Water Resources

4. WATER RESOURCES

4.1. Introduction

This Chapter provides a description of the existing groundwater and surface water environments in the study area. The study area encompasses the corridor for the proposed rail spur from the existing Whyalla – Port Augusta rail line to the proposed Bulk Commodities Export Facility (BCEF) and the site itself. The possible impacts on water quality and quantity associated with the construction, operation and decommissioning of the Project are assessed and recommendations regarding mitigation of these impacts are provided. Specifically, this Chapter focuses on both the groundwater systems and the perennial, ephemeral and tidal streams within the study area.

4.2. Relevant Legislation

The following legislation, policy and guidelines were identified as relevant and have been referenced in the preparation of this Chapter.

- *Environment Protection Act 1993*
- *Environment Protection (Water Quality) Policy 2003.*

4.2.1. Environment Protection Act 1993

Environmental water quality in South Australia is protected by the Environment Protection Act 1993 (EP Act) and any subsequent protection policies made under it. The EP Act requires that *'all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment and to prevent, reduce, minimise or where possible, eliminate harm to the environment'.*

Part five of the EP Act sets out specific Environment Protection Policies that outline the requirements or standards enforced under the Act. The Environment Protection (Water Quality) Policy (EPP Policy) together with the EP Act forms the legislative framework which regulates the activities likely to affect the surface water and groundwater.

Further, the EP Act also identifies Water Protection Areas (WPA's) within South Australia that have been defined to provide special environmental protection.

4.2.2. Environment Protection (Water Quality) Policy 2003

This policy applies to all surface waters and underground waters in the State and provides the most specific and detailed guidance for the protection of the State's water sources.

This policy specifies the Environmental Values (EVs) for protection of designated water bodies and defines the water quality criteria for protecting the specified environmental values. This policy imposes a general duty of care to ensure that all reasonable and practicable measures are applied to meet applicable water quality criteria. Schedule One of this policy defines the protected EVs and Schedule Two provides the water quality criteria. They are discussed further in the following sections.

4.2.2.1. Environmental Values

The protected EVs for inland surface water and groundwater components as defined under Schedule One of the EPP Policy includes the protection or enhancement of the following:

- Fresh water aquatic ecosystems
- Human uses which include:
  - Recreational values (primary and secondary)
  - Aesthetic values
  - Drinking water uses
- Agriculture and aquaculture uses, including irrigation and livestock
- Industrial uses.

The EP Act and the EPP Policy refer to WPAs in South Australia, which are defined for the purpose of providing specific environmental protection beyond the general requirements of the Act. The study area does not include or extend into any defined WPAs.

The relevant EVs for protection of inland surface water (the term used for all terrestrial water bodies) and groundwater is tabulated below in **Table 4.2a** in accordance with the EPP policy.

The applicable environmental values for the waters within the study area are:

- Protection of freshwater aquatic ecosystems– surface water and groundwater
- Protection of recreational and aesthetic values – surface water and groundwater
- Industrial – groundwater only, which is utilised for irrigation by Santos as described below and therefore agricultural water quality criteria are considered more appropriate in this case.

There is no current use of surface water for potable, agriculture, aquaculture or industrial purposes within the study area. The industrial value of groundwater is on the basis that there are records of two potentially operational bores in the locality (unit nos. 6432-1097 and 6432-1101) which are both within the Santos terminal area at Port Bonython (WaterConnect, 2013). The bores are listed as irrigation bores. They are drilled to a depth of ten metres and eight metres respectively into the Simmons Quartzite and no yield or salinity data is recorded.

Table 4.2a: Applicable Environmental Values

Water body	Aquatic Ecosystem		Recreation & Aesthetics			Potable	Agriculture/Aquaculture			Industrial
	Fresh	Marine	Primary Contact	Secondary Contact	Aesthetics		Irrigation	Livestock	Aquaculture	
Inland surface water	X	-	X	X	X	X	X	X	X	X
Groundwater	X	-	X	-	X	X	X	X	X	X

4.2.2.2. Water Quality Criteria

The water quality objectives associated with the applicable EVs are presented in **Table 4.2b** below.

Table 4.2b: Water Quality Criteria

Pollutants	Protected Environmental Values			
	Aquatic Ecosystem	Recreation & aesthetics		
	Freshwater	Primary	Secondary	Aesthetics
Metal Pollutants (mg/L)				
Aluminium (soluble)	0.1			
Antimony (total)	0.03			
Arsenic (total)	0.05			
Beryllium (total)	0.004			
Boron (total)				
Cadmium (total)	0.002			
Chromium (total)				
Chromium IV	0.001			
Cobalt (total)				
Copper (total)	0.01			
Iron (total)	1			
Lead (total)	0.005			
Lithium (total)				
Manganese (total)				
Mercury (total)	0.0001			
Molybdenum (total)				
Nickel (total)	0.15			
Selenium (total)	0.005			
Silver (total)	0.0001			
Thallium (total)	0.004			
Uranium (total)				
Vanadium (total)				
Zinc (total)	0.05			

Pollutants	Protected Environmental Values			
	Aquatic Ecosystem	Recreation & aesthetics		
	Freshwater	Primary	Secondary	Aesthetics
Inorganic Pollutants(mg/L)				
Ammonia (total as nitrogen)	0.5			
Ammonia (NH3 as nitrogen)	0.01			
Biochemical Oxygen Demand (5 day test)	10			
Chlorine (total)	0.003			
Colour (Hazen units)	30			
Fluoride				
Oxidised nitrogen (as nitrogen)	0.5			
Phosphorus (total as phosphorus)	0.5			
Phosphorus (soluble as phosphorus)	0.1			
Salinity (percentage variation)	10			
Sulphide	0.002			
Suspended Sediment	20			
Total nitrogen (as nitrogen)	5			
Total organic carbon	15			
Turbidity (Nephelometric Turbidity Units)	20			
Organic Pollutants(mg/L)				
Chlorinated phenols (mg/L)				
monochlorophenol	0.007			
2,4-dichlorophenol	0.0002			
trichlorophenol (total)	0.018			
tetrachlorophenol	0.001			
Oil and grease	10			10
pentachlorophenol	0.00005			

Pollutants	Protected Environmental Values			
	Aquatic Ecosystem	Recreation & aesthetics		
	Freshwater	Primary	Secondary	Aesthetics
Chlorobenzenes (mg/L)				
1,2-dichlorobenzene	0.0025			
1,3-dichlorobenzene	0.0025			
1,4-dichlorobenzene	0.004			
monochlorobenzene	0.015			
1,2,3-trichlorobenzene	0.0009			
1,2,4-trichlorobenzene	0.0005			
1,3,5-trichlorobenzene	0.0007			
1,2,3,4-tetrachlorobenzene	0.0001			
1,2,3,5-tetrachlorobenzene	0.0001			
1,2,4,5-tetrachlorobenzene	0.0002			
pentachlorobenzene	0.00003			
hexachlorobenzene	0.000007			
Organotins				
tributylins	0.00008			
Other organic pollutants (mg/L)				
benzene	0.3			
pesticides	0			
polyaromatic hydrocarbons (PAHs)	0.003			
phenol	0.05			
polychlorinated biphenyls (PCBs)	0.000001			
2,3,7,8 -tetrachlorodibenzodioxin (2378 TCDD)	0			
toluene	0.3			
Microbiological pollutants (organisms/ 100 ml)				
Faecal coliforms or E.coli		150	1000	
Enterococci		33		
Oxygen (dissolved)	> 6			
pH (pH units)	6.5 - 9			

4.3. Methodology and Assumptions

4.3.1. Review of Existing Information

The existing groundwater and surface water characteristics have been assessed by a review of available information both in terms of data collected and held by government agencies, as well as information previously discovered in background information relating to previous environmental assessments and studies.

Field investigations were not undertaken with respect to groundwater as the data and the characteristics of the environment indicate its occurrence is very limited in quantity. This is supported by the area's low rainfall which limits recharge and the local geology and rock properties which indicate the likelihood of fractured rock aquifers of limited storage and yield. On this basis the existing data was considered to adequately assess the likely baseline condition and enable any impacts of the proposed development to be assessed.

Field investigations were also not undertaken with respect to surface waters. The occurrence of rainfall to generate sufficient, sustained flows in the ephemeral drainage lines is uncommon and base flows do not occur.

In developing the Project, an objective has been and will be to avoid impacts where feasible. The assessment of any residual impacts the proposed BCEF activities may have on groundwater and surface water was carried out by identifying those activities, evaluating the potential impact on the environmental values described in **Section 4.2.2.1**, considering the significance and likelihood of such impact, rating the risk and proposing the mitigation. Where appropriate, mitigation will include field work and appropriate actions which are defined in **Chapter 19, Environmental Management Plan.**

For the purposes of producing assessment description of the existing environment, a desktop investigation was undertaken based on the available information. The desktop study included:

- Review of available GIS datasets including topographical information, watercourses, geology, vegetation and land use. The datasets were provided by the Department of Environment, Water and Natural Resources
- Review of available background information, including previous EIS reports that covered the study area. **Section 4.3.1.1** lists the reports reviewed
- Identification of any existing stream gauging stations collecting water quality data in the study area
- Review of the DEWNR groundwater data available through the WaterConnect website of the South Australian Government, including salinity, lithology and groundwater levels
- Review of the Australian River Assessment System (AUSRIVAS) database for available water quality data
- Review of the DEWNR WaterConnect database for existing Environment Protection Agency (EPA) Aquatic Ecosystem Condition reports and monitoring data in the study area
- Review of climate records including rainfall records and evaporation data for the Whyalla region provided by the Bureau of Meteorology.

4.3.1.1. Background Information

The following reports were reviewed to understand the existing environment of the study area relating to surface water and groundwater:

- Olympic Dam Expansion Draft Environmental Impact Statement published in 2009 by BHP Billiton (BHPB) including **Chapter 11 Surface Water, Chapter 12 Groundwater, Appendix J Surface Water** and **Appendix K Groundwater and Geochemistry**
- Eyre Peninsula Coastal Action Plan and Conservation Priority Study, published in 2011 by the Eyre Peninsula NRM Board and Department of Environment and Natural Resources
- Assessment of the Environmental Impact of the Port and Terminal Facilities at Stony Point published in 1981 and proposed by Santos Limited on behalf of the Cooper Basin Producers.

It is noted that AUSRIVAS and WaterConnect databases do not contain any specific water quality or aquatic ecosystem condition information on or relevant to the study area or the Port Bonython area in general.

4.3.2. Significance Criteria

The surface water and groundwater in the study area have been assessed according to the environmental values stipulated for these waters in EPP Policy and these form a key component to the significance criteria for this assessment. The final significance criteria are given in **Table 4.3a** below.

Table 4.3a: Impact Significance Criteria – groundwater and surface water

Impact Significance/ Consequence	Description of Significance
Very High	Impact is considered critical to the decision making process. They tend to be permanent or irreversible, long term and are of national significance, e.g. the Murray Darling system. Indicated by a long-term, irreversible change to water quality and associated environment value. Long-term change, irreversible to groundwater quality (i.e. greater than 20 years) that supports a protected EV, changes to groundwater levels or bore pressure to the extent that it is unusable for the purpose it has been protected for i.e. protection of aquatic ecosystems, recreation and aesthetics or industrial use.
High	Impact is considered important to the decision making process. They tend to be permanent, ranging long term to medium term, and are of State significance. Indicated by a medium term loss of environmental values ascribed to surface and ground waters that can be mitigated only over the medium-term (i.e. within seven to 20 years). The quality and quantity of groundwater is changed to the extent it is unusable for its purpose without significant treatment and regularly exceeds water quality criteria.
Moderate	These impacts are considered as relevant to decision making process (but not likely to be key decision making issues) and tend to range from short to medium (i.e. one to seven years) and are of regional or local significance. Indicated by: » Deterioration of water quality conditions of surface waterways for a medium term that can be mitigated » Change in water quality of surface waterways with breaches to selected parameters as documented in the EPP water quality criteria » Short to medium term changes to the quality and quantity of groundwater to the extent that it is not suitable for its intended environmental value
Minor	Impacts are recognisable or detectable, but deemed acceptable. These impacts are not considered as key to decision making but are relevant when considering mitigation measures. Indicated by: » A temporary change to existing surface or ground water quality or hydrological processes that is easily mitigated » A short-term deterioration of water quality for selected parameters with impacts limited to local scale » Permanent or long term lowering of groundwater level one or both of the irrigation bores so that pumping is no longer possible.
Negligible	Negligible impact at local scale or minimal change to the existing situation. Indicated by: » No change to existing surface or ground water quality or changes that are beneath levels of detection » Temporary or medium term lowering of groundwater level at one or both of the irrigation bores so that pumping is no longer possible.
Beneficial	The quality and quantity of water is improved beyond existing background levels that support EVs.

4.4. Existing Environment

4.4.1. Study Area Characteristics

4.4.1.1. Topography

Topographic information was obtained from the DEWNR dataset, supplemented by descriptions of the wider area and specific locations in published documents referenced in **Section 4.3.1.**

The main elements of the proposed BCEF are located on the low plateau of the Point Lowly peninsula which forms the southern extremity of the Cultana Ridge, part of the Eyre Peninsula.

The ridge reaches a maximum elevation of approximately 66m Australian Height Datum (AHD) in the Project area while the adjacent plain is less than 10m AHD. The east side of the ridge is formed of steep cliffs and crossed by frequent short, natural drainage channels. The slope on the western side is less steep and the drainage pattern is more extensive. The eastern side of the ridge is largely bare of vegetation while the west side is more vegetated.

The Long Sleep Plain is flat and low, with salt flats and lagoons in the intertidal zone.

4.4.1.2. Surficial Geology and Soils

The Cultana Ridge comprises Quaternary sediments underlain by quartzite rock of the Simmens member of the Neoprotorozoic (Precambrian) Tent Hill formation. This is a cream coloured blocky sandstone, resistant to weathering (in Appendix K of BHPB, 2009).

The Long Sleep Plain is formed of coastal marine sediment assigned to the Saint Kilda Formation, of Holocene age. These strata comprise calcareous, fossiliferous sand and mud of intertidal sand flats, beaches and tidal marshes; organic, gypsiferous clay of supratidal flats. This is shown in **Figure 4.4a**.

4.4.2. Groundwater Conditions

4.4.2.1. Occurrence

Information on groundwater in the study area is limited, and most of the following account is based on inference. There are no monitoring wells in the study area or the immediate hinterland, and limited records of bores in the vicinity with two active irrigation bores identified within the Santos facility. Contour maps of Total Dissolved Salts (TDS) concentration and of shallow groundwater level are published on the DEWNR website, and an extract of these covering the Project area is given in **Figure 4.4a**.

The Cultana Ridge is formed of ancient crystalline metamorphic rocks. Groundwater which does infiltrate is likely to be stored and transmitted in fissures, joints and discontinuities. Fractured rock aquifers such as this one are characterised by low storage and yield which makes exploiting them generally uneconomic in that the cost of drilling and equipping a bore may not be justified by the amount of water that can be reliably abstracted.

4.4.2.2. Recharge and Discharge

The Whyalla region is a dry area with an annual average rainfall at Whyalla of 278mm (1906 – 2001) and an estimated annual potential evaporation of about 2500mm. Sub-tropical high pressure systems dominate the weather and this causes dry continental air to blow over the area for most of the year, although monsoonal lows in summer can bring episodic, heavy rain. (Bureau of Meteorology, 2013a)

The high density of surface drainage on the Cultana Ridge is indicative of low permeability and therefore recharge to the underlying strata is likely to be very limited. The high density of drainage here contrasts with the flat, low-lying Long Sleep Plain which has an almost complete absence of obvious surface watercourses. Recharge here is potentially a little higher, but the high annual evaporation is likely to reduce actual recharge to negligible quantities.

Due to the very low recharge to groundwater, discharge will be correspondingly small to insignificant. There is no evidence or record of any discharges such as springs or seeps in the area.

4.4.2.3. Quality and Utilisation

Under the prevailing climatic conditions it is likely that groundwater will be saline, particularly beneath the plain. This is confirmed by the DEWNR contour map of TDS or salinity (Refer to **Figure 4.4a**) which indicates that groundwater on the peninsula has a TDS concentration of between 7000 mg/l and 14,000 mg/l, which is classified as brackish to saline. Further west, beneath the plain, the TDS is given as in excess of 14,000 mg/l. Recorded water quality data is scant and where it exists, only TDS is recorded. There is one record of a bore drilled in 1975 near the Port Bonython Road and about five kilometres east of the Lincoln Highway. The bore's status is unknown but it was drilled to a depth of 68 metres and flowed at 11 litres per second with a TDS of 23,000 mg/l. It is suspected it was sunk to provide construction water for the building of the Port Bonython Road. At the TDS reported, it is about half the salinity of the local seawater.

Figure 4.4a: Geology and Soils and Dissolved Salts

Figure 4.4a: Geology and Soils and Dissolved Salts

Port Bonython EIS
Flinders Ports Holdings
Figure 4.4a -
Shallow Groundwater Level and Sailinity (Data from the Department of Environment, Water and Natural Resources via Waterconnect website)

Legend

- Groundwater Wells
- Proposed Development Alignment
- Railways
- Shallow Groundwater Level
- Shallow Total Dissolved Solids

Geological areas:

- Callanna Group
- Hiltaba Suite
- Pandurra Formation
- Saint Kilda Formation
- Simmens Quartzite Member
- Unnamed GIS Unit - see description
- Wilpena Group

ARUP

Spencer Gulf Port Link

1:75,000 (at A3)

0 1 2 4
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

4.4.3. Surface Water

4.4.3.1. Occurrence and Discharge

The surface waterways in the study area comprise a network of ephemeral drainage lines. **Figure 4.4b** shows drainage lines within the study area.

The waterways form part of the Tent Hill Land system that covers the area south of Port Augusta to Point Lowly. This land system is characterised by steep escarpments and plateaus, delineated by alluvial plains. The region is made up of a network of well-defined drainage paths comprised of minor creeks. There are no permanent streams or rivers within this region; the existing streams flow intermittently in response to seasonal rains and storm events. Downstream, the minor creeks combine to form larger creeks as they enter flat, broad floodplains.

Myall Creek is the major waterway located to the north of the study area. Review of the surface water courses dataset indicated that the drainage networks are intermittent in nature and are mostly dry. When flow occurs after significant rainfall, flows are characterised by high turbidity and low salinity levels.

To the south of the corridor for the proposed rail spur is the low lying Long Sleep Plain which is characterised by salt flats and lagoons. The lagoons are intertidal and are intermittently inundated.

The proposed rail corridor and other land-based infrastructure will cross a number of waterways which are all classified as ephemeral streams and drainage channels. All streams in the Project corridor were observed as being dry during site visits undertaken during March 2013.

Figure 4.4c shows a dry culvert located at the turn off to Port Bonython Road from the Lincoln Highway. This is typical of the engineering treatment of the interface between drainage lines and transport infrastructure throughout the region.

Any surface run-off throughout the region traverses the ephemeral network and depending on the soil moisture and rainfall intensity, may under certain conditions make its way to the surrounding coastal region and discharge into the sea.

4.4.3.2. Water Quality and Utilisation

The waterways are characterised by episodic flows dependant on rainfall. The study area does not contain any surface water monitoring stations and no recorded water quality data has been identified for this region. It is important to note that water quality in ephemeral streams is subject to inherent variation due to the episodic nature of flows. Such streams are typically characterised by low salinity and high turbidity during flow events that follow significant rainfall. There is no baseline water quality dataset for such water bodies for assessment against the relevant water quality criteria.

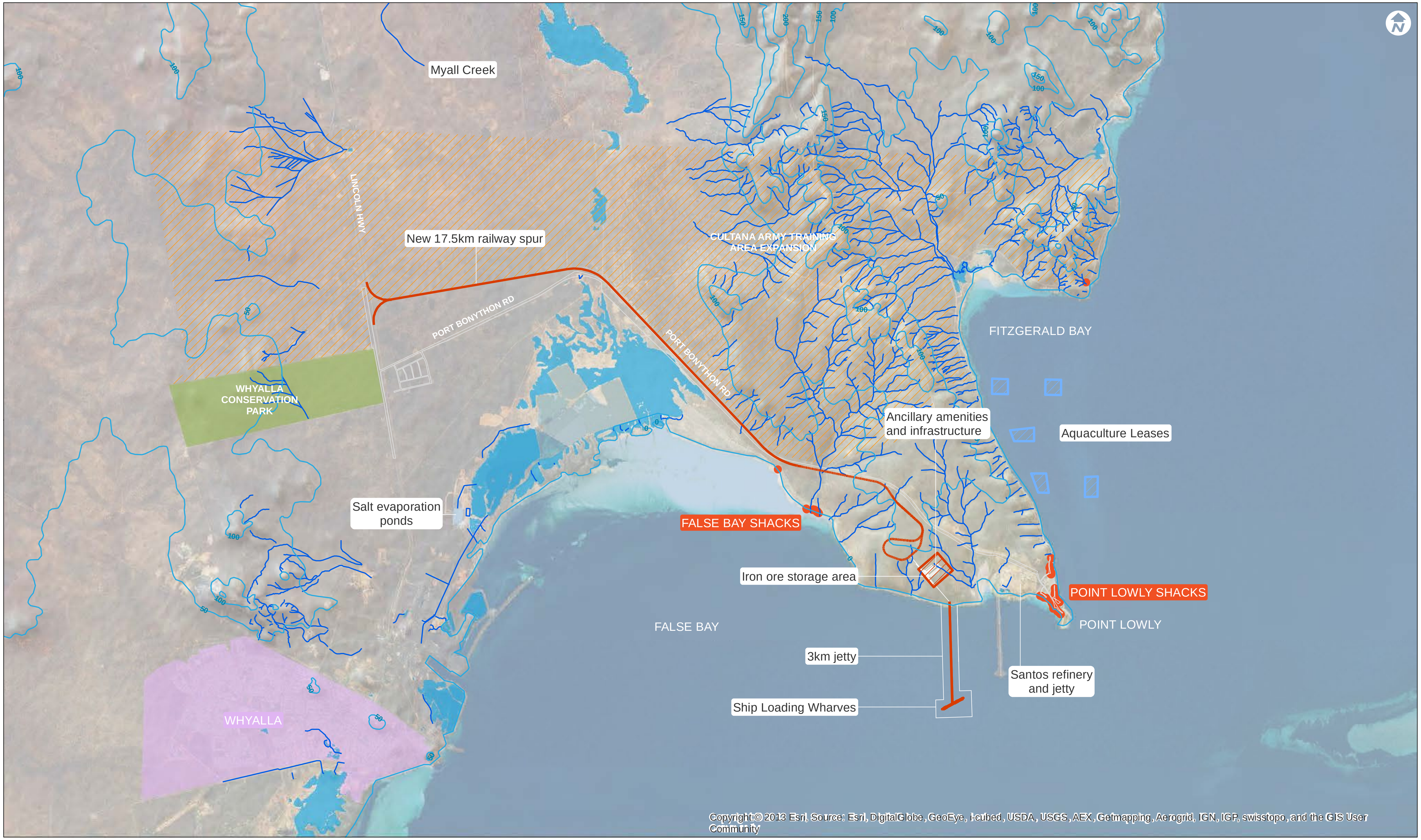
Due to the limitations noted, it is not possible to analyse existing water quality with detailed reference to the policies and guidelines set out in the EIS Guidelines.

Given that the water courses in the study area are primarily ephemeral in nature, the use of surface water in the region is limited and confined to catchment and storage in stock dams, typical of the pastoral nature of the region.

Figure 4.4c: Culvert at turnoff to Port Bonython Road

Figure 4.4b: Surface waterways

Figure 4.4b: Surface waterways



Port Bonython EIS
Spencer Gulf Port Link

Figure 4.4b - Surface And Waterways

Legend

- Shacks
- Aquaculture Leases
- Cultana Army Training Area Expansion
- Whyalla
- Whyalla Conservation Park
- Watercourses
- Waterbodies
- Contours (50m.)

ARUP

Spencer Gulf Port Link

1:100,000 (at A3)

0 1 2 4

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

4.5. Potential Impacts

This assessment of impacts aims to address the environmental values described in **Section 4** that could be potentially affected by the proposed works. These impacts could occur during the construction, operations or eventual decommissioning phases of the Project.

The construction phase will be characterised by relatively high volume construction vehicle, plant and human traffic within the study area as well as earthworks to do with site clearing and preparation, stone and concrete work associated with ballasting for the rail spur and the creation of civil structures including culverts, hard standing and building footings. This will be followed by steel erection works, further concrete and brick or block work, as well as mechanical, electrical and instrumentation work. Concrete for site work could be ready mixed and supplied from Whyalla or a batching plant could be temporarily erected on site. The batching plant option is likely in which case its source of water is likely to be a supply from the Morgan-Whyalla Pipeline. This is because potable quality water is required to batch good quality concrete and the known groundwater in the general vicinity is too saline for good quality concrete production.

The same water source is used by concrete batching plants in Whyalla, so the net result is equivalent in terms of water use. Once the concrete is poured and cures, the water used to batch it becomes chemically bound into the concrete matrix or evaporates. There is no run-off from the production and pouring of concrete. There is some potential run-off from batching plant and equipment wash water, but as much of this as possible will be captured and recycled into new concrete production. Any potential residual impacts on surface and ground waters are discussed in the following sections.

The operations phase will be characterised by significant rail movements delivering product to the site for stocking and then by conveyor on to shipping. Operational vehicle and plant movements as well as human traffic will be of low volume. Run off from roofing and hardstands will be significant during episodic rainfall events as will flows down the natural drainage lines and through any structures built across them.

The decommissioning phase will be many years into the future but is envisaged to have similar characteristics to the construction phase.

4.5.1. Potential Groundwater Impacts

The potential impacts to groundwater arising from the Project are related to the risk of groundwater contamination as well as some possible minor, localised reduction in recharge and slight salinity increase. These issues are addressed in the sections below, separated into construction stage risks and operational stage risks, with mitigation measures identified. The proposed development does not include below ground structures or extensive deep excavations and there should be no requirement to carry out works below the water table except for the exploration and potential use of groundwater for construction.

4.5.1.1. Construction Phase

There is a risk that materials or substances brought to the site and stored or used during the construction process could be released into the groundwater environment. Liquids such as fuels, lubricants and herbicides spilled or leaked onto the ground could percolate through the unsaturated zone and reach the water table. Solid materials such as cement and concrete additives could be transported in rainfall runoff or in water used for dust suppression and subsequently might enter the groundwater system through infiltration below the ground surface.

Wastewater generated from vehicle and plant wash down as well as that generated from local ablution blocks provided for the construction workforce could contaminate local groundwater. Welding and metal grinding will generate metal particles that could ultimately oxidise and leach into the local groundwater. Similarly, paints and solvents and their wastes could have the same fate. Significant earthmoving activity increases the risk of erosion during periods of significant rainfall. The impact on sediment transport and clogging of groundwater recharge areas can be minimised by managing the surface water situation during construction and this is discussed further in that section.

Water will be required for construction and some prospecting for groundwater of suitable quantity and quality to provide a temporary supply is intended. Should a suitable groundwater supply be found, the potential impact will be a localised change in groundwater movement patterns and standing water level during the abstraction and recovery phase.

4.5.1.2. Operations Phase

During the operations phase of the Project a risk is a potential impact on groundwater quality due to spills or leaks of liquids during storage, handling or transport as well as rainfall runoff from hardstand areas and from rail wagons discharging at the storage area. Treated wastewater will be generated from an on-site plant proposed for the treatment of sewage from an ablution block containing showers and toilets to accommodate up to 12 people per shift. The water source is treated potable water proposed to be provided from the SA Water operated Morgan-Whyalla Pipeline. The treated water is intended to be used for local irrigation of landscaping which poses a possible risk to mixing with groundwater. There is also a risk of potential impact on groundwater quantity by reduced recharge due to increased impervious surfaces. The groundwater environment in this locality is a low throughput system. Given the naturally low rate of recharge, small reductions in recharge caused by roof and hardstand areas might result in the salinity of the localised groundwater body increasing.

4.5.2. Surface Water

The potential impacts on surface waters associated with this Project include alterations to the existing drainage patterns and flows, altered flow regimes and altered water quality resulting from increases in impervious areas, vegetation clearance, erosion and use of surface water for site reuse, and potential water contamination through release of Project specific polluting substances (fuels, oil, litter, herbicides, etc.) resulting from spillages and leaks from either the rail corridor or storage areas.

Construction of the rail spur is estimated to require about 1,000,000 cubic metres of cut material and about 800,000 cubic metres of fill material. The cut material is intended to be used as fill, leaving about 200,000 cubic metres of surplus which will be used for storage site landscaping. In addition there will be an estimated 620,000 cubic metres of cut to fill activity to profile the storage site. Control of erosion will be a key issue in minimising the impact on surface water.

These issues are addressed in the sections below, categorising the impacts into construction stage and operational stage with mitigation measures identified.

4.5.2.1. Construction Phase

The Project crosses a number of ephemeral drainages as presented in **Figure 4.4b**. There are no permanent water courses that lie in the Project corridor. Downstream of part of the study area is False Bay and the location between Stony and Black Point is a known cuttlefish diving and viewing area.

The proposed construction corridor for railway spur construction is anticipated to be between 30 to 50m wide. The Project concept includes the construction of several culverts along the proposed rail alignment that will either maintain existing surface flows through existing drainage lines or direct localised runoff into existing drainage lines. Approximately 49 culverts are presently contemplated along the full 17.5 kilometres of the rail spur. During the rail corridor construction phase the main potential impact is the coincidence of major works with a significant rainfall event that impedes or increases the flow of water in drainage lines and contributes to an increase in sediment loads or changes flow characteristics that result in increased erosion. This would increase sediment loads which could be further exacerbated by erosion caused by vehicle movements, excavations and some clearance of vegetation for construction purposes.

The construction work in the storage and terminal area, in particular the earthworks, concrete and steel erection works for the creation of hardstands, roads, shedding and conveyor footings will loosen the local, skeletal soils and coupled with vegetation removal will also increase the likelihood of increased localised flows as well as turbidity and sediment loads during a rainfall event. Wastewater generated from vehicle and plant wash down as well as that generated from local ablution blocks provided for the construction workforce could also be mobilised into surface water flows by significant rainfall events.

Construction work in both areas also brings with it the potential for fuel, oil and other contaminants including cement and concrete waste and metal particles to be entrained in overland and then stream flows. These flows could deposit such contaminants in the stream bed downstream and ultimately into the marine environment.

4.5.2.2. Operation Phase

Potential operations impacts on surface water are increased stormwater runoff due to additional impervious areas as a result of the Project works. Potential runoff from storage areas that could contain substances impacting water quality if released to the drainage lines is also possible. Higher rates of localised runoff as well as localised changes to conditions could increase the incidence of erosion.

4.6. Proposed Mitigation Measures

4.6.1. Groundwater

4.6.1.1. Construction Phase

Mitigation of the risk of contamination of groundwater during construction will be by establishing appropriate procedures for handling, transporting and using potentially contaminating substances including diesel, petrol, oils, greases, cement, construction chemicals and herbicides in the Construction EMP (refer to **Chapter 19, Environmental Management Plan**) as well as by the storage areas for these substances being contained in sealed and bunded enclosures. Portable toilets are proposed during construction with their wastewater removed from site and disposed of at an authorised site. The EMP also includes appropriate procedures for recovery of spills and leaks from sumps and containment areas, so that secondary escapes cannot occur. Details of how wash down and other wastewaters, metal particles, paint and solvent emissions and wastes will be contained, collected and managed so as not to contaminate the environment are also addressed. In siting construction storage and containment locations, areas will be chosen that consider the existence of a water table. The information to determine this will be obtained from the site geotechnical investigations that will form part of the detailed design phase.

Identification and conditions of use of any groundwater sourced construction water supply will be subject to the approval of DEWNR and its licencing conditions.

4.6.1.2. Operations Phase

Mitigation measures to deal with the risk of groundwater contamination during the operational phase are similar to those which should be adopted during the construction phase; namely the use of proper procedures for storage and handling of contaminating materials and substances, and the incorporation of these procedures into the Operations EMP. Procedures for bunding and sealing of areas where these potential contaminants will be stored or used will also be included. Runoff from hardstand areas will be directed by sealed drains into a sealed storage area for appropriate treatment and reuse as wash-water, or for dust suppression or irrigation. Roof runoff will be collected and also reused for such purposes. Treatment of ablution block wastewater to a quality suitable for irrigation and management of that irrigation will be the subject of an irrigation management plan as a subset of the EMP.

The reduction of recharge and consequent risk of slightly increased salinisation will be mitigated by managed reuse of stored and treated runoff, e.g. landscape irrigation even if at small scale.

4.6.2. Surface Water

4.6.2.1. Construction phase

Mitigation of the surface water flow and quality risks during construction will be by establishing appropriate procedures for handling, transporting and using potentially contaminating substances including diesel, petrol, oils, greases, cement, construction chemicals and herbicides in the Construction EMP (refer to **Chapter 19, Environmental Management Plan**) as well as by the storage areas for these substances being contained in sealed and bunded enclosures. The EMP includes appropriate procedures for recovery of spills and leaks from sumps and containment areas, so that secondary escapes cannot occur and it will also detail how wash down and other wastewaters, metal particles, paint and solvent emissions and wastes will be contained, collected and managed so as not to contaminate the environment.

The construction contractors will be required to prepare and implement an Erosion and Sediment Control Plan (ESCP) during the construction phase to control erosion and manage sediment release on site. Management techniques include mulching, design of drains, straw baling of drains, revegetation, regular inspections and maintenance of mitigation assets.

The works design and staging as well as the number of active work fronts will have regard to the likely weather and rainfall during the construction period with the aim of managing and reducing the risk of significant wet weather or flooding causing an unacceptable impact on the environment or on the works.

Drainage design for the permanent works will be aimed at minimising the disruption to natural drainage patterns. For temporary works, measures will also be undertaken in the form of stormwater drainage and flood protection plans. Erosion control for both temporary and permanent works will be addressed using hay bale, sediment curtain, rock and concrete controls and through the use of natural vegetation as appropriate to the circumstances.

Preliminary designs indicate that the rail corridor design includes suitably sized culverts located alongside the existing culverts on the roadway. This is to ensure that a consistent flow path and capacity is provided for surface water flows. Further detailed design of culverts will be undertaken to ensure that they comply with appropriate flood design requirements and minimise surface water impacts during both construction and operations. The interaction between existing road culverts, proposed rail corridor culverts and surface drainage will be considered in discussions with the Eyre NRM Board and DPTI as the relevant drainage authorities.

For the storage and terminal facility, appropriate wet weather and flood protection measures will be incorporated as part of stormwater management on site. Temporary works will be provided to intercept and hold local runoff to allow sediments to settle out before managing the release of water into the local drainage lines.

The appropriateness of design standards, guidelines and final designs will be in accordance with standards and guidance documents related to road and rail track drainage as well as detailed requirements to be discussed with the City of Whyalla and the Eyre NRM Board.

4.6.2.2. Operations Phase

Mitigation measures to deal with the risk of groundwater contamination during the operational phase are similar to those which should be adopted during the construction phase; namely the use of proper procedures for storage and handling of contaminating materials and substances, and the incorporation of these procedures into the Operations EMP. In addition, impacts during the operational phase will be mitigated by the inclusion of water sensitive features developed during the design phase and implemented during construction and operation. These features include the use of appropriate plantings, use of rock gabions and rock mattressing and the provision of detention ponds for containing runoff of unsuitable quality for immediate reuse or release to the environment and treating it by settlement or separation to a quality suitable for reuse or controlled release to drainage lines. The procedures for dealing with such events are included in **Chapter 19, Environmental Management Plan.**

Moderate stormwater flows on site including roof runoff are expected to be stored, treated and re-used for watering landscapes and for dust suppression. The runoff from the ore storage areas will be diverted through swale drains for preliminary treatment prior to storage, appropriate treatment, quality monitoring and reuse.

4.7. Residual Impacts

4.7.1. Groundwater

The residual impact of the construction phase on the local, fractured rock groundwater resource could be reduced recharge through the removal of vegetation, local compaction and reduced permeability of soils and the creation of permanent hardstands. The characteristics of the aquifer are such that should this impact occur, it will be localised and confined to the immediate area of modification. Any aquifer that may be approved for use as a construction water supply will progressively recover to approach its original condition following cessation of use.

The residual impact during the operations phase will be a localised reduction in recharge due to the influence of sealed and hardstand areas. This could contribute to a similarly localised but slight increase in groundwater salinity. Neither outcome is considered to have material consequences.

4.7.2. Surface Water

The residual impact to existing local drainage following the implementation of agreed stormwater drainage design and construction practices is expected to be low and subject to discussions with the City of Whyalla, the erosion presently evident in Myall Creek, downstream of Point Lowly Road culverts, may be reduced with a beneficial environmental effect.

During operations along the rail corridor, runoff will flow into the drainage lines as at present but with some expected minor changes to the flow hydrographs. These changes are not expected to be material in terms of either net or instantaneous surface water flows or quality.

At the storage facility, the capture and storage of local site runoff for reuse will reduce the quantity of runoff from the site and into the departing drainage lines. For small to medium rainfall events, the impact of this is expected to be minor as it is the major events that provide meaningful drainage flows. Runoff from major rainfall events that exceed the agreed design criteria will flow into the surrounding natural drainage lines with the ‘first flush’ which contains most of any polluting material, caught in the storages. For this reason, the residual impact of the Project on the environmental effect of major rainfall events is also expected to be minor.

The storage, treatment and reuse of runoff partly for local landscape irrigation is a potentially beneficial effect. Appropriate planting will help control erosion and excessive sediment transport. A reliable water supply will assist in the survival of the vegetation. Appropriate vegetation will also provide habitat, shelter and food for local fauna including insects, lizards and birds.

It is therefore considered that the residual impact to surface water quality resulting from the Project works is low.

4.8. Conclusion

4.8.1. Groundwater

The potential impacts to groundwater arising from the Project are related to the risk of groundwater contamination as well as some possible minor, localised reduction in recharge and slight salinity increase.

Mitigating the risk of groundwater contamination will be achieved by creating, documenting, adopting and monitoring compliance with procedures that are recorded in the Project's Construction EMP. Mitigation of the risk of contamination of groundwater during construction will be by establishing appropriate procedures for handling, transporting and using potentially contaminating substances including diesel, petrol, oils, greases, cement, construction chemicals and herbicides. During operation, similar risks apply but with a lower likelihood. Mitigation is also similar and the Operations EMP will guide this. Identification and conditions of use of any groundwater sourced construction water supply will be subject to the approval of DEWNR and its licencing conditions.

There is a residual risk of locally reduced groundwater quantity and increased salinity due to reduced recharge as a consequence of compacted areas, hardstands and roofed areas. However the groundwater resource in the area is minimal in quantity, is brackish to saline and such potential localised impact is considered minor in nature.

A summary of the impact of the Project on groundwater is provided in **Table 4.8a.**

4.8.2. Surface Water

The potential impacts on surface waters associated with this Project include alterations to the existing drainage patterns and flows, altered flow regimes and altered water quality resulting from increases in impervious areas, vegetation clearance, erosion and use of surface water for site reuse, and potential water contamination through release of Project specific polluting substances (fuels, oil, litter, herbicides, etc.) resulting from spillages and leaks from either the rail corridor or storage areas.

Mitigation will be largely achieved through the Construction EMP process as described above. An Erosion and Sediment Control Plan (ESCP) will also be required during the construction phase to control erosion and manage sediment release on site. Drainage design for the permanent works will be aimed at minimising the disruption to natural drainage patterns. The appropriateness of design standards, guidelines and final designs will be in accordance with standards and guidance documents related to road and rail track drainage as well as detailed requirements to be discussed with the Eyre NRM Board and DPTI.

Potential operations impacts on surface water are increased stormwater runoff due to additional impervious areas as a result of the Project works. Potential runoff from storage areas that could contain substances impacting water quality if released to the drainage lines is also possible. Higher rates of localised runoff as well as localised changes to conditions could increase the incidence of erosion. The procedures for dealing with such events will be included in the EMP.

Moderate stormwater flows on site including roof runoff are expected to be stored, treated and re-used for watering landscapes and for dust suppression. Residual negative impacts are anticipated to be negligible outside of the development area and the storage and use of water for irrigation of plantings for erosion control could have a modest positive impact in providing additional habitat for small local fauna.

A summary of the impact of the Project on surface water is provided in **Table 4.8b**.

Table 4.8a: Groundwater Impact Assessment

Activity	Impact Assessment - Groundwater							
	Potential Impact	Significance	Likelihood	Risk Rating	Mitigation	Significance	Likelihood	Risk rating
Construction Phase								
Storage and use of construction materials, plant, processes etc. results in release of substances to the groundwater environment	Groundwater contamination due to spills, leaks, improper practices.	Minor	Possible	Medium	Construction EMP. Bunds, sealing.	Negligible	Unlikely	Low
Operation Phase								
Increased hard surfacing reduces incident rainfall hence reduced recharge to groundwater	Increase in salinity of groundwater due to reduction of fresh water input	Minor	Unlikely	Low	Sustainable drainage systems which replicate natural application of rainfall to the subsurface.	Negligible	Unlikely	Low
Storage and use of fuels, oils etc. results in release of substances to the groundwater environment	Groundwater contamination due to spills, leaks, improper practices.	Minor	Possible	Medium	Operational EMP. Bunds, sealing.	Minor	Unlikely	Low
Runoff from laden and unladen rail wagons introduces pollutants to the groundwater environment	Groundwater quality deterioration	Minor	Possible	Low	Operational EMP. Wagon washing offsite.	Minor	Unlikely	Low

Table 4.8b: Surface Water Impact Assessment

Activity	Impact Assessment – Surface Water							
	Potential Impact	Significance	Likelihood	Risk Rating	Mitigation	Significance	Likelihood	Risk rating
Construction Phase								
Location of development works	Risk of flooding and impact to local drainage.	Minor	Possible	Medium	Appropriate erosion and sediment control measures during construction phase. Control of high flow velocities using rock and concrete control measures as well as natural vegetation to check velocities in low flow areas	Minor	Unlikely	Low
Release of oils, chemicals , construction materials to surface water	Visual impact. Contaminated substance entry into surface water. Deterioration of water quality parameters.	Moderate	Likely	High	Implement CEMP. Store chemicals in bunded areas. Regular inspections of storage areas. No direct discharge of contaminated water to surface waterways.	Minor	Unlikely	Low
Generation of litter	Visual impact	Moderate	Likely	High	Implement CEMP. Use of litter traps and pollution control devices.	Negligible	Possible	Low
Release of sediment laden water to adjacent waters	Visual impact. Worsening of water quality.	Moderate	Likely	High	Implement appropriate erosion and sediment control measures. Divert flows to buffers, silt fences, vegetated swales or detention basins prior to discharging to receiving waterways.	Minor	Unlikely	Low

Activity	Impact Assessment – Surface Water							
	Potential Impact	Significance	Likelihood	Risk Rating	Mitigation	Significance	Likelihood	Risk rating
Operation Phase								
Location of development works	Risk of upstream flooding and impact to local drainage.	Minor	Possible	Medium	Siting of infrastructure outside flood risk areas. Re-instate local drainage patterns post construction. Use of WSUD features to control flow velocities.	Minor	Unlikely	Low
Storage and use of fuels, oils etc. results in release of substances to the receiving environment.	Surface water contamination due to spills, leaks, improper practices. Deterioration of water quality. Visual amenity.	Minor	Possible	Medium	Storage of hazardous substances in bunded areas. Regular inspections of storage areas. Regular water quality monitoring.	Negligible	Possible	Low
Stormwater discharge and release of sediment laden waters	Contaminated substance entry into waterways.	Minor	Possible	Medium	Storage of hazardous substances in bunded areas. Treatment of stormwater prior to discharge to waterways via buffer strips, vegetated swales, etc. Regular water quality monitoring at discharge point.	Minor	Unlikely	Low