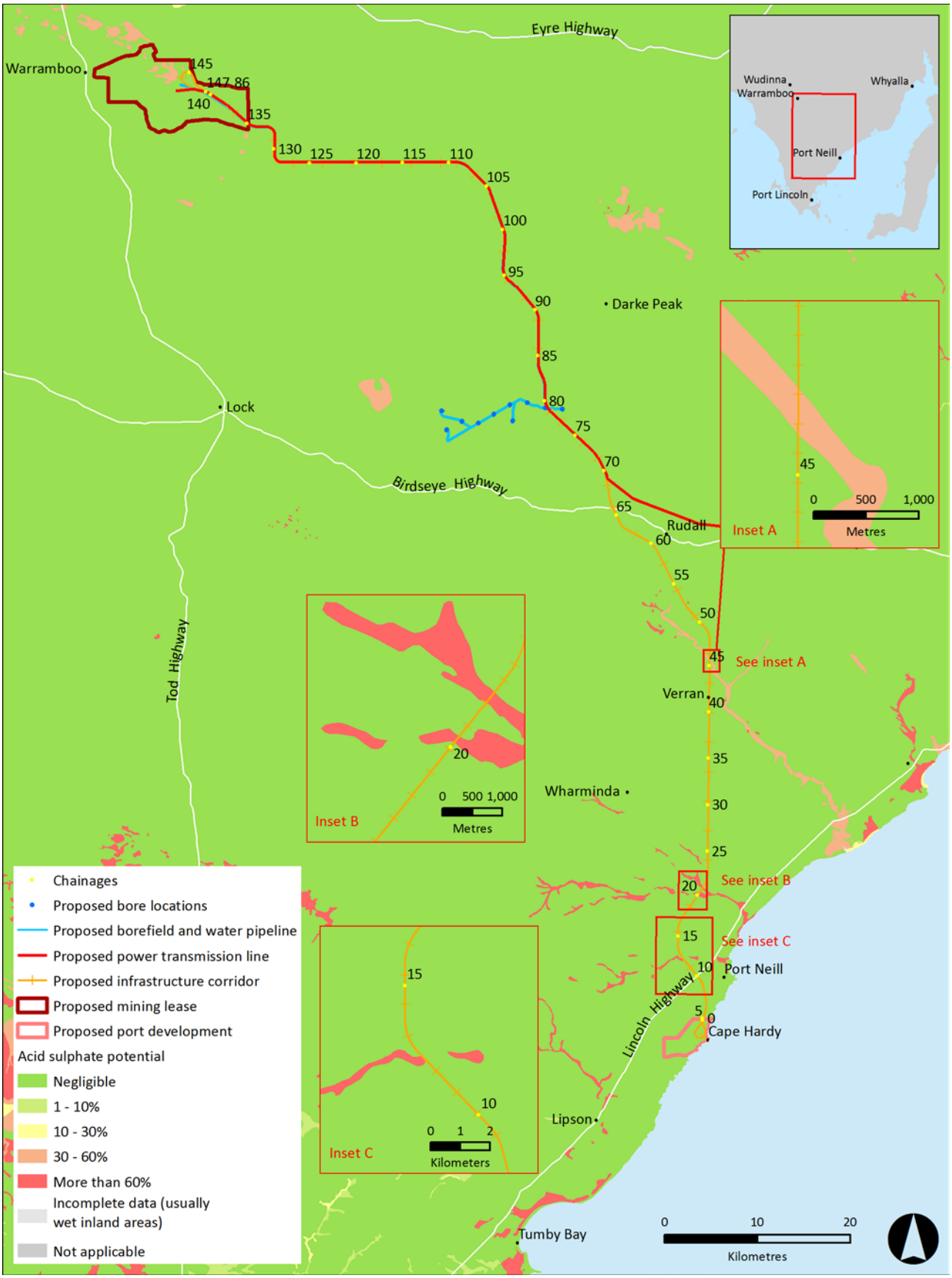

Figure 17-2 Potential ASS within the Infrastructure Corridor

17.3.3 Site Contamination

This section identifies potential sources of soil or groundwater contamination that may represent a risk to soil and land quality within the area of the proposed CEIP Infrastructure during construction and operation. Potential sources of contamination are identified by each component of the CEIP Infrastructure.

Port Site

Three unoccupied dwellings are currently located within the proposed port site, including a small number of storage sheds and associated agricultural infrastructure. The residences are located in the central-southern and north-western portions of the site. A review of historical site ownership indicated that the occupations of the previous private owners were generally listed as farmers and/or graziers.

Environment Protection Authority (EPA) records indicate that no agreements, orders, licences or other authorisations exist relating to the site. The EPA further advised that it does not possess any records or reports in respect to any previous environmental and/or contamination assessment of the land. No licences for the storage of dangerous goods exist for the port site within the SafeWork SA database.

Based on a review of available historical information, significant site contamination within the port site is considered unlikely. Potential contamination sources at the site are summarised in Table 17-1.

Table 17-1 Potential Contamination Sources at Proposed Port Site

Historical Activity	Potential Contaminants	Likelihood of Significant Contamination
Historical farming practices	Organochlorine Pesticides (OCP) and Organophosphorous Pesticides (OPP)	Considered to be low
Potential historical weeding practices	Broadleaf herbicides and weedicides	Considered to be low
Potential termiticide treatment beneath buildings present across the site	OCP and arsenic	Considered to be low
Potential fill materials on site beneath buildings/structures and roadways (and other areas of site)	Broad range of contaminants including heavy metals	Considered to be low
Onsite sewerage treatment systems at farming residences (e.g. septic tank, soakage trench)	Microbiological contaminants (e.g. *Escherichia coli*)	Considered to be low, however there may be isolated hot spots near residences
Potential fuel storage on remote farming residences	Total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylenes (BTEX), and polycyclic aromatic hydrocarbons (PAH)	Unknown but likely to be low
Individual rural landfills	Broad range of contaminants including heavy metals, phenols, methane	Unknown but likely to be low (no current or former licensed waste depots on the relevant EPA Section 7 records)
Potential asbestos containing materials in older buildings and structures	Asbestos	Unknown but considered to be limited to buildings and associated infrastructure

Infrastructure Corridor

The proposed infrastructure corridor predominately comprises agricultural land and, to a lesser extent, areas of remnant vegetation which are isolated to small patches. A review of aerial imagery combined with ground truthing indicates that farming residences are present at 20 locations within 500 m of the proposed infrastructure corridor. Based on aerial imagery and known historical and current land use it is anticipated that most properties surrounding the proposed infrastructure corridor have been owned by farmers and/or graziers.

Based on a review of available historical information, significant site contamination within the infrastructure corridor is considered unlikely. Potential contamination sources identified are summarised in Table 17-2.

Table 17-2 Potential Contamination Sources along Proposed Infrastructure Corridor

Historical Activity	Potential Contaminants	Likelihood of Significant Contamination
Application or administration of pesticides (agricultural activities)	OCPs, OPPs, metals (e.g. arsenic, boron)	Low given there was no evidence identified to suggest intensive agricultural activities occurred across the site (i.e. no small agricultural allotments, no evidence of glass houses)
Application or administration of herbicides (agricultural activities)	Phenoxy acid herbicides, triazine herbicides	Low given there was no evidence identified to suggest intensive agricultural activities occurred across the site (i.e. no small agricultural allotments, no evidence of glass houses)
Application or administration of fertilisers (agricultural activities)	Nutrients (e.g. nitrogen, phosphorous, sulfur), metals (e.g. boron, copper, iron, manganese, molybdenum, nickel, zinc)	Low given there was no evidence identified to suggest intensive agricultural activities occurred across the site (i.e. no small agricultural allotments, no evidence of glass houses)
Fill or soil importation for construction of roads and beneath bitumen road surfaces	Various, including metals and metalloids, petroleum hydrocarbons, pesticides, herbicides, asbestos	Low given that fill materials for roads are likely sourced locally from areas not likely to have been subject to PCAs
Application of bitumen road surfaces (pre 1970's bitumen with tar-based binders)	Petroleum hydrocarbons including: total recoverable hydrocarbons (TRH), monocyclic aromatic hydrocarbons (MAH), and polycyclic aromatic hydrocarbons (PAH)	Unknown but expected to be isolated to bitumen roads intersected by the site (e.g. Birdseye Highway and Lincoln Highway)
Illegal dumping of asbestos-containing materials (ACM) or other non-inert waste materials	Asbestos, broad range of CoC	Unknown, however no evidence was identified to suggest this ever occurred across the site

Long-Term Employee Village

The proposed long-term employee village to be located northeast of Wudinna, is largely vacant of any structures and is utilised for agricultural purposes. A review of historical ownership indicates that the site has always been utilised for agricultural purposes.

EPA records indicate that no agreements, orders, licences or other authorisations exist relating to the site. The EPA further advised that it does not possess any records or reports in respect to any previous environmental and/or contamination assessment of the land. No licences for the storage of dangerous goods exist for the site within the SafeWork SA database.

Based on a review of available historical information, significant site contamination at the proposed long-term employee village is considered unlikely. Potential contamination issues identified are summarised in Table 17-3.

Table 17-3 Potential Contamination Sources at Proposed Site of Long-Term Employee Village

Historical Activity	Potential Contaminants	Likelihood of Significant Contamination
Agricultural activities (associated with historical farming practices)	OCPs, OPPs, broadleaf herbicides and weedicides	Considered to be low
Fill or soil importation (associated with the minor development and construction within the site)	Various, including (but not necessarily limited to) heavy metals, total recoverable hydrocarbons (TRH), monocyclic aromatic hydrocarbons (MAH), polycyclic aromatic hydrocarbons (PAH) and pesticides OCPs and OPPs, asbestos	Considered to be very low

17.3.4 Summary of Key Environmental Values

The area comprising the proposed CEIP Infrastructure and its surrounds is currently managed to support the land for agricultural purposes, predominately grain cropping. Within the surrounding region there are scattered rural dwellings with a variety of ancillary infrastructure supporting the agricultural industry, such as grain silos and farm sheds.

Across the area of the proposed CEIP Infrastructure, two types of soil are prevalent; calcareous earths and shallow sands over calcrete. Characteristics of these soil types are largely consistent; prone to water repellence and erosion, shallow effective rooting depth, high levels of salinity, low inherent fertility and low levels of water retention. Remnant native vegetation is supported throughout the Eyre Peninsula despite soils being generally nutrient poor. The application of fertilisers and appropriate management has improved soils to provide significant economic returns for the agriculture industry.

The likelihood of significant site contamination is considered to be low given current and historical uses of the CEIP Infrastructure area. Similarly, the overall likelihood of ASS being present within the area of the proposed CEIP Infrastructure is considered to be low, with the exception of small isolated areas within the infrastructure corridor at the intersection of the Driver and Dutton Rivers (as previously depicted in Figure 17-2).

17.4 Design Measures to Protect Environmental Values

The following design control measures have been incorporated to minimise impacts and risks to soils and land quality as a result of the construction and operation of the proposed CEIP Infrastructure:

- Areas of potential site contamination or ASS have been avoided where practicable when siting infrastructure.
- Hydrocarbon and chemical storage facilities will be designed in accordance with Australian Standards, relevant legislation and best practice guidelines.
- Fuel and lubricant storage and dispensing facilities will be designed and installed in accordance with:
    - AS 1940-2004: The storage and handling of flammable and combustible liquids
    - AS 1692-2006: Steel tanks for flammable and combustible liquids
    - Bunding and spill management guideline (EPA 2012)
    - Relevant South Australian legislation
    - Best practice guidelines
- Establishment of designated haul routes and light vehicle roads to restrict soil compaction to designated areas.

17.5 Impact Assessment

Activities undertaken during construction and operation of the proposed CEIP Infrastructure represent a number of impacts and risks to the existing environmental values of the area. Impacts considered as part of the soil and land quality assessment include:

- Loss of soil quality
- Soil compaction
- Contamination of soil
- Disturbance of existing site contamination or ASS
- Erosion (discussed in Chapter 15)
- Propagation of weed species (discussed in Chapter 13)
- Loss of productive agricultural land (discussed in Chapter 22)

This section assesses soil and land quality impacts that would result from the construction and operation of the proposed CEIP Infrastructure.

Impacts have been assessed in accordance with the impact assessment methodology outlined in Chapter 9 and Section 17.2. A summary table of key impacts is provided in Section 17.5.5.

17.5.1 Loss of Topsoil During Stockpiling

Topsoil will be stripped from temporary construction areas and stockpiled from the commencement of construction. Stockpiles will be categorised based upon the former land use and the seedbank they contain (i.e. native seedbank, agricultural seedbank). The topsoil will be stockpiled until it is utilised in progressive rehabilitation, exposing the stockpiles to wind and rain for an extended duration. Without appropriate management, the extended exposure of stockpiles can result in decreased seedbank viability and exposure to weeds. Stockpiles are also vulnerable to wind and water borne erosion, contributing to dust generation and loss of topsoil.

Soil management procedures will be established to minimise the loss of soil quality. The soil management procedures will provide for the appropriate stockpiling of soil, including maximising opportunities for progressive rehabilitation. Specifically, soils beneath compacted areas during site rehabilitation will be deep ripped to facilitate nutrient cycling and biological processes to support reintroduction of agriculture or revegetation, and topsoil will be stripped prior to disturbance for use during rehabilitation (refer Section 17.6 for further information).

Soil stockpiling activities will largely maintain the quality of soil, and maximise the amount of soil suitable for rehabilitation and future resumption of agricultural activities at temporary construction areas. As such, no significant loss of usable topsoil is anticipated at the CEIP Infrastructure site as a result of topsoil stripping or stockpiling activities, and is considered to be a **negligible impact**.

17.5.2 Soil Compaction

Soil will be compacted with the establishment of roads and hardstand areas (including temporary construction areas) throughout the proposed CEIP Infrastructure footprint. Compaction of soil can result in a number of detrimental effects on soil quality and future crop yield potential (Department of Primary Industries 2004) including:

- Reduced capacity for water infiltration into soil
- Increased potential for surface water runoff and soil erosion
- Impeded root growth and decreased capability of crops to take up nutrients and water from soil
- Altered pore space size and distribution resulting in reduced cycling and release of plant-available nutrients

As outlined in Section 17.6, deep ripping of compacted soil will be undertaken in areas to be rehabilitated for agricultural or revegetation purposes. Areas of the CEIP Infrastructure to be rehabilitated include temporary construction areas such as hardstands and laydown areas. As such, impacts associated with soil compaction will be limited within the proposed CEIP Infrastructure footprint, and are able to be remediated in the short term through deep ripping of compacted areas. As such, soil compaction is considered to be a **low impact**.

17.5.3 Contamination of Soil

The overarching objective in the storage and handling of hydrocarbons and chemicals is to prevent spills from occurring and as such, spillage is not planned as part of the project. Therefore, the spillage of hydrocarbons or chemicals is considered to be a **negligible impact**, and is further discussed as a risk associated with the project in Section 17.7.

17.5.4 Disturbance of Existing Site Contamination or ASS

The presence of any existing site contamination or ASS has not been confirmed anywhere within the proposed CEIP Infrastructure footprint, and as outlined in Section 17.3 is considered unlikely to be encountered. Therefore, the disturbance of existing site contamination or ASS is considered to be a **negligible impact**, and is further discussed as a risk associated with the project in Section 17.7.

17.5.5 Summary of Impacts

Impacts relating to soils and land quality as a result of the construction and operation of the proposed CEIP Infrastructure are summarised in Table 17-4. Through the implementation of design and management controls, all impacts have been categorised as ‘low’ or ‘negligible’ and were considered as low as reasonably practicable (ALARP). As such, the impacts do not warrant specific control measures beyond standard environmental management controls.

Table 17-4 Soils and Land Quality Impacts

Impact	Comment	Level of Impact
Loss of topsoil suitable for rehabilitation purposes as a result of stockpiling (e.g. seedbank viability, volume of soil)	Topsoil stripped during construction activities will be stockpiled for use in progressive rehabilitation. A soil management programme will provide for the appropriate stockpiling of soil, the deep ripping of compacted areas to facilitate nutrient cycling and maintenance of the seedbank.	Negligible
Compacted soil reducing soil productivity and/or vegetation growth	Compaction of soil can reduce water infiltration, increase runoff and erosion, impede root growth and reduce the release of plant available nutrients. The soil management programme will outline requirements for deep ripping of compacted areas to be undertaken during rehabilitation.	Low
Contamination of soil through the uncontrolled release of hydrocarbons or chemicals	Not planned as part of construction or operation. Whilst spills may occur, they are not planned and are considered a risk to the project and are discussed in Section 17.7.	Negligible
Disturbance of existing site contamination or ASS	Significant site contamination or ASS has not been confirmed anywhere within the footprint of the CEIP Infrastructure.	Negligible

17.6 Control and Management Strategies

In order to minimise the impact on, and potential risks to soil and land quality during construction and operation, a series of control strategies and management approaches will be incorporated into the Construction Environmental Management Plan (CEMP) or Operations Environmental Management Plan (OEMP) and implemented for each project component. Key control and management strategies are summarised in Table 17-5. Chapter 24 provides a framework for implementation of these strategies and a register of the environmental controls for the whole of the CEIP Infrastructure is presented in Appendix AA (Construction) and Appendix BB (Operation).

Table 17-5 Control and Management Strategies: Soil and Land Quality

Control and Management Strategies	EMP ID
Construction	
Restriction of vegetation clearance to the project footprint and undertaking progressive rehabilitation where practicable to minimise erosion.	SD_C6

Develop and implement soil management procedures to manage soil compaction and loss of soil quantity, including:
• Vehicle movements limited to predetermined haul routes and light vehicle roads to minimise vehicle compaction of soil.
• Deep ripping of soils beneath compacted areas during site rehabilitation to facilitate nutrient cycling and biological processes to support agriculture or revegetation.
• Develop and implement procedures to minimise off-road driving and access to non-designated areas.
• Stripping topsoil prior to disturbance and stockpiling outside the area of disturbance at a height of no greater than 2 m, where practicable, to minimise compaction and ensure the soil does not have to be repeatedly moved throughout the life of the project.
• Locating stockpiles away from surface water flows and trafficked areas.
• Developing and maintaining a topsoil inventory, detailing:
  • Original location of the topsoil
  • Likely seedbank properties within stockpiles
  • The volume of topsoil stockpiled
  • Stockpile location
• Topsoil progressively distributed on rehabilitated surfaces where practicable
	SD_C7

Control and Management Strategies	EMP ID
As ASS has been identified as potentially occurring within the infrastructure corridor, an ASS management plan will be prepared. The ASS management plan will be developed on the principles of avoidance, minimisation of disturbance and treatment using a risk-based approach: • **Avoidance** – avoiding potential areas of ASS will be maximised when finalising the construction methodology and location of temporary construction areas at the CEIP Infrastructure site. • **Minimisation of disturbance** – when disturbance of potential ASS cannot be avoided, alterations to the design and construction methodology will be investigated to limit the extent of disturbance of potential ASS material. • **Treatment** – where required, application of alkaline materials (e.g. lime dosing) will be undertaken to mitigate impacts should the presence of ASS material be confirmed. Soils identified to require treatment will be immediately neutralised and managed at the excavation site, or segregated and isolated from uncontaminated soil and treated at a separate facility.	SD_C8
Develop and implement dune management procedures to dune stability and blowouts, including the following (or similar): • Establishment of sand trapping fences to minimise erosion and support in the restoration of dunes through the accumulation of sand. • Revegetation of dune surfaces through the application of hydro mulch with seedbank to stabilise exposed surfaces. • Battering of slopes with materials more stable than sand (such as a mixture of sand and clay, or rock mulch).	SD_C10
Operation	
Impacts to land quality as a result of erosion and uncontrolled runoff will be managed through the implementation of surface water CEMP and OEMP requirements.	SD_O1 SD_O2 SD_O3
Impacts to land quality as a result of the introduction of weeds will be managed through the implementation of weed management CEMP and OEMP requirements.	PPA_O1 PPA_O2
To reduce the risk of contaminating soils during the storage and handling of hydrocarbons and chemicals, the following measures will be implemented: • Develop and implement chemical and fuel storage, handling and emergency response procedures in accordance with AS 1940-2004. • Develop and implement a regular inspection programme to audit and monitor fuel and chemical storage areas to ensure integrity, housekeeping and correct use. • Maintain appropriate spill kit/clean up material, as required by the developed procedures.	CHS_C7 CHS_C8 CHS_C9

17.7 Residual Risk Assessment

This section identifies and assesses soil and land quality risks that would not be expected as part of the normal operation of the CEIP Infrastructure, but could occur as a result of faults, failures and unplanned events. Although the risks may or may not eventuate, the purpose of the risk assessment process was to identify management and mitigation measures required to reduce the identified risks to a level that is considered to be as low as reasonably practicable and therefore acceptable. A summary of the residual environmental risks after management and control strategies are applied is presented in Section 17.7.6. The soil and land quality management and mitigation measures identified are presented in Section 17.6 and form the basis of the Environmental Management Framework presented in Chapter 24.

Through the adoption of design modification or specific mitigation measures, all identified risks were reduced to levels of medium or lower, which is considered to be as low as reasonably practicable and therefore acceptable. The key environmental risks would be monitored through the CEIP environmental management framework.

17.7.1 Contamination of Land

The storage and handling of hydrocarbons and chemicals as part of the proposed CEIP Infrastructure creates potential for soil contamination to occur as a result of uncontrolled releases. At a local level, soil or groundwater contamination may reduce the ability of temporary construction areas to support agriculture, inhibit revegetation and limit future land uses.

More broadly, soil contamination can represent a threat to human health and biological processes. Given the design and control measures to be implemented (as previously described in Sections 17.4 and 17.6), the consequences of a spill or leak are considered to be **minor**; localised and able to be immediately remediated.

Considering that a range of hydrocarbons and chemicals are to be stored and used at various locations across the proposed CEIP Infrastructure, it is considered **possible** that a spill or leak will occur at some point during the construction or operation of the proposed development. As such, the risk associated with the uncontrolled release of hydrocarbons and chemicals is considered to be **low**.

17.7.2 Disturbance of Existing Site Contamination

Pre-existing site contamination can represent a threat to public safety or the environment if not appropriately managed. If site contamination is encountered, the consequences are considered to be **moderate**; localised and, at worse, able to be remediated in the long term. Based on the current and historical use and development of the proposed CEIP Infrastructure (and its immediate surrounds) the potential for significant site contamination to be present is considered to be low. As such, the likelihood of disturbing existing site contamination is considered to be **rare**. Therefore the risk associated with the disturbance of existing site contamination is considered to be **low**.

17.7.3 Disturbance of Existing Acid Sulfate Soils

ASS can represent a threat to public safety or the environment if not appropriately managed. Given the management measures outlined in Section 17.6, the consequences of encountering ASS are considered to be **minor**; localised and able to be immediately remediated. A desktop review of potential ASS indicated that isolated areas of the site (shown on Figure 17-2) have a greater than 30% potential for the presence of ASS. As such, it is considered **possible** that ASS will be encountered during construction and operation of the CEIP Infrastructure. Therefore, the risk associated with disturbing ASS materials is considered to be **low**.

17.7.4 Elevated Soil Salinity

Saline water will be extracted from the borefield for usage at the proposed mine site. Saline water may also be used for dust suppression purposes during construction of the CEIP Infrastructure. Uncontrolled discharge of saline materials may potentially elevate soil salinity levels, reducing soil quality and therefore restricting vegetation growth and agricultural productivity. An uncontrolled discharge may occur via:

- Spill or leak from water distribution infrastructure or water storage infrastructure
- Failure of surface water management measures to contain runoff
- Drift of dust suppression spray if application occurs during extreme weather events (e.g. high winds)
- Overuse of saline water for dust suppression

If elevated soil salinity off-lease does occur, the consequences are considered to be **minor**; limited to localised areas and able to be remediated.

Saline water will only be used for dust suppression during construction of CEIP Infrastructure and runoff from areas subject to saline water application will be controlled and directed to swales or sedimentation ponds. To maintain performance of the swales and sedimentation ponds if required, sediment will be periodically removed and disposed of appropriately in accordance with EPA requirements. Regular inspection of water distribution infrastructure within the infrastructure corridor will be undertaken for the early detection and rectification of potential spills or leaks. As a result of this, in addition to the surface water management strategies outlined in Chapter 15, it is considered **unlikely** that the discharge of saline water will limit the viability of soils to support vegetation or agriculture.

As such, the risk of saline water discharge restricting vegetation growth or agricultural activities outside of the proposed mining lease is considered to be **low**.

17.7.5 Loss of Soil Quality

Topsoil stripped from temporary construction areas within the CEIP Infrastructure area would be stored from the commencement of construction until used during rehabilitation. Improper storage or management of topsoil may result in the topsoil becoming unusable for rehabilitation purposes. Improper stockpiling does not compromise rehabilitation practices which can still be undertaken through seed collection and direct seeding.

Successful soil management programmes have been undertaken at a number of mining projects throughout South Australia, resulting in successful rehabilitation of land. For example, Arrium's Southern Iron operations successfully rehabilitated 76 Ha of previously cleared land during the 2012-13 financial year, utilising the local seedbank (Arrium 2013).

The consequences of incorrectly managing stockpiles are considered to be **moderate**; localised and able to be resolved in the long term through the procurement of additional topsoil or seeding practices. Given the management strategies outlined in Section 17.6, it is considered **rare** that topsoil will be improperly stockpiled. As such, the risks associated with improper topsoil stockpiling are considered to be **low**.

17.7.6 Dune Instability

Cutting through existing sand dunes to support the construction of the railway line can result in dune instability or 'blowouts'. Blowouts of dunes can occur when vegetation is cleared from the dune, leaving exposed sand that then blows across localised areas of the landscape in large quantities. Sand generally moves with the prevailing wind, resulting in blowouts being able to extend from the source of the clearance, smothering additional vegetation at the outer edge of the blowout and progressively increasing in area.

As previously outlined in Section 17.6, dune instability and blowouts will be managed (if required) through the use of sand trapping fences, revegetation of dunes and/or battering slopes with material more stable than sand (e.g. a mix of sands and clay). As such, significant blowout of dunes is not anticipated, with any landform alterations anticipated to represent a **minor** change. It is considered **possible** that minor alterations to the local landform will occur at some point during the construction and operation of the CEIP Infrastructure. As such, the risk of dune blowout as a result of railway cuttings is considered to be **low**.

17.7.7 Summary of Risks

A summary of each of the identified risks is provided in Table 17-6. All identified risks are categorised as 'low', and were considered ALARP and not warrant specific control measures beyond standard environmental management controls.

Table 17-6 Residual Risk Assessment Outcomes: Soils and Land Quality

Risk Event	Pathway	Receptor	Project Phase	Likelihood	Consequence	Residual Risk
Contamination of land	Uncontrolled releases of hydrocarbons and chemicals	On site/ adjoining property soil resources	Construction Operation	Possible	Minor	Low
Disturbance of existing contaminated land	Construction activities (e.g. excavation of land)	On site/ adjoining property soil resources	Construction	Rare	Moderate	Low
Disturbance/ oxidisation of ASS	Construction activities (e.g. excavation of land)	On site/ adjoining property soil resources	Construction	Unlikely	Minor	Low
Elevated soil salinity restricting vegetation growth and agricultural activity	Saline water use for dust suppression purposes/spills and leaks	On site/ adjoining property soil resources	Construction Operation	Unlikely	Minor	Low
Loss of soil quality	Improper storage/care of stockpiled material	On site soil resources	Construction Operation	Rare	Moderate	Low
Dune instability or blowout	Railway cuttings through dunes	Existing dunes	Construction Operation	Possible	Minor	Low

17.8 Findings and Conclusion

A site history assessment and ASS desktop review was conducted for the proposed infrastructure corridor, port and long-term employee village. The presence of site contamination at the CEIP Infrastructure sites was considered to be unlikely based on the historical use of land for agricultural purposes. Equally, the risk of disturbance of ASS was considered to be negligible throughout the majority of the proposed CEIP Infrastructure sites. Small, isolated portions of potential ASS were identified along the proposed infrastructure corridor at the intersection of watercourses. The risk associated with disturbance of these areas of potential ASS will be mitigated through the preparation of an ASS management plan and the principles of avoidance, minimisation of disturbance and neutralisation (as required).

Temporary construction areas subject to soil compaction will be deep ripped to facilitate nutrient cycling and biological processes to support reintroduction of agriculture or revegetation. Soils will be remediated to support envisaged land uses should spillage of hazardous materials such as chemicals or hydrocarbons occur.

Additional impacts and risks relevant to soil and land quality are discussed elsewhere in the EIS, including erosion (Chapter 15), propagation of weed species (Chapter 13) and loss of productive agricultural land (Chapter 22). Once design and mitigation measures have been considered, residual impacts were categorised as 'negligible' or 'low' and residual risks to land quality were categorised as 'low'. As such, impacts and risks were considered to be as low as reasonably practicable and not warrant specific control measures beyond standard environmental management controls. Consequently, impacts and risks associated with soil and land quality were not considered further in the impact assessment.