Buckland Dry Creek Pty Ltd

DRY CREEK SALT FIELD

Integrated Program for Environment Protection and Rehabilitation and Mine Operations Plan

PARTS 1 to 4

Revision 3 v.3 – March 2017

Integrated PEPR / MOP – Holding Pattern, Residual Operations, Investigations, and Closure Operations at the Dry Creek Salt Field

Prepared by:

Buckland Dry Creek Pty Ltd
with Withers Environmental Risk Strategies Pty Ltd and JBS&G Australia Pty Ltd

for

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Document history

Date	Document File Name / Reference No	Purpose of Revision	Issued to
17/12/2014	Dry Creek Salt Field PEPR December 2014.pdf	Revision 1 - Initial PEPR	Andrew Querzoli, DSD
12/9/2015	Dry Creek Salt Field PEPR September 2015.pdf	Revision 2 – for changed compliance point for discharges via SA water outfall and for extension of trial discharges to Gawler River	Andrew Querzoli, DSD
21/03/2017	Dry Creek Salt Field PEPR February 2017.pdf	Revision 3 – for inclusion of all minor changes since Revision 2, and for inclusion of closure operations for PM248	Andrew Querzoli, DSD

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1 Site Operator and Contacts:

The operator of the salt field is Buckland Dry Creek Pty Ltd. Buckland Dry Creek Pty Ltd (ACN 114 007 153; ABN 82 114 007 153) has its registered Head Office at Wayville SA 5034.

Contact Persons:

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2 Declaration of Accuracy

The following declaration is made in accordance with Regulation 65(8) of the *Mining Regulations 2011*.

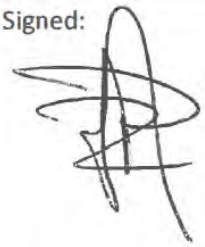
Company Senior Executive Declaration

On behalf of Buckland Dry Creek Pty Ltd, I declare I have reviewed the content of this integrated PEPR / MOP and consider the information has been accurately presented. To ensure the accuracy of the PEPR / MOP:

- I engaged suitably qualified and experienced consultants from Withers Environmental Risk Strategies Pty Ltd and JBS&G Australia Pty Ltd. The work was led and reviewed by Nick Withers MA Cantab (Engineering Tripos), Environmental Consultant specialising in environmental impact, risk and compliance management; and Lachlan Wilkinson. Lachlan is a Certified Environmental Practitioner and Impact Assessment Specialist.

- I was comprehensively briefed on the contents of the final document by Nick Withers on 2 February 2017.

Signed:



Peter Jurkovic

Director
Buckland Dry Creek Pty Ltd

Dated: 21 March 2017

3 Purpose, Scope and Organisation of this Document

3.1 Purpose of the Document

This document sets out operations to be undertaken by Buckland Dry Creek Pty Ltd (BDC) for the Holding Pattern, Residual Operations and Closure of the Dry Creek Salt Field (refer Figure 3-1).

As the salt field is under two types of tenure with different regulatory regimes under the *Mining Act 1971*, this document provides an integrated:

- Program for Environment Protection and Rehabilitation (PEPR) under s 70B of the Mining Act for the mining tenements; and
- Mine Operations Plan (MOP) under s 73G of the Mining Act for the private mines.

The purpose of the PEPR / MOP is to provide a basis for government to approve the works to be implemented. This PEPR / MOP will undergo a number of controlled revisions as the complexity of the issues posed by the site means that the investigation, design and implementation of closure will happen in stages, with works proceeding at different times and rates in different parts of the site.

Each revision to this PEPR / MOP will be prepared in steps – consultation draft, submission for approval, final approval. It is intended that the development of each revision of the PEPR / MOP will be the subject of extensive consultation with relevant government agencies and the community so that it addresses their issues and requirements.

This PEPR / MOP covers the activities summarised in Table 3-1.

Table 3-1: Summary of operations covered by this PEPR / MOP

Section of Salt Field	Holding Pattern and Residual Operations	Closure Operations
Section 1 (South of Dry Creek)	Residual operations in Section 1 including washing or dissolving salt and removing commercially useable salt from the site.	
	Disposal of salt residues that cannot be recovered for commercial use.	
	Functional separation of land needed for residual operations in Section 1 from that to be used for constructing the Northern Connector.	
	Pilot trial for design of filling for Bulk Earthworks for Closure	Filling of PM 248 in Section 1, subject to further approval from DSD, as described in Part 4.
	Trial of discharge of brine to North Arm Creek or to the Port River.	
	Trial for the design of filling of F and G Row pits with salt residues.	
Section 2 (Dry Creek to St Kilda Road)	Cessation of discharge of brine from Section 2 into Section 1 and from Section 3 into Section 2 (PA5 into PA6)	
	Investigations of Acid Sulphate Soil conditions	
	SA Water Trials of nutrient removal from treated effluent from Port Adelaide	
	Drain to import excess fresh water from Smith Creek into XC3	

Section of Salt Field	Holding Pattern and Residual Operations	Closure Operations
Sections 3 and 4 (St Kilda Road to Middle Beach)	Trial of discharge to the Gawler River from Pond XE6.	
	Licensed discharge of brine from PA5 by pumping into the SA Water Outfall	
	Draining XF1, XF2, XE4, XC1, XC2, XC2S, and the keeping of these ponds in a free draining condition	
	Trials in XC2, XC2S and XE4 of candidate soil amendments to encourage revegetation	
	Investigations of Acid Sulphate Soil conditions in drained ponds	
	Lidar survey of ground levels in drained ponds and bathymetry survey (plus sub-bottom profiling) in inundated ponds	
	Trials of techniques to reduce dust emissions from XC2	
	Shorebird and Waterbird Habitat Manipulation Trial in XD1 to XA7	
	DEWNR Trial of Tidal Inundation of XB8A for rehabilitation purposes and for provision of shorebird and waterbird habitat	

3.1.1 Scope and Organisation of the Document

This document is structured as follows:

- **Part 1** contains required information for the PEPR / MOP including documentation of changes and revisions and demonstration of compliance of the PEPR with the Ministerial Determination and the MOP with Regulation 80. The Glossary and Reference sections of the document are also in this Part.

- **Part 2** provides an overview of the salt field, the planning framework, site description and surrounding environment, historical operations and stakeholder engagement. The purpose of this Part is to provide background context for Parts 3 and 4 of the PEPR / MOP.

- **Part 3** describes the residual operations in Section 1, the Holding Pattern in Sections 2-4, and the trials that will be undertaken to inform and guide closure planning. It assesses the environmental impacts of these operations and sets out the environmental outcomes that BDC will be required to meet, along with the criteria that will be used to measure achievement of the outcomes. This Part currently covers the majority of the operations on the site

- **Part 4** describes the proposed closure activities on the salt field – in other words, the operations that will be carried out to prepare the site for the post mining agreed land uses. As closure operations will occur in a staged way within each section, some parts of sections will still be subject to the holding pattern or residual operations, while others will be undergoing closure activities. Eventually, all operations within the salt field will come under this Part. This Part describes the environmental impacts of closure operations and outcomes to be achieved. It also sets out the outcomes and criteria that will be used to define mine completion – the point at which closure activities have been successfully completed and the salt field ceases to be regulated under the Mining Act.

- **Part 5** contains the Appendices of supporting information for Parts 1 to 4.

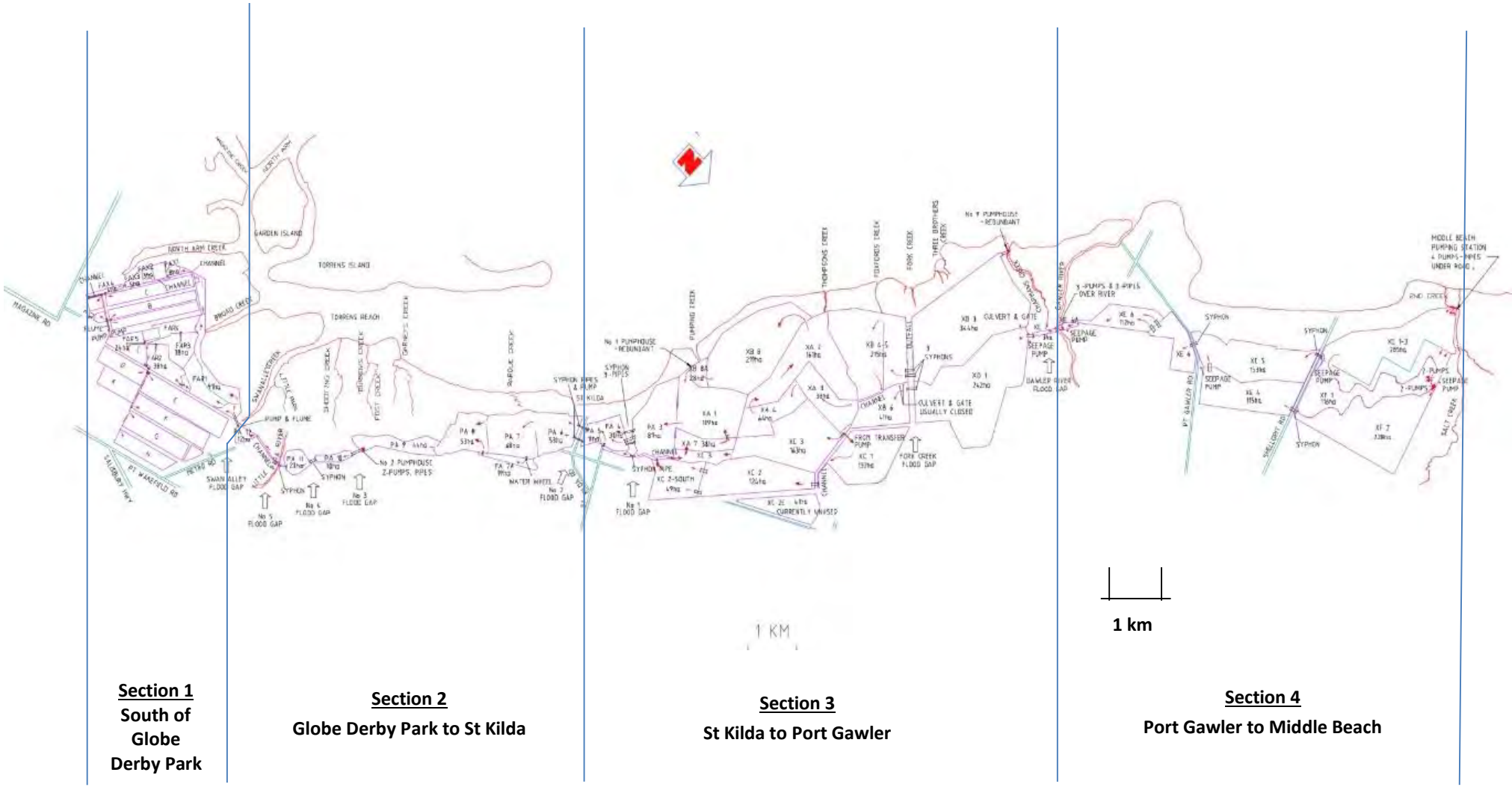


Figure 3-1: Dry Creek Salt Field - area covered by this PEPR / MOP

4 Record of Revisions and Minor Changes to the PEPR / MOP

Record of Revisions and Minor Changes to the PEPR / MOP for the Dry Creek Salt Fields			
Description of revision or minor change	**Date revision or minor change submitted to DSD**	**Document reference / control number**	**Date of DSD or other regulatory authority endorsement**
Initial PEPR	17 December 2014	Dry Creek Salt Field PEPR	Initial PEPR
SA Water Trial in PA9	5 December 2014	Minor Change Application 141205.docx	SA Water Trial in PA9
Drain XF1	16 January 2015	Change of Process Application 140930	22 January 2015
Extension of SA Water trial to more of PA9 and to PA10	24 July 2015	Minor Change Application 150724.docx	28 August 2015
Revision 2 – for changed compliance point for discharges via SA Water outfall and for extension of trial discharges to Gawler River	9 October 2015	Dry Creek Salt Field PEPR October 2015.pdf	23 October 2015
Initial trial of Brine Discharges to Port River	23 November 2015 – submitted to DSD and EPA	Email of 23 November 2015, with attached documents: ▪ Brine Main Pressure Test Procedure 151112 ▪ Results of lab tests on brine Main water Sample ▪ AWQC report 140411_P-7	EPA email of 25 November 2015
Pilot Trial for Filling in Section 1 on PM248	21 June 2016	Combined Files - Notification Rev 2 160621.pdf	29 June 2016
Trial Filling of F and G Row Pits on PM 248 with Salt Residues	1 July 2016	▪ Revised Application for Approval - F & G Row Pits160701.pdf ▪ 20155395R005RevE_Trial Plan_160701.pdf ▪ SKMBT_C284e16062810110.pdf	9 August 2016
Trial of Brine Discharge to North Arm and Dry Creeks from ML389 – 391, 702, 5908 and PM248	22 September 2016	Application for Approval - Trial Brine Discharge to Nth Arm and Dry Creeks160922a.pdf	26 October 2016
Extension of SA Water Trial to PA8 and PA7a	Included with Revision 3 of PEPR / MOP	▪ DSD cover letter - expansion for stage 3.docx ▪ Salt pan Stage 3 expansion proposal Sept 2016 V2.docx ▪ Salt pan Stage two trial progress report final Sept 2016.docx	To be approved as part of this PEPR
DEWNR Tidal Flushing Trial for XB8A	Included with Revision 3 of PEPR / MOP		To be approved as part of this PEPR
Bird Habitat Enhancement Trial in XD1 to XA7	25 October 2016	Planned Habitat Manipulation Trial 161025.docx	To be approved as part of this PEPR
Revision 3 – to capture all the above minor changes since Revision 2 revisions	21 march 2017	Dry Creek Salt Field PEPR Revision 3 v.3 Mar 2017	

Record of Revisions and Minor Changes to the PEPR / MOP for the Dry Creek Salt Fields			
Description of revision or minor change	**Date revision or minor change submitted to DSD**	**Document reference / control number**	**Date of DSD or other regulatory authority endorsement**
and also to provide for bulk earthworks for filling for closure of PM248			

4.1 Scope of PEPR Revisions

This is the third version of the PEPR / MOP with revisions to the original document as shown in Table 4-1.

Table 4-1: Scope of each PEPR/MOP revision

Revision	Date	Document File Name	Scope of Works	Chapters changed / added since last integrated PEP / MOP Revision
1	16/12/2014	Dry Creek Salt Field PEPR December 2014.pdf	1. Residual Operations in Section 1 of the Salt Field 2. Holding Pattern in Sections 2 to 4 of the Salt Field 3. Investigations and trials to inform design of the staged closure works 4. Initial communications and engagement.	This was the first version of the PEPR / MOP.
2	8/9/2015	Dry Creek Salt Field PEPR September.pdf	1. Changes related to draining of XF1. 2. Changed compliance point for discharges via SA Water outfall and for extension of trial discharges to Gawler River 3. Other minor changes.	Sections 6 and 8 and Tables 30 and 31
3	10/02/20176	Dry Creek Salt Field PEPR Revision 3.pdf	As above, plus: 1. Restructure of Document into 5 Parts as described above in 3.1.1. 2. Inclusion of the following operations representing minor changes: ▪ In Part 3 - Pilot Trial of Filling in Section 1 ▪ In Part 3 - Phases 1 to 3 of Trial of Filling in F and G Row Pits ▪ In Part 3 - SA Water Trials in Section 2: Including the extension of these trials to include Ponds PA7a and PA8 as well as PA9 and PA10. ▪ In Part 3 – Habitat Manipulation Trial in Ponds XD1 to XA7 ▪ In Part 3 - Trial of Brine Discharge from Section 1 to North Arm Creek and Dry Creek 3. Inclusion of the following operations representing revisions: ▪ In Part 3 – DEWNR Trial of tidal flushing in Pond XB8A in Section 3	See Table 4-2 below

Revision	Date	Document File Name	Scope of Works	Chapters changed / added since last integrated PEP / MOP Revision
			▪ In Part 4 - Broad scale filling for closure of PM248 4. Surrender of mining tenements: ▪ for the purposes of the construction of the Northern Connector. This also includes the works to create functional separation between the land excised for the Northern Connector and the remainder of Section 1. ▪ As and when decided by Buckland Dry Creek Pty Ltd, and for the purposes of excising parts of mine tenements that have not been functionally used by the operational salt field.	

Table 4-2: Changes Incorporated in Revision 3 of this PEPR / MOP

Section	Revision
All	Division of PEPR/MOP into four parts
1	Updated site operator details due to sale of Ridley Dry Creek Pty Ltd to Buckland Dry Creek Pty Ltd
3-6	Updated to reflect changes to PEPR/MOP structure
7	Amendment of tenement list to show those surrendered for Northern Connector project
10.4	Minor changes due to BDC ownership of site
11.5	Updated information of potential future land uses following expressions of interest process
12.6	Revised with information from recent flora and fauna studies
12.7	Revised with information from recent acid sulfate soils studies
15.3	Inclusion of additional studies for closure planning
16.5	Revised to consider information from recent acid sulfate soils studies
17	Additional measurement criteria for additional trials
19	New section to describe proposed closure activities in Section 1
20	New environmental assessments to address closure operations
21	New outcomes and measurement criteria for closure and mine completion.

5 PEPR Compliance with Ministerial Determination

MINIMUM INFORMATION REQUIREMENT	Location in PEPR
1. Company Senior Executive Declaration	
The PEPR must include a signed statement by the leaseholder (or their agent) in accordance with regulation 65(8) that the content of the PEPR has been reviewed and is accurate and a summary of the steps undertaken to ensure its accuracy	page 2 (Part 1)
2. Description of the Environment	
Any changes to the environment or information about the environment since the previous description of the environment was provided (be it as a mining proposal, management plan or PEPR) must be provided. This must include any new baseline data relevant to the proposed criteria.	Updated information in 12
3. Description of Proposed Mining Operations	
3.1 General description and maps / plans of operations	10
3.2Reserves, products and market	13
3.3 Exploration activities	N/A
3.4 Mining plan	N/A
3.5 Mining activities	N/A
3.6 Wastes	13
3.7 Supporting surface infrastructure	13
3.8 Vegetation clearance	N/A
3.9 Mine completion	18, 19
3.10 Resource inputs	N/A
4. Results of Consultation	

Summarise the results of any attempted consultation that has been undertaken. The summary must list:
▪ a description of the process undertaken for identifying stakeholders with an interest in, or stakeholders likely to be directly affected by the mining operation;
▪ a description of the process undertaken for the delivery of information to, gathering of feedback from, and responding to those identified stakeholders;
▪ the results of the consultation undertaken with those identified stakeholders, including:
  ▪ the concerns / issues raised; and
  ▪ the steps taken, or that are proposed to be taken to address those concerns.
▪ if any individual or group of similar impacted persons were not able to be consulted, what steps were taken to consult with them.
	14

An ongoing engagement plan with the landowner must be provided (if not the leaseholder)	Table 14-1 and Table 14-2
If required by lease conditions, an ongoing community engagement plan must be provided that: ▪ identifies any community likely to be affected by mining operations authorised by the lease, ▪ includes processes for: ▪ identifying community attitudes and expectations ▪ providing information to the community ▪ receiving feedback from the community	Not required but addressed to some extent in Table 14-1 and 14-2

MINIMUM INFORMATION REQUIREMENT	Location in PEPR
▪ analysing community feedback and considering community concerns or expectations in relation to mining operations authorised by the lease ▪ includes a process for registering, documenting and responding to complaints and other communications from members of the community in relation to mining operations authorised by the lease.	
5. Environmental Outcomes	
5.1 Environmental outcomes	16
5.2 Control and management strategies	16
5.3 Measurement criteria	16
5.4 Leading indicator measurement criteria	16
5.5 Operator compliance monitoring plan	Table 17.1
5.6 New environmental risks	16
6. Operator Capability	
Sufficient information must be provided on each of the factors listed under Regulation 89 (1) (a–j) to demonstrate these have been implemented to an appropriate standard to provide confidence that the operator has appropriate experience, processes and procedures in place to be able to operate the tenement(s) to achieve compliance with the regulatory requirements and relevant environmental outcomes under the Act.	10.4
7. Lease / Licence Conditions	
Where the lease or licence includes specific conditions that are not environmental outcomes, a section must be included that demonstrates where these have been addressed in the PEPR (if relevant) or demonstrates how otherwise they have or will be complied with.	N/A
8. Format of the PEPR	
Three hard copies and an electronic version of the PEPR must be submitted; the information in all must be identical	Compliant
9. Maps and Plans	
All maps and sections must conform to the following standards: ▪ Australian Height Datum (AHD) ▪ state the relevant datum (e.g. GDA94, WGS84) ▪ metric units ▪ title, north arrow, scale bar, text and legend ▪ date prepared and author ▪ be of appropriate resolution and scale for represented information.	Generally compliant – maps sourced from third parties may not have this information.
Proposed mining operations plan(s)	N/A
Vertical sections/cross-sections	N/A
10. Description of the Receiving Environment	
10.1 Topography and landscape	
Description and map of tenement area and general surrounds	12.2
10.2 Climate	
A summary of rainfall and temperature patterns, evaporation rates, wind direction and speed	12.4
Details of the maximum average recurrence interval or annual exceedance probability rainfall event used for design of the project, and the justification for the value selected	N/A

MINIMUM INFORMATION REQUIREMENT	Location in PEPR
10.3 Topsoil and Subsoil	
Description of the profile, characteristics and productivity of all soils in the application area	12.7
Identify soil characteristics that may be an issue for disturbance or rehabilitation	12.7
10.4 Geology	
A description of: • regional geology • geology within the tenement area • representative cross-sections, long projection and geological map • exploration data	N/A
10.6 Geochemistry and geohazards	
Geochemical and mineralogical assessment of all rock types to be disturbed	N/A
Potential for natural geohazards to be present	12.7
Hydrogeology	
A description of: • local and regional hydrogeology • environmental value of the water resources • Groundwater Dependent Ecosystems • Current and historical uses of groundwater • Whether in a Prescribed Water Resources area • A plan with all drillholes and boreholes • Diagram of potentiometric surface of mining operations are likely to intersect one or more aquifer • Cross-section of interpreted hydrostratigraphy.	12.9
Hydrology	
Description and map of current drainage patterns including: • Location of watercourses, drains and dams • Surface water catchment boundaries • Direction of drainage and discharge • Statement advising if within prescribed water resources area • Statement advising if in water protection area • Groundwater – surface water interactions • Water quality data for identified watercourses • Assessment of use of water if there is potential for change in flow volume.	12.8
Vegetation, weeds and plant pathogens	
Provide: • a description of existing flora (native and introduced) in the tenement area and surroundings, and display on a map; • the State conservation status and habitat value of native vegetation present in the tenement area; • a description of the presence of Commonwealth Environment Protection and Biodiversity Conservation Act 1999 listed species and ecological communities; • a description of the extent the tenement area and adjoining land is affected or potentially affected by pathogens and • weeds, including phytophthora and broomrape; and	12.6

MINIMUM INFORMATION REQUIREMENT	Location in PEPR
• if known, the history of land use to identify if the existing vegetation is the result of deliberate cultivation.	
Fauna	
Describe the native and feral fauna that may be present in the tenement area noting State or Commonwealth conservation status of all species, in particular if they are species of conservation significance or feral.	12.6
Caves	
Presence of any caves	N/A
Local community	
Provide: • a description of the local population, the economy, services and employment; and • • details of nearest town or urban areas, with a summary of the demographics of the local population	12.1
Landowners and land use	
Provide a description of: • land ownership for all titles within and adjacent to the tenement area • land use (historical, current and potential) for the tenement area and the surrounding areas • the zoning as defined by relevant council (or out of council) development plans • any policies relevant to the tenement area, including council wide, zone specific and sub areas within a zone • known plans for future land use changes by other parties • a statement as to whether the tenement area falls within the Murray Darling Basin, Adelaide Dolphin Sanctuary or a Marine Park • • any other interests or restrictions on the tenement area.	11.3, 11.4, 12.1, 12.3
Proximity to infrastructure or housing	
Provide: • information and maps identifying residences within and near the tenement area; • information and maps identifying other human infrastructure such as (but not limited to) schools, hospitals, commercial or industrial sites, roads, sheds, bores, dams, ruins, pumps, cemeteries, scenic lookouts, roads, railway, lines, fences, transmission lines, gas and water pipelines, and telephone lines (both underground and above ground) • information and maps identifying public roads to be utilised or affected as part of operations, including an estimate of the existing traffic movements.	12.1
Amenity	
Provide a description of scenic or aesthetic values for the tenement area and immediate surrounds, including caves or karst features or other features of tourist or visitor interest.	16.10
Air quality	
Provide a description of the existing levels of dust and contributors to air quality including odour (both natural and anthropogenic).	12.5
Noise	
Provide a description and measurement data of the existing levels of noise and contributors to noise (both natural and anthropogenic).	12.10
Heritage	
Detail:	12.11

MINIMUM INFORMATION REQUIREMENT	Location in PEPR
• any registered heritage sites in or adjacent to the tenement areas that are protected under legislation (in so far as may be permitted under the relevant legislation); and • • include a statement concerning whether or not an Aboriginal cultural heritage survey has been conducted by the tenement holder and, if so, the results of the survey.	
Proximity to conservation areas	
Provide information on proximity to national parks and reserves, private conservation areas, Commonwealth recognised conservation areas, heritage agreement areas and geological heritage sites.	12.3
Pre-existing site contamination and previous disturbance	
Provide information on any known existing contamination of the site and of any disturbance by previous mining operations or other activities.	12.7
11. Management of environmental impacts	
11.1 Assessment of environmental impacts	16, 20
11.2 Control measures, uncertainty assessment, statement of environmental outcomes and criteria	16, 20

6 MOP Compliance with Regulation 80

MINIMUM INFORMATION REQUIREMENT	Location in PEPR
80(2) Nature and Character of Environment	
Description of the nature and character of the environment (including physical and biological features) that can reasonably be expected to be affected by operations carried out at the private mine.	12
80(3) Objectives	
Objectives must relate to	16, 20 The term 'outcomes' is used in the PEPR to apply to environmental objectives, identified in accordance with reg 80
▪ The construction and operation of the mine and any related facilities	15, 19
▪ The management of potential impacts on the environment including impacts relating to the following: ▪ erosion; ▪ noise; ▪ dust; ▪ visual effects; ▪ vegetation clearance or disturbance; ▪ habitat clearance or disturbance; ▪ silt; ▪ stormwater; ▪ topsoil management; ▪ waste management	16, 20
▪ Ongoing and final rehabilitation of the site, site closure and future use of the site	11.5, 18, 19
▪ The action to be taken in the event of an emergency situation at the site of the mine.	10.4.4
80(4) Criteria for Measurement	
▪ Criteria must be described in specific terms to clearly define the outcomes upon which achievement of the objectives can be measured ▪ outcomes may be expressed in quantitative or qualitative terms ▪ if the measurement of the achievement of an objective is to be undertaken by the acquisition of field data over time, the criteria must indicate (subject to possible changes in circumstances)— ▪ the type of study, monitoring or other activity to be undertaken to acquire the data; and ▪ the type of information to be gathered; and ▪ the timelines that are to apply to acquiring, interpreting and publishing the data.	16, 20
80(5) Additional Requirements	
Material to be recovered at the mine	N/A
Geological environment, and estimated reserves, of the mine.	N/A
The type or types of mining operation to be carried out.	15, 19
The sequence of operations.	15, 19
Hours of operation that are to apply.	N/A
Plans for the use of explosives.	N/A

MINIMUM INFORMATION REQUIREMENT	Location in PEPR
Plans for any silt retention.	N/A
Plans for any stockpiling at the mine.	15
Any processing plant located (or to be located) at the mine.	N/A
Services and utilities that are to be used at, or supplied to, the mine.	15
The procedures to be followed in the event of an incident or situation which gives rise to, or could adversely affect, a matter of environmental significance.	10.4.4

7 Tenements Covered By This PEPR/MOP

In the original and subsequent first revision of this PEPR /MOP, the salt field comprised 46 Mining Leases and two Private Mines. These are listed in Table 7-1 and Table 7-2 below

A number of the mining tenements (or portions thereof) and private mines (or parts thereof) were surrendered in 2016 for the Northern Connector and are no longer covered by this PEPR / MOP. Figure 7-1 and Figure 7-2 below show the area and coordinates of surrendered land and land which has been retained. The surrendered land is no longer covered by this PEPR / MOP.

Figure 7-3 to Figure 7-7 show the tenements that are listed in Table 7-1 and Table 7-2.

Table 7-1: Mining leases included in original PEPR / MOP

Note: (Leases or parts thereof surrendered in 2016 and so excluded from this Revision 3 of the PEPR / MOP are highlighted by *)

Item No	Mining Lease / Miscellaneous Purpose Licence	Parcel Identifier	Hundred	Next renewal day	Area (ha)	Ponds or location	Underlying tenure (includes partial occupancy)
1	234	S326, S327	Pt Adelaide H105800	31/3/2019	235.13	PA8, PA9 Swan Alley Mangroves	Crown CR 5766/828 CR 5744/249
2	235	Pts of S328, S329	Pt Adelaide	31/3/2019	259	PA10, part PA9, Swan Alley mangroves	Crown CR 5744/250 CR 5766/829
3	237	S324, S325, S535	H105800	31/3/2019	173.2	Parts PA7, PA8	Crown CR 5766/826 CR 5766/827 CR 5760/408
4	357	S322, Pts of S310, S321, S323, S315, D50216 A104	Pt Adelaide	30/6/2019	68	PA6	Crown CR 5766/820 CR 5766/821 CR 5844/945 CR 5766/825 CR 5766/824 CR 5766/823
5	358	Pt S314, F108213 A16	H105800	30/6/2019	18.86	PA5	Crown CR 5766/819 Cheetham Freehold CT 5887/225
6	359	Pts of S512, S513, S514, S515	Pt Adelaide	30/6/2019	202	PA3, PA4, XA1, XB8 and No 1 Flood Gap	Crown CR 5766/835 CR 5766/836 CR 5766/837 CR 5766/838

Item No	Mining Lease / Miscellaneous Purpose Licence	Parcel Identifier	Hundred	Next renewal day	Area (ha)	Ponds or location	Underlying tenure (includes partial occupancy)
7	360	Pts of S510, S512	Pt Adelaide H105800	30/6/2019	259	XA1, XA2, XA4 and XB8	Crown CR 5766/834 CR 5766/835
8	361	S629, Pt of S509	Pt Adelaide H105800	30/6/2019	221	Ponds XB4-5 and XA2	Crown CR 5757/317 CR 5766/833
9	389 *	Pt of D44233 A100	Pt Adelaide H105800	31/3/2019	33	Parts of Ponds FA2, FA3, FA4,FA5	Land Management Corporation freehold CT 5913/768
10	390 *	D44233 A99, Pt of D44233 A100	Pt Adelaide H105800	31/3/2019	217	Final areas and crystallisers B and C	Land Management Corporation freehold CT 5913/768 CT 5707/129 CT 5382/774
11	391 *	Pt of D44233 A100	Pt Adelaide H105800	31/3/2019	241	North- western end of the Final areas and crystallisers	Land Management Corporation freehold CT 5913/768 CT 5707/129
12	392 *	S330, D44233 A106, Pts of S328, S329, S615	Pt Adelaide H105800	31/3/2019	132	5% of lease area used for ponding, rest mangroves	Crown CR 5744/250 CR 5766/829 CR5751/448 CR 5902/103
13	404	S506, Pt of S624, S508	Pt Adelaide H105800	31/3/2019	162.68	Pond XB3 and Gawler flood gap	Crown CR 5766/831 CR 5757/317 CR 5766/832
14	405	Pt of S510	Pt Adelaide H105800	31/3/2019	157	Ponds XA3, XA4 and XC3	Crown CR 5766/834
15	406	Pts of S512, S513, S514, S515	Pt Adelaide H105800	31/3/2019	144	Pond XC3, XA7, PA3 and PA4	Crown CR 5766/835 CR 5766//836 CR 5766/837
16	416	S337	Pt Adelaide H105800	30/6/2019	4	A wedge of PA8	Crown CR 5780/407
17	417	Pts of S513, S514,	Pt Adelaide H105800	31/3/2019	13	Pond PA4, No 1 Flood Gap St Kilda	Crown CR 5766/836 CR 5766/837

Item No	Mining Lease / Miscellaneous Purpose Licence	Parcel Identifier	Hundred	Next renewal day	Area (ha)	Ponds or location	Underlying tenure (includes partial occupancy)
							Out of cadastre
18	418 *	F126162 A6, F207067 A93, Pt of F114617 A56	Pt Adelaide H105800	31/3/2019	2	Strips of roadway and a 0.11 ha corner of Block 3068 Pond PA11	Crown Freehold CT 5828/520 CT 5810/662 Crown Unallocated
19	421	Pts D50216 A104, S323	Pt Adelaide H105800	31/3/2019	4	Western part of Pond PA6	Crown CR 5844/945 CR 5766/825
20	429	Pts F108213 A16, S316, S321, S320	Pt Adelaide H105800	30/6/2019	16.89	Parts of ponds PA5, PA6 and PA7	Cheetham Freehold CT 5887/225 Crown CR 5766/821 CR 5766/823 CR 5766/822
21	439	Pts of R3065 AX, F108216 Q23	Pt Adelaide H105800	31/3/2019	3.2	Part of pond PA11	Cheetham Freehold CT 5199/354 Crown Unallocated
22	440	Pt S327	Pt Adelaide H105800	31/3/2019	4	Swan alley mangroves and Pond PA9	Crown CR 5744/249
23	441	Pt S326	Pt Adelaide H105800	31/3/2019	2	Pond PA9	Crown CR 5766/828
24	442	Pts of S320, S321, S322, S323	Pt Adelaide H105800	31/3/2019	2	Pond PA9	Crown CR 5766/826
25	443	Pts D50216 A104, S315, S310, S314	Pt Adelaide H105800	31/3/2019	2	Closed road. St Kilda ponds PA5 and PA6	Crown CR 5766/820 CR 5766/821 CR 5766/819 CR 5844/945
26	444	Pt S514	Pt Adelaide H105800	31/3/2019	1	Closed road. Part of Pond PA4	Crown CR 5766/837
27	445	Pts 182, 513	Pt Adelaide H105800	31/3/2019	3	Closed Road. Part of pond PA3	Crown CR 5766/836
28	446	Pt of S512	Pt Adelaide H105800	31/3/2019	4	Closed road. Part of pond XA1	Crown CR 5766/845

Item No	Mining Lease / Miscellaneous Purpose Licence	Parcel Identifier	Hundred	Next renewal day	Area (ha)	Ponds or location	Underlying tenure (includes partial occupancy)
29	447	Pt S510, S512	Pt Adelaide H105800	31/3/2019	6	Closed road. Part of ponds XA3, XA4, XB8 and XC3	Crown CR 5766/834
30	448	Pt of D50216 A104	Pt Adelaide H105800	31/3/2019	1	Top part of pond PA6	Crown CR 5844/945 Unallocated
31	587	Pt of S624	Pt Adelaide H105800	31/3/2019	182	No 9 Pumphouse and western part of XB3	Crown CR 5757/317 CR5779/709
32	600	Pts of S510, S512, S513	Pt Adelaide H105800	31/3/2019	105	XB8	Crown CR 5766/834 CR 5766/835 CR 5766/836
33	605	S703, S704, S705, Pt of S702	Pt Gawler H140800	31/3/2019	234.73	Salt Creek	Crown OL 12570 CR 5748/918 CR 5748/919 CR 5748/920 CR 5748/921
34	606	S707, S830, Pts of S706, S829	Pt Gawler H140800	31/3/2019	169.97	XE1-3	Crown OL 12570 CR 5748/922 CR 5744/712 CR 5744/714 CR 5744/715
35	607	S827	Pt Gawler H140800	31/3/2019	19.83	Western portion of pond XE5	Crown CR 5744/713
36	608	S809	Pt Gawler H140800	31/3/2019	206.4	Part of XE6	Crown CR 5769/617
37	617	Pt S508	Pt Adelaide	31/3/2019	2	Closed road in XB5	Crown CR 5766/832
38	618	Pt S509	Pt Adelaide	31/3/2019	2	Closed road in the southern part of XB4	Crown CR 5766/833
39	702	Pts of D44233 A105, D44233 A104, D44233 A103, D44233 A102	Pt Adelaide H105800	31/3/2019	160	Broad Creek mangroves	Crown CR 5382/777
40	5205	Pt of F108211	Pt Gawler H140800	30/6/2019	119.19	Pond XF2	Cheetham Freehold

Item No	Mining Lease / Miscellaneous Purpose Licence	Parcel Identifier	Hundred	Next renewal day	Area (ha)	Ponds or location	Underlying tenure (includes partial occupancy)
		A13					CT 5197/300
41	5206	Pt of F108211 A13	Pt Gawler H140800	30/6/2019	155.51	Pond XF2	Cheetham Freehold CT 5197/300
42	5207	F108211 A14	Pt Gawler H140800	30/6/2019	151.2	Pond XF2	Cheetham Freehold CT 5197/300
43	5208	S34, Pt of D1671 B44	Pt Gawler H140800	30/6/2019	114.06	Ponds XE4 and XE5	Cheetham Freehold CT 5197/302 CT 5197/304
44	5209	S6, Pt of D1671 B44	Pt Gawler H140800	30/6/2019	131.87	Ponds XE4 and XE5	Cheetham Freehold CT 5197/304 CT 5197/315
45	5210	F3965 A1, F3965 A2	Pt Gawler H140800	30/6/2019	31.7	Pond XE6	Cheetham Freehold CT 5197/298 CT 5197/301
46	5908	D 41507 A300, Pts of D63323 A2, D41507 A302	Pt Adelaide H105800	25/10/2015	50.2	K row	Land Management Corporation Freehold CT 5906/440 City of Salisbury CT 5930/304 CT 5928/43

Hundred and Parcel Identifiers:

F = Filed Plan

D = Deposited Plan

H = Hundred

S = Section

Q = Piece

A = Allotment

B = Block

Tenure Documents:

OL = Licence to Occupy

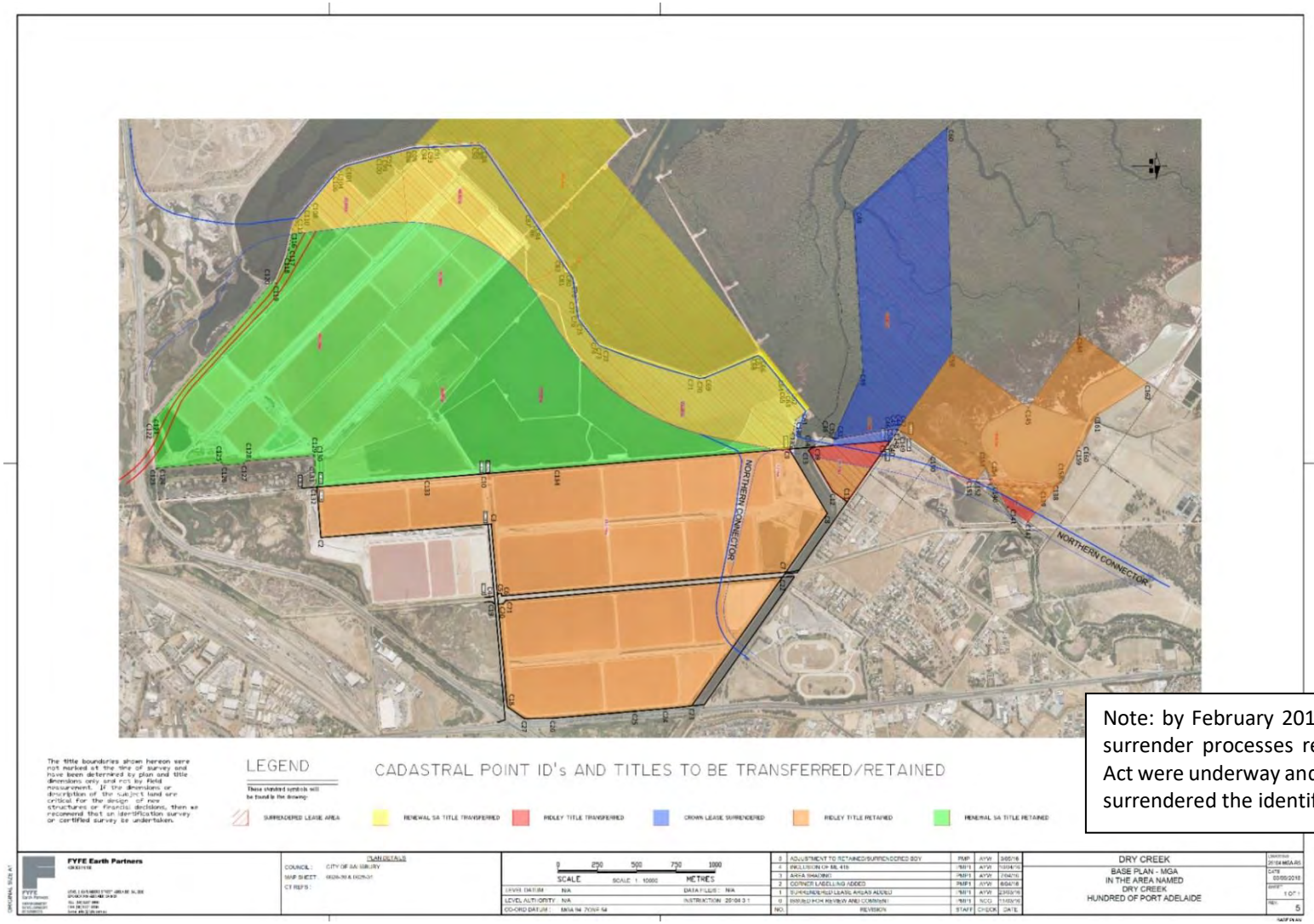
CT = Certificate of Title

CR = Crown Record

Table 7-2: Private mines included in PEPR / MOP

Note: Mines or parts thereof surrendered in 2016 and so excluded from this Revision 3 of the PEPR / MOP are highlighted by *

Private Mine #	Hundred	Sections (S), or Allotments (A) and Filed Plans (FP)	Area(ha)	Certificate of TitleVol/Folio
248 *	Port Adelaide H105800	FP 2871 A1 and A2 excluding ETSA easements	316.27	Cheetham Freehold CT 5931/18
199 *	Port Adelaide and Port Gawler H105800 and H140800	F108216 Q23, Q22, Q21, Q20, A19 F108212 A15 F108210 A12 F108207 A9 F108206 A8 F28223 A10, A11 F 3965 A5 S505, S667, S668, S671, S674, S675, S676, S677, S678, S682, S683, S684, S685, S689, S690, S691, S692 F114472 Q11 (includes easements across the sewer outfall) F3965 A7	1292.5	Cheetham Freehold CT 5199/354 CT 5913/692 CT 5297/309 CT 5404/395 CT 5197/299 CT 5197/297 CT 5197/294 CT 5197/307 CT 5154/618 PL CT 5417/486 Freehold CT 5875/910 SA Water Corp Freehold CT 5278/129 CT 5207/813



Note: by February 2017, the mine tenement surrender processes required by the Mining Act were underway and BDC has operationally surrendered the identified land to DPTI.

Figure 7-1: Land surrendered and retained for purposes of the Northern Connector

SURRENDERED LEASE AREAS

ML 390		
S29	277073.0	6144128.8
S28	277042.6	6144377.9
S27	277035.5	6144477.7
S26	277036.7	6144517.5
M98	276580.6	6144481.4
M100	276675.4	6144128.2
M101	276677.9	6144118.8
M102	276687.2	6144101.8
M103	276700.5	6144083.8
M104	276722.8	6144064.8
M106	277014.8	6143812.8
M107	277028.9	6143805.3
M108	277044.1	6143798.8
M109	277063.0	6143793.3
M110	277257.6	6143752.8
M111	277398.9	6143692.8
S30	277459.6	6143747.4

P 248 West		
S6	278586.6	6147011.4
P17	278480.9	6146948.8
P1	278506.9	6146625.1
S7	278512.9	6146549.7

PM 248 North		
P30	278469.9	6147096.6
P32	278492.4	6147072.8
P33	278751.0	6147225.8
P34	278816.4	6147317.8
P35	278430.6	6147590.1
P36	278459.2	6147230.8

ML 392		
S3	278361.5	6147637.4
S4	278358.0	6147622.4
S5	278419.5	6147230.8
M123	278459.2	6147230.8
M124	278430.6	6147590.1
M125	278366.4	6147633.9

ML 391 West		
S20	277198.3	6145046.1
S19	277257.1	6145126.9
S18	277323.8	6145201.5
S17	277397.5	6145269.1
S16	277415.6	6145282.6
M28	277387.1	6145373.3
M29	277377.9	6145402.3
M30	277286.0	6145509.3
M31	276698.8	6145107.8
M32	276679.0	6145094.3
M33	276573.3	6145022.3
M34	276563.2	6145012.3
M35	276547.8	6144990.3
M36	276541.8	6144976.3
M37	276540.6	6144953.3
M38	276562.1	6144556.3
M39	276573.1	6144511.8
M40	276580.6	6144481.4
S26	277036.7	6144517.5
S25	277038.4	6144577.6
S24	277051.2	6144676.8
S23	277073.9	6144774.2
S22	277106.2	6144868.8
S21	277147.8	6144959.8

ML 389		
M15	277358.6	6145557.8
M14	277381.9	6145573.8
M13	277375.1	6145583.8
M12	277352.0	6145567.8
M11	277339.4	6145558.8
M10	277321.5	6145546.3
M9	277280.3	6145517.8
M8	277377.9	6145402.3
M7	277387.1	6145373.3
S16	277415.6	6145282.6
S15	277432.4	6145295.2
M16	277405.6	6145380.3

PM 199 Nth		
P39	278701.4	6148256.9
P40	278706.6	6148259.8
P41	278849.8	6148338.8
P42	278940.7	6148467.3
S1	278699.8	6148668.7
S2	278678.1	6148244.0

ML 391 East		
S9	278372.1	6146123.1
S8	278495.1	6146438.4
S7	278512.2	6146545.2
M45	278234.2	6147060.9
M46	278218.0	6147080.3
M47	277870.6	6146801.8
M48	277864.3	6146794.8
M49	277860.3	6146784.8
M50	277859.5	6146776.3
M51	277861.1	6146766.3
M52	277864.3	6146755.8
M53	277927.0	6146610.9
M54	278008.9	6146421.8
M55	278015.2	6146401.8
M56	278017.4	6146378.8
M57	278015.1	6146356.8
M58	277930.8	6146098.3
M59	277816.1	6145756.3
M60	277806.4	6145738.3
M61	277792.3	6145721.8
M62	277653.7	6145616.8
M63	277635.1	6145607.3
M64	277613.6	6145602.3
M65	277409.3	6145586.8
M66	277389.8	6145579.3
M67	277381.9	6145573.8
M68	277358.6	6145557.8
M69	277405.6	6145380.3
S15	277432.4	6145295.2
S14	277477.6	6145328.9
S13	277750.6	6145493.3
S12	277921.4	6145622.1
S11	278021.0	6145620.0
S10	278217.2	6145809.4

ML 418		
M137	278701.4	6148257.0
M138	278671.0	6148240.2
M139	278670.5	6148239.9
M140	278668.7	6148171.2
M141	278668.1	6148147.3
M142	278666.3	6148080.2
S33	278663.7	6148076.5
S32	278621.1	6147964.5
M135	278696.6	6148071.9
M136	278698.0	6148124.9

Surrendered Lease Areas

RETAINED LEASE COORDINATES - MGA

ML 390		
S26	277036.7	6144517.5
S27	277035.5	6144477.7
S28	277042.6	6144377.9
S29	277073.0	6144128.8
S30	277459.6	6143747.4
S31	277410.8	6143687.1
M115	277424.6	6143659.0
M116	277424.6	6143658.8
M78	278248.7	6142947.2
M79	278275.2	6142924.3
M80	278262.3	6142897.3
M81	278285.6	6142899.2
M82	278302.6	6142900.6
M83	278316.1	6142901.7
M84	278599.6	6142924.8
M85	278604.0	6142925.2
M86	278598.5	6142939.3
M87	278566.5	6143342.3
M88	278580.6	6143358.8
M89	278570.6	6143483.3
M90	278554.2	6143496.8
M91	278519.9	6143929.3
M92	278556.5	6143932.3
M93	278582.5	6143934.3
M94	278721.0	6143946.7

ML 391 West		
M24	277678.2	6144792.3
M25	277660.9	6144809.3
M26	277509.6	6145017.8
M27	277480.5	6145075.8
S16	277415.6	6145282.6
S17	277397.5	6145269.1
S18	277323.8	6145201.5
S19	277257.1	6145126.9
S20	277198.3	6145046.1
S21	277147.8	6144959.8
S22	277106.2	6144868.8
S23	277073.9	6144774.2
S24	277051.2	6144676.8
S25	277038.4	6144577.6
S26	277036.7	6144517.5
M23	277889.3	6144584.8

ML 391 East		
S7	278512.2	6146545.2
S8	278495.1	6146438.4
S9	278372.1	6146123.1
S10	278217.2	6145809.4
S11	278021.0	6145620.0
S12	277921.4	6145622.1
S13	277750.6	6145493.3
S14	277477.6	6145328.9
S15	277432.4	6145295.2
M17	277489.1	6145114.8
M18	277510.8	6145061.8
M19	277546.6	6145001.3
M20	277602.4	6144924.3
M21	278635.6	6145017.5

ML 389		
M21	278635.6	6145017.5
M20	277602.4	6144924.3
M19	277546.6	6145001.3
M18	277510.8	6145061.8
M17	277489.1	6145114.8
S15	277432.4	6145295.2
S16	277415.6	6145282.6
M6	277480.5	6145075.8
M5	277509.6	6145017.8
M4	277660.9	6144809.3
M3	277678.2	6144792.3
M2	277889.3	6144584.8
M1	278665.2	6144646.8

ML 392		
S4	278358.0	6147622.4
S3	278361.5	6147637.4
M126	278357.1	6147640.5
M127	278355.4	6147641.7
M128	277869.1	6147983.8
M129	276436.9	6147951.3
M130	276966.1	6147357.8
M118	277788.8	6147406.9
M119	277988.5	6147418.8
M122	278411.1	6147230.8
S5	278419.5	6147230.8

PM 199		
P47	277897.2	6147988.6
P46	278232.2	6148458.2
P45	278468.7	6148793.2
P44	278674.3	6148689.8
S1	278699.8	6148668.7
S2	278678.1	6148244.0
P51	278667.9	6148147.4
P50	278666.3	6148080.1
P48	278367.3	6147658.3

ML 418		
S32	278621.1	6147965
S33	278663.7	6148076
M143	278514.0	6147865
M144	278367.2	6147658
M133	278392.1	6147641
M134	278539.0	6147848

Note: by February 2017, the mine tenement surrender processes required by the Mining Act were underway and BDC had operationally surrendered the identified land to DPTI.

Retained Lease Coords

Figure 7-2: Coordinates of land surrendered and retained for purposes of the Northern Connector

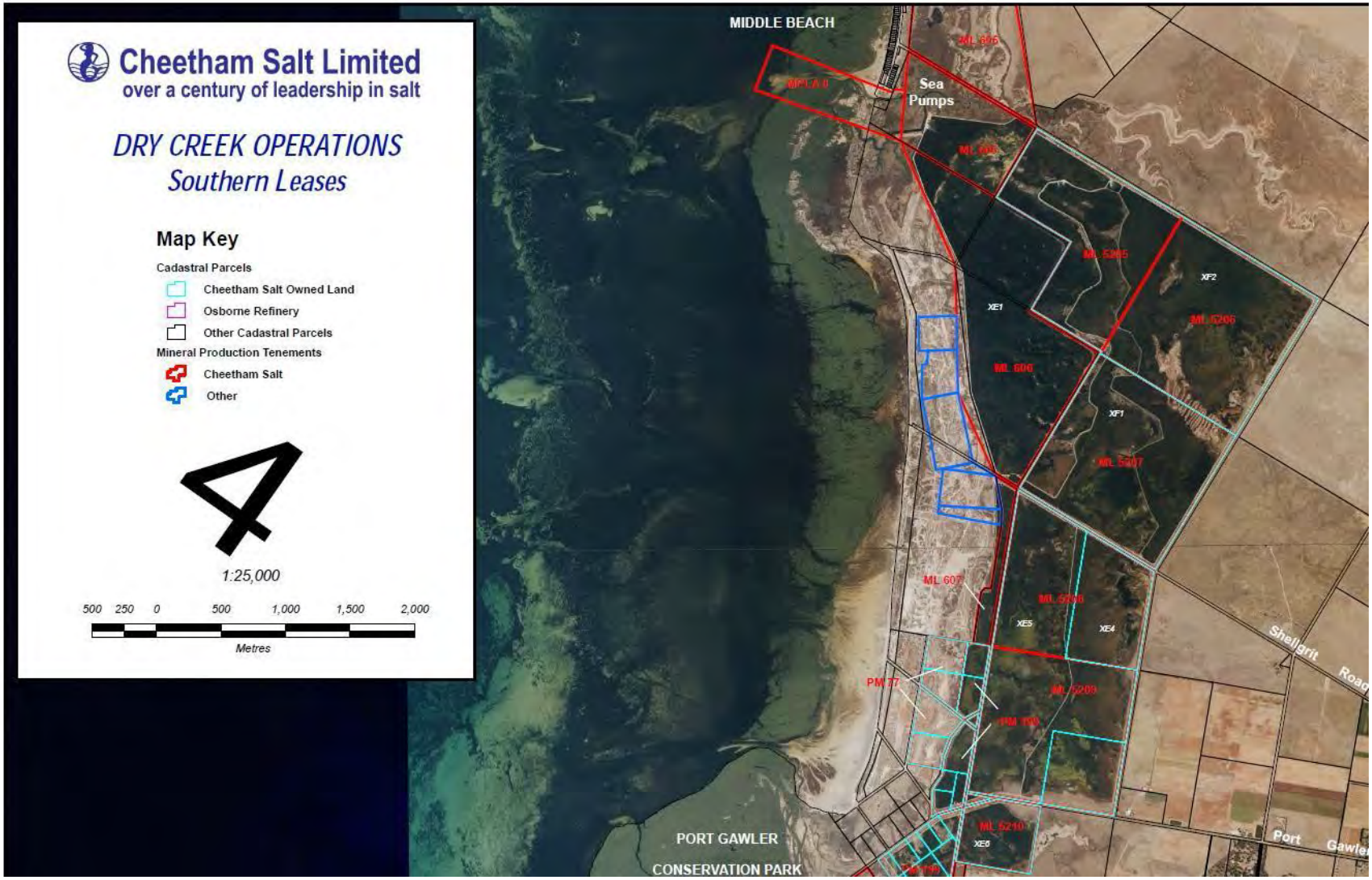


Figure 7-3: Tenements –- Section 4 (Port Gawler to Middle Beach)

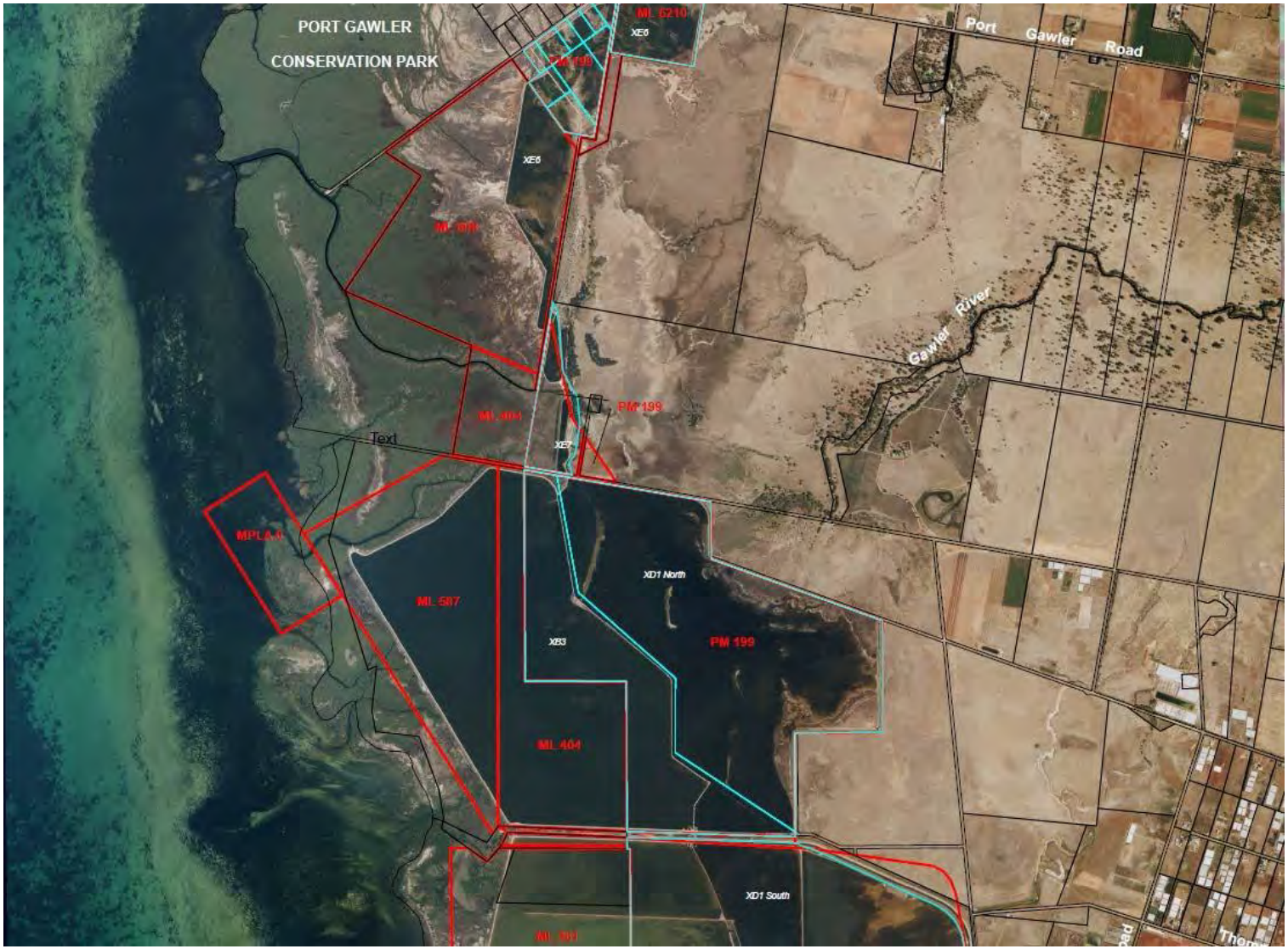


Figure 7-4: Tenements - Section 3 (St Kilda to Port Gawler) showing northern area (Buckland Park to Port Gawler)

Figure 7-5: Tenements – Section 3 (St Kilda to Port Gawler) showing southern area (St Kilda to Buckland Park)

Figure 7-6: Tenements - Section 2 (Globe Derby Park to St Kilda) – subject to changes shown in Figure 7-1 and Figure 7-2

Figure 7-7: Tenements -Section 1 (South of Globe Derby Park) – subject to changes shown in Figure 7-1 andFigure 7-2

8 Glossary

Term or Acronym	Meaning
AMLR	Adelaide and Mount Lofty Ranges
ACM	Asbestos containing material
AHD	Australian Height Datum
anaerobic	Relating to or requiring an absence of free oxygen
ASS	Acid sulfate soils
BDC	Buckland Dry Creek Pty Ltd
biodiversity	The variety of plant and animal life in the world or in a particular habitat
bitterns	A solution of bromides, magnesium and calcium salts remaining after sodium chloride is crystallised out of seawater
BOD	Biological Oxygen Demand
brine	Water saturated with or containing large amounts of salt, especially sodium chloride
calsilt	A by-product from the Penrice manufacturing plant, mostly calcium carbonate
camelles	Salt stacks formed from a series of overlapping cones of salt
CE Steering Group	Chief Executives Steering Group
CoP	Change of process
CoS	City of Salisbury
Cst	Coastal Zone under the current Development Plan
DEWNR	Department of Environment, Water and Natural Resources
DO	Dissolved oxygen
DoE	Department of the Environment (Cth). (Changed to Department of the Environment and Energy July 2016)
DEE	Department of the Environment and Energy (Cth)
DPTI	Department of Planning, Transport and Infrastructure
DSD	Department of State Development (including the former Department for Manufacturing, Innovation, Trade, Resources and Energy prior to 1 July 2014)
DSTO	Defence Science and Technology Organisation
EIn	Extractive Industry zone under the current Development Plan
entrainment	The upward movement of eroded particles into the water column by net turbulent drag and lift.
EoI	Expressions of Interest
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
freehold	Permanent and absolute tenure of land or property with freedom to dispose of it at will.
maiden brine	Saturated brine ready for the crystallisation of salt
MBO	Mono-sulphidic black ooze
MFP	Multifunction Polis zone
ML	Mining Lease

Term or Acronym	Meaning
MOP	Mine Operations Plan
MOSS	Metropolitan Open Space System
NABCWMB	Northern Adelaide and Barossa Catchment Water Management Board
NaCl	Chemical grade solar salt
NEPM	National Environment Protection Measure
NGO	Non-government organisation
NRM	Natural resource management
OTH	Over-the-horizon radar
PASS	Potential acid sulfate soils
PEPR	Program for Environment Protection and Rehabilitation
piscifauna	all the fishes that live in a particular place, time or habitat
ppt	Parts per thousand
PIRSA	Department of Primary Industries and Regions SA
Ramsar Convention	Convention on Wetlands (Ramsar, Iran, 1971)
SA	South Australian (Government)
salinas	A set of interconnected lagoons
samphire	Sparse to medium density dwarf shrubland of semi-woody plants
SAR	Sodium absorption ratio
SEB	Significant environmental benefit
SME	Special Mining Enterprise Agreement
SOP	Standard operating procedure
STAG	Strategy and Technical Advisory Group
TDS	Total dissolved solids
TJpa	Terajoule per annum
tpa	tonne per annum

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DRY CREEK SALT FIELD PEPR REVISION 3 - PART 2

10 General Description and Location of the Project

10.1 Location and Layout of the Dry Creek Salt Field

The salt field occupies approximately 5,500 hectares of land along 28 km of coastline north of Adelaide from Dry Creek to Middle Beach. It comprises a mix of Crown land and freehold land owned by BDC.

Forty six mining leases and two private mines (see Chapter 7) provide the mining tenure for the mining operations. The mining operations fall within the Hundreds of Port Adelaide and Port Gawler, and the local government areas of City of Salisbury, City of Port Adelaide Enfield, City of Playford and the District Council of Mallala. The entire site is located within the 2008 gazetted boundaries of the Adelaide and Mt Lofty Ranges Natural Resource Management Board.

10.2 Previous Mining Works and Their Cessation

The Dry Creek Salt Field was established under a set of mining leases by Imperial Chemical Industries in the 1930s to supply salt to its Osborne Soda Ash Plant. The first salt was harvested in 1939. The northern extent of the salt field was extended in the 1960s to Middle Beach from Chapman Creek (Bell 2014).

Salt production at Dry Creek comprised the growing and harvesting of chemical grade solar salt (NaCl). It was a seasonal process that used a renewable natural resource, rather than extraction of a finite, distinct deposit of a more typical mining operation.

The salt field was constructed by establishing bunds on low lying land (approximately 1 to 4 m above sea level) to form a set of interconnected lagoons (salinas). This land originally supported salt marsh, sedgeland and marshes, coastal grasslands and included several estuarine areas. Changes to the topography were minimal. An existing levee, constructed by the government in 1886 / 87 to reduce tidal flooding, formed the western edge of the salt field (Bell 2014). Earthworks were conducted to win soil to construct bunds, seepage trenches and syphons under roads, and to provide flow paths where the topography impeded the flow of water. The formation of the salinas changed the existing biodiversity, and the biodiversity that has since developed is regarded as valuable.

To produce salt, sea water was pumped south from Middle Beach through 25 km of condenser ponds to Dry Creek, and in the process became more concentrated as a result of evaporation. High concentration brine was collected at Dry Creek where salt crystallised and was subsequently harvested. The harvested product was dissolved in fresh water from groundwater bores to form a purified brine. This brine was pumped via pipeline to Penrice Soda Products at Osborne.

In 1993, the Dry Creek Salt Field, Angaston limestone mine and Osborne Soda Ash plant were sold to Penrice Soda Products Pty Ltd (Penrice). They were operated by Penrice under a Special Mining Enterprise Agreement (SME) with the Crown, dated 1 September 1998. The salt field also included some private mines which were not governed by the SME, but were operated as specified in the Developmental Programme prepared 11 November 1998 under Regulation 10 of the *Mines and Works Inspection Regulations 1998*. They were and are not operated as separate entities, but rather form part of the integrated salina system of the salt field.

In 2005, Penrice divested itself of the Dry Creek Salt Field, which was purchased by Cheetham Salt Limited (a subsidiary of Ridley Corporation Ltd) along with contracted obligations to continue the supply of salt to Penrice in accordance with a long term supply agreement. Cheetham Salt Limited set up

Cheetham (Dry Creek) Pty Ltd to operate the salt field. In 2012, Ridley Corporation sold Cheetham Salt Ltd but retained Cheetham (Dry Creek) Pty Ltd, renaming it to Ridley Dry Creek Pty Ltd.

The nature and the conduct of the operations at the salt field, conducted by Penrice pursuant to the SME, did not substantially change while salt production continued under Cheetham and then Ridley management.

As a result of the 2005 commercial transaction, Penrice's benefits under the SME were to be assigned to Cheetham (Dry Creek) Pty Ltd (now Buckland Dry Creek Pty Ltd) by means of a new Crown Agreement, and changes to reflect current legislation. Between 2005 and 2012, there were discussions about a new Crown Agreement between Cheetham (Dry Creek) Pty Ltd, Cheetham Salt Limited, and the Minister for Mineral Resources Development for and on behalf of the Crown. These discussions did not produce the new Crown Agreement before Cheetham Salt left the Ridley group in 2012, and Cheetham (Dry Creek) Pty Ltd was renamed to Ridley Dry Creek Pty Ltd, and has not been produced since.

In early 2013, Penrice formally advised Ridley Corporation that, following its decision to import soda ash, it would no longer require an on-going supply of salt from the Dry Creek operation from 30 June 2013. Given this, and considering the scale of the field, Ridley Corporation had to make the decision to permanently cease operations and commence the process to close the site.

In 2016, following an expressions of interest process, Ridley Dry Creek Pty Ltd was purchased by Buckland Dry Creek Pty Ltd.

10.3 Adoption of the Care and Maintenance Plan

The cessation of salt production entailed:

- cessation of the pumping of brine into Section 1, so that no new salt is crystallised
- continued pumping of water from Middle Beach through the salinas to maintain water levels and quality in the ponds that were chosen to remain inundated
- draining of water from selected salinas so that these may become free draining and not require pumped water
- discharge of water with elevated salt concentrations as a result of evaporation in inundated ponds. This is necessary to prevent excessive salt concentrations in the salinas
- removal of the existing salt from Section 1.

These activities present a range of hazards with potential consequences for diverse receptors that have variable likelihoods, severities, durations, and degrees of reversibility. The receptors that may experience risk from these hazards and their potential consequences include the following:

- workers at the site
- residents in the local area and / or broader metropolitan Adelaide
- shorebirds (including internationally listed migratory species)
- marine waters and marine species including an important nursery for commercial fish species in an aquatic reserve
- surface water
- flora
- groundwater.

Both the South Australian (SA) Government and BDC are concerned to identify and manage these risks in a prudent manner. In addition, BDC wishes to close the site as soon as practicable and in a manner that complies with its obligations under the Mining Act. Until mine completion, BDC needs to operate the site in a manner that complies with its regulatory requirements.

Between February and August 2013, BDC engaged with South Australian Government agencies (Department of State Development (DSD), Department of Planning, Transport and Infrastructure (DPTI), SA Water, Department of Environment, Water and Natural Resources (DEWNR), Environment Protection Authority (EPA), Department of Primary Industries and Regions SA, (PIRSA)) on a staged conceptual mine completion plan for the site, centred around:

- Stage 1: Works to put the field into operational closure – so that:
  - no water entered Section 1 and its crystallisers from October 2013, and no further salt was manufactured by the site
  - environmental risks were managed while site characterisation was undertaken.

- Stage 2: Investigations and design during operational closure to provide the basis for a mine completion PEPR to be submitted for approval.
  - BDC envisaged that, subject to environmental investigations and monitoring in this stage, water levels in ponds could be drawn down in a controlled manner; with entrainment flows at Middle Beach and Chapman Creek and outflows at Gawler River and Pumping Creek adjusted to maintain water quality in the ponds.
  - BDC also envisaged that all salt field operating systems (pumps, syphons, pond connections etc.) and procedures would remain in place pending the implementation of an approved Stage 3 mine completion PEPR.

- Stage 3: Implementation of works under an approved mine completion PEPR.

By May 2013, the South Australian Government agencies and Ridley had agreed:

- that PEPRs should be submitted for each of the above stages
- on a closure strategy that would form the basis for Stages 1 and 2 work
- that the final closure strategy would be informed by the outcomes from the Stage 2 work and may evolve from that used as the basis for Stages 1 and 2 work.

In July 2013, Ridley submitted a consultation draft for a PEPR for Stage 1 only. In this PEPR, the preliminary concept was outlined for Stage 3 closure. This involved, subject to the outcomes of the investigations and design in Stage 2, staged drying of the ponds, with the maintenance of a wetlands area that BDC suggested could be handed over to Government for ongoing management.

In August 2013, Ridley was advised by DSD that there was insufficient scientific evidence to support this PEPR for Stage 1; that is, for the works to put the site into operational closure. As a consequence, Ridley was advised it was necessary to implement a care and maintenance plan for the site whilst it prepared a supported evidence- based closure approach. The resulting indicative sequence for closure is illustrated in Figure 10-1.

The care and maintenance activities are set out in Part 3 of this PEPR / MOP. **These remain unchanged from the previous revision of this PEPR / MOP.** They continue to have the purposes of:

- stopping salt production and implementing residual salt processing operations in Section 1
- implementing a Holding Pattern for Sections 2 to 4:
  - sustaining water quality within inundated ponds (using a combination of managed entrainment and licensed pumped discharge)
  - providing opportunities to investigate, in a managed environment, the opportunities and constraints on pond drainage and drying.

- providing time (i.e. with acceptable and manageable levels of environmental risk) for the investigations and design needed to develop the mine completion PEPR.

From August 2013 to March 2014, both Ridley and the key South Australian Government agencies (DSD, SA Water, EPA, DEWNR, DPTI and PIRSA) worked to determine a practicable care and maintenance plan for the BDC operations.

In April 2014, following submission of a negotiated document describing a change of process to implement residual operations in Section 1 and a Holding Pattern in Sections 2 to 4, Ridley received a new licence from the EPA and other relevant approvals.

The current EPA licence is provided in Appendix 1.

10.4 Environmental Management Framework for the Site

10.4.1 Environment Policy

The operator of the salt field is now Buckland Dry Creek Pty Ltd (BDC), following sale of Ridley Dry Creek Pty Ltd by Ridley Corporation.

BDC is committed to:

- Implementing Standard Operating Procedures for Dry Creek Salt Field. These have been inherited from the previous owner, Ridley Dry Creek Pty Ltd and remain unchanged.
- Implementing the DSD endorsed PEPR / MOP for the Salt Field.
- Complying with the EPA Licence for the Salt Field; and
- Complying with other permits and approvals for the Salt Field (e.g., Water Licences, PIRSA Permits etc)

10.4.2 Operating Procedures for Dry Creek Salt Fields

BDC maintains site-specific standard operating procedures and addresses quality, safety, legislative and environmental aspects of the operations.

A summary of the operating procedures that deal with environmental aspects of the site is provided in Table 10-1. These procedures can be made available to DSD on request.

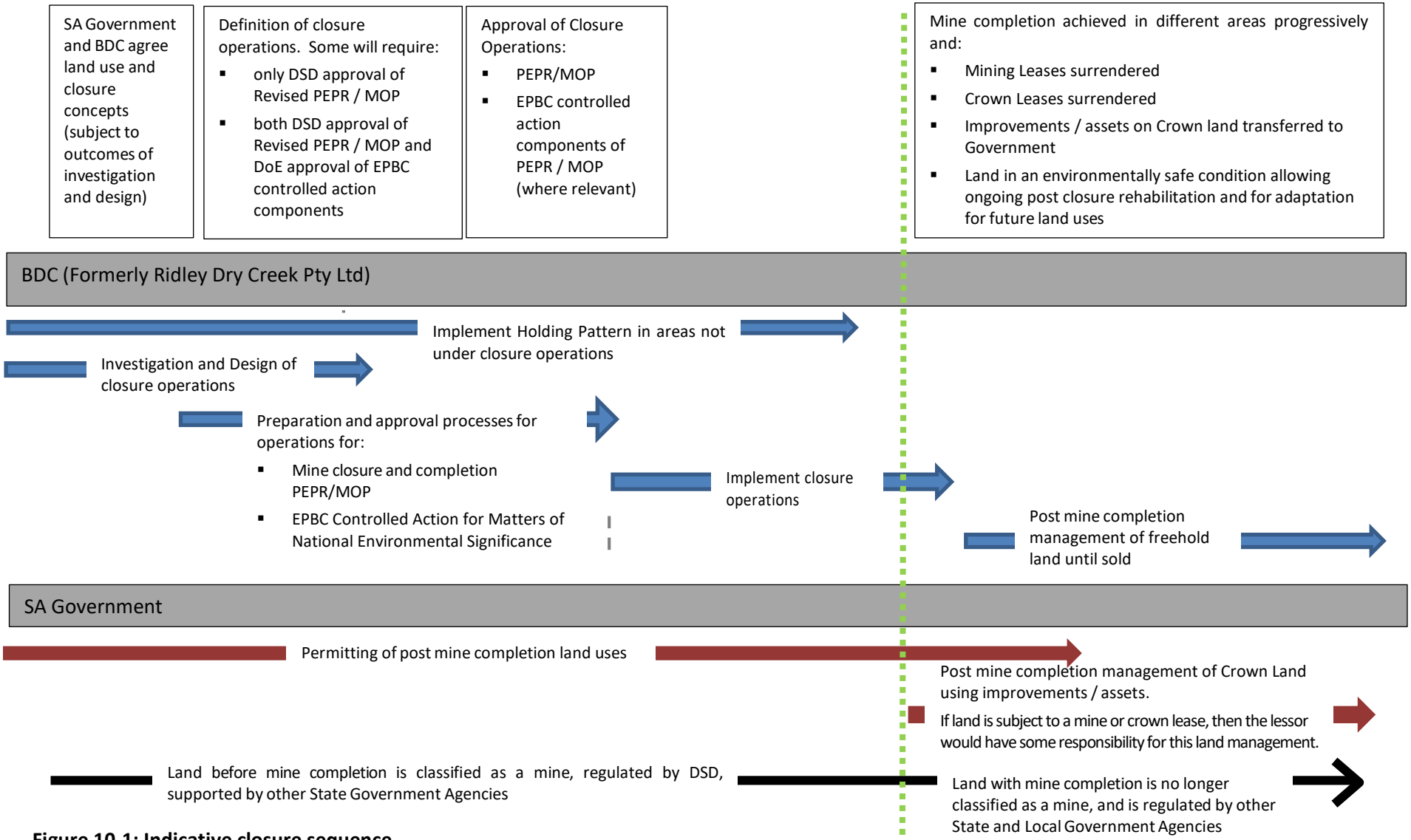


Figure 10-1: Indicative closure sequence

Table 10-1: Operating procedures for Dry Creek Salt Fields

Environmental Management Aspects	Dry Creek site-specific procedures
Environmental Aspects	#SOP-SC-A008 ENVIRONMENTAL MANAGEMENT PLAN
Objectives	#SOP-SC-A008 ENVIRONMENTAL MANAGEMENT PLAN #SOP-SC-A015 ENVIRONMENT IMPROVEMENT PLAN
Training, Awareness and Competency	# 1028 General Induction # 1085 Salt Refinery Induction #1068 Salt Fields Classifications Flowchart #1071 Internal Training Completion Form # 1091 Harvest Induction # 1100 Materials Handling Induction Hazard ID.xls spreadsheet
Communication	#SOP-SC-A002 MONTHLY REPORTS
Operational Controls	#SOP-SC-A004 SECURITY #SOP-SC-A006 BORE MANAGEMENT #SOP-SC-A011 RESOURCE MANAGEMENT #SOP-SC-A012 WASTE MANAGEMENT #SOP-SC-A013 HERITAGE MANAGEMENT #SOP-SC-A014 LAND MANAGEMENT #SOP-SC-C003 LIME MATERIALS MANAGEMENT #SOP-SC-C004 SPILLS CONTINGENCY #SOP-SC-C008 SEA AND T3 BORE WATER #SOP-SC-C010 WORKPLACE HOUSEKEEPING INSPECTION PROCEDURES #SOP-SC-E001 EMERGENCY RESPONSE PROCEDURE #SOP-SC-K007 WETLANDS WATER #SOP-P-001 WEED SPRAYING PROCEDURE #SOP-SC-P005 BIOLOGICAL MONITORING #SOP-SC-P010 LEVY BANK INSPECTIONS #80 WORKSHOP SPILL INSTRUCTIONS #81 HAZARD REGISTER INSTRUCTION #143 BRINE MAIN REPAIR INSTRUCTIONS #150 CHEMICAL HYGIENE
Emergency Preparedness and Response	#SOP-SC-C004 SPILLS CONTINGENCY #SOP-SC-E001 EMERGENCY RESPONSE PROCEDURE #SOP-SC-P010 LEVY BANK INSPECTIONS #80 WORKSHOP SPILL INSTRUCTIONS #81 HAZARD REGISTER INSTRUCTION #143 BRINE MAIN REPAIR INSTRUCTIONS #150 CHEMICAL HYGIENE INSTRUCTION
Monitoring and Measurement	#SOP-SC-A002 MONTHLY REPORTS #SOP-SC-A008 ENVIRONMENTAL MANAGEMENT PLAN #SOP-SC-C005 MARINE DISCHARGE #SOP-SC-P005 BIOLOGICAL MONITORING

10.4.3 System to Monitor, Record, Evaluate, Audit and Review Compliance

Monitoring of compliance with quality, legislative, safety and environmental requirements is managed through the implementation of BDC's #SOP-SC-A008 ENVIRONMENTAL MANAGEMENT PLAN and #SOP-SC-C005 MARINE DISCHARGE.

10.4.4 Response to Non-compliances and Emergencies

BDC has implemented the following standard operating instructions to ensure adequate response to incidents:

- #SOP-SC-C004 SPILLS CONTINGENCY
- #SOP-SC-E001 EMERGENCY RESPONSE PROCEDURE
- #SOP-SC-P010 LEVY BANK INSPECTIONS
- #143 BRINE MAIN REPAIR INSTRUCTIONS
- #80 WORKSHOP SPILL INSTRUCTIONS
- #81 HAZARD REGISTER INSTRUCTION
- #150 CHEMICAL HYGIENE INSTRUCTION

The over-arching procedure for emergency response is in #SOP-SC-E001 EMERGENCY RESPONSE PROCEDURE. This is provided in Appendix 2.

11 Mine Completion Planning Framework

11.1 Closure Strategy

The closure strategy is described in Part 4 of this PEPR / MOP. For Section 1 of the Salt Field, the future land use is a mixed used urban development, but with parts of the land excised for the Northern Connector (about to be constructed). For Sections 2 to 4, options for land uses are under consideration and being informed by further discussions and investigations. For this reason, a base case closure strategy has been developed for Sections 2 to 4 to provide a planning framework for closure. This is further described in Part 4 of this PEPR / MOP.

As closure operations will occur in a staged manner within each section, some parts of sections will still be subject to the holding pattern or residual operations, while others will be undergoing closure activities. When it is accepted by DSD that a part of a section has achieved mine completion, it will be surrendered and ongoing responsibility accepted by the next land user.

11.2 Organisational Framework

The South Australian Government is a key stakeholder in the closure process. The salt field includes significant areas of Crown land which will return to government management following mine completion. Much of this land will be an important component of the proposed Adelaide International Bird Sanctuary. Freehold land currently occupied by the salt field will contribute to *The 30 Year Plan for Greater Adelaide.* Land use planning for the salt field is likely to identify other government uses and / or ways in which future use will contribute to government priorities.

For these reasons, the South Australian Government has established an organisational structure to oversight closure planning for the salt field, work cooperatively with BDC through the closure process and ensure all regulatory requirements are met. A number of groups have been, or are proposed to be established, as part of this structure:

- Steering Group: to provide high level oversight within Government of the Holding Pattern and Closure process.
  - Chief Executives of DPTI (Chair), DSD, EPA, DEWNR, PIRSA, SA Water and Renewal SA; a senior representative on behalf of the three Councils (Salisbury, Playford and Mallala
- Strategy / Technical Advisory Group: to provide technical and strategic input to the closure process.
  - Senior representatives of DSD (Chair), DEWNR, DPTI, EPA, PIRSA, SA Water, Renewal SA; a representative on behalf of the three Councils (Salisbury, Playford and Mallala), and BDC.

The Strategy / Technical Advisory Group (STAG) has developed a number of principles for the design of closure of this site. These are described in Part 4 of this PEPR / MOP.

11.3 Relevant Legislation

11.3.1 Mining Act

The *Mining Act 1971* and *Mining Regulations 2011* provide the framework for the approval and regulation of all mining operations in South Australia and is administered by DSD. The Mining Act is the principal legislation for regulating the operations and closure of the Dry Creek Salt Field.

As noted at Section 10.1, 46 mining leases and two private mines make up the existing operations. The mining leases are currently operated as a Special Mining Enterprise (SME) under sections 56A-

D of the Mining Act. Prior to 2011, the documentation required under section 56B of the Mining Act fulfilled the function of a Mining and Rehabilitation Program. Since 2011, a PEPR has been required for mining operations on a mining tenement. Under section 70B of the Mining Act, a PEPR must include information on the:

- mining operations
- environmental outcomes expected to occur as a result of the mining operations
- criteria to measure achievement of environmental outcomes
- ability of the miner to achieve the environmental outcomes.

Further requirements for the content of a PEPR are set out in regulation 65 of the Mining Regulations and in a Ministerial Determination made under reg 65(7) of the Mining Regulations (12 July 2012 and amended 5 December 2015). The compliance of this PEPR with the Ministerial Determination is shown in Part 1.

The private mines are not included in the SME but do form part of the integrated salina system of the salt field. Land within a private mine is not subject to a mining tenement under the Mining Act. Mining operations on a private mine require approval of a MOP by DSD under s 73G of the Mining Act. Mining operations on the two private mines that are part of the Dry Creek Salt Field are carried out in accordance with a Development Program prepared under regulation 10 of the *Mines and Works Inspection Regulations 1998* (now regulation 9 of the *Mines and Works Inspection Regulations 2013).* Under transitional arrangements, this program was deemed to be a MOP for the purpose of section 73G of the Mining Act.

The current requirements of a MOP are set out in regulation 80 of the Mining Regulations. A MOP must include:

- a description of the nature and character of the environment (including physical and biological features) that can reasonably be expected to be affected by operations carried out
- objectives relating to:
  - construction and operation of the mine and any related facilities
  - management of potential impacts on the environment
  - ongoing and final rehabilitation of the site, site closure, and future use of the site
  - action to be taken in the event of an emergency situation at the site of the mine.
- details of the operations to be carried out at the mine and associated facilities
- procedures to be followed in the event of an incident or situation which gives rise to, or could adversely affect, a matter of environmental significance.

Compliance of this PEPR / MOP with the Mining Regulations is shown in Part 1. It is noted that Ridley Dry Creek Pty Ltd submitted a compliance report to DSD covering its operations under the PEPR / MOP to 31 May 2016 (Ridley 2016) and that this report was accepted by DSD. BDC effectively took over the operations and responsibility for compliance from 1 June 2016.

11.3.2 Environment Protection Act 1993

The *Environment Protection Act 1993* provides for the protection of the environment and defines the functions and powers of the EPA. The Act facilitates the adoption and implementation of environment protection measures and regulates activities, products, substances and services that, through pollution of production of waste, may cause environmental harm. The Act also regulates the generation, storage, transportation, treatment and disposal of waste.

Environment protection policies established under section 28 of the Environment Protection Act of particular relevance to the Dry Creek Salt Field include:

- *Environment Protection (Air Quality) Policy 1994*

- *Environment Protection (Noise) Policy 2007*
- *Environment Protection (Water Quality) Policy 2003*.

The environmental outcomes proposed in this PEPR will need to comply with these policies.

Schedule 1 of the Environment Protection Act specifies 'Prescribed activities of environmental significance' that require environmental authorisation from the EPA. BDC Corporation holds Licence 40942 for the following prescribed activities on the salt field:

- 1(1) Chemical storage and warehousing facilities
- 1(2)(b) Chemical works: Salt production
- 8(7) Discharge to marine or inland waters.

A change to this licence was approved on 12 March 2014 to allow for the Holding Pattern. Important requirements of this licence include:

- Saline water may only be discharged into coastal waters at the SA Water Bolivar Waste Water Treatment Plant Outfall Weir (Weir 2).
- The discharge must not have a salinity greater than 45 parts per thousand. Continuous in-line monitoring of salinity is required and BDC must cease discharge if the salinity criteria is exceeded.
- BDC must develop and implement a Discharge Criteria Management Plan which includes:
  - methodology to maintain compliance with the 45 parts per thousand salinity criteria at Location A
  - proposed measures to address any exceedances of salinity criteria
  - steps BDC will take to resume discharge any exceedances.
- Bitterns (a solution of bromides, magnesium and calcium salts remaining after sodium chloride is crystallised out of seawater) may only be discharged at specified points. The water quality criteria for bittern discharge are:
  - suspended solids: less than 80 mg / lt + 80% seasonal maximum
  - pH: 6-5 – 9.2
  - salinity: hydrography of stream flow causes a permanent change in isohaline patterns of no more than 10% of background variation
  - oxygen (dissolved): discharge is subject to turbulent flow to ensure it is discharged with highest possible Oxygen saturation.
- BDC must develop and implement an inundated Pond Water Level Control Plan to address prevention of mobilisation and exposure of monosulfidic black ooze and acid sulfate soils. This must include:
  - levels of water to be maintained in each of the inundated ponds
  - measures that will be taken to ensure the water levels are maintained at the proposed levels in each inundated pond
  - method of monitoring to ensure the water levels are maintained at the proposed levels in each inundated pond.
- BDC must also develop and implement a Dredging Notification Plan, Dust Management Plan, Odour Management Plan and Noise Management Plan.

The requirement for a licence for prescribed activities is to ensure such activities do not cause environmental harm. Environmental outcomes and criteria proposed in this PEPR will need to consider the current licence requirements and any likely future requirements. While salt production has ceased on the salt field, ongoing EPA licensing is expected to be required due to the need to continue discharge to the marine environment.

11.3.3 Fisheries Management Act 2007

The *Fisheries Management Act 2007* provides for the conservation and management of the aquatic resources of the State, the management of fisheries and aquatic reserves, the regulation of fishing and the processing of aquatic resources, the protection of aquatic habitats, aquatic mammals and aquatic resources and the control of exotic aquatic organisms and disease in aquatic resources.

Section 77 of the Act prohibits disturbance of water beds, or removal or interference with animals or plants, in an aquatic reserve without authorisation. BDC holds a permit to allow discharge of water from the Bolivar Channel Outfall into the St Kilda – Chapman Creek Aquatic Reserve. The permit is subject to the discharge criteria set by the EPA licence.

Until 25 March 2015, BDC also had an exemption under s 115 of the Act allowing use of nets to remove carp from the Bolivar Channel Outfall. That exemption was not renewed, because the salinity of the water in the outfall channel, as a result of the discharge from PA5, precludes carp.

The St Kilda – Chapman Creek Aquatic Reserve is considered in this PEPR as an environmental value. There is a need for ongoing discharge to the marine environment. Consequently, environmental outcomes proposed in this PEPR will need to consider the protection of this reserve.

11.3.4 Development Act 1993

The *Development Act 1993* provides a legislative framework for the planning and regulation of new developments, the use and management of land and buildings, the design and construction of buildings and the maintenance and conservation of land and buildings. The Act does not prevent, or otherwise affect, operations carried out under the Mining Act, or the operation of a private mine.

The Act will apply to the salt field when the mining tenements are relinquished. New developments following relinquishment may require approval under the Development Act. All development applications are assessed against the objectives and principles of the relevant Council development plan. Development Plans are self- contained policy documents prepared under, and given statutory recognition under the Development Act. The Development Plans relevant to the Dry Creek Salt Field include:

- Salisbury Council Development Plan
- Port Adelaide Enfield Council Development Plan
- Playford Council Development Plan
- Mallala Council Development Plan.

Post completion land uses proposed in this PEPR will need to take account of these Development Plans.

11.3.5 Natural Resources Management Act 2004

The *Natural Resources Management Act 2004* promotes the sustainable and integrated management of the State's natural resources, and provides for the protection of the State's natural resources. The Act establishes Natural Resource Management (NRM) Regions and Boards and provides for the preparation of a State NRM Plan and Regional NRM plans to promote the objectives of the Act.

The Dry Creek Salt Field is contained within the Adelaide – Mount Lofty Ranges NRM Region. The NRM Plan regulates water affecting activities, stormwater management, management and protection of land, and control of plants and animals. Environmental outcomes and strategies proposed in this PEPR will need to take account of the Adelaide – Mount Lofty Ranges NRM Plan and the State NRM Plan. Permits may be required for certain activities included in the PEPR from the NRM Board.

11.3.6 Native Vegetation Act 1991

The *Native Vegetation Act 1991* provides incentives and assistance to land owners for the enhancement and preservation of native vegetation and acts to control the clearance of native vegetation.

Clearing undertaken for mining activities approved under the Mining Act is exempt from the Native Vegetation Act. This exemption, however, is subject to a requirement that all mining operations (other than exploration) that involve the clearance of native vegetation must be undertaken in accordance with a management plan that the Native Vegetation Council has signified will result in a significant environmental benefit (SEB). The role of the Council for this function has been delegated to DSD.

The intent of SEB is not only to replace the immediate environmental values lost through clearance, but also to achieve a net gain that contributes to improving the condition of the environment and biodiversity of the region. SEB may be made through on ground management and restoration of native habitats as guided by an approved vegetation management plan or by direct monetary contribution into the Native Vegetation Fund. The Council has released *Guidelines for a native vegetation Significant Environmental Benefit policy for the clearance of native vegetation associated with the minerals and petroleum industry* (September 2005).

Some closure strategies in this PEPR may result in loss of vegetation. If so, an SEB may be required for approval by DSD.

11.3.7 National Parks and Wildlife Act 1972

The *National Parks and Wildlife Act 1972* provides for the establishment and management of reserves, the conservation of wildlife in a natural environment, and for other purposes such as permits for the keeping of native animals and compliance.

The Act protects all native flora and fauna in South Australia and lists species of state conservation significance in Schedule 7 (Endangered), 8 (Vulnerable) and 9 (Rare) of the Act. There are no approval requirements under this legislation to impact on a listed species. If native vegetation is to be removed, the impacts are assessed under the *Native Vegetation Act 1991*.

11.3.8 Adelaide Dolphin Sanctuary Act 2005

The *Adelaide Dolphin Sanctuary Act 2005* establishes a sanctuary to protect the dolphin population of the Port Adelaide River Estuary and Barker Inlet and its natural habitat, and provides for the protection and enhancement of the Port Adelaide River Estuary and Barker Inlet. In making decisions under this Act, and other specified Acts and Regulations, Ministers are required to consider the operation or application of this Act and must act consistently with, and seek to further, the objects and objectives of this Act.

11.3.9 Heritage Places Act 1993

The *Heritage Places Act 1993* makes provision for the identification, recording and conservation of places and objects of non-Aboriginal heritage significance and establishes the South Australian Heritage Council.

11.3.10 Aboriginal Heritage Act 1988

The *Aboriginal Heritage Act 1988* provides for the protection and preservation of Aboriginal heritage.

11.3.11 Other South Australian legislation

Other South Australian legislation relevant to the Dry Creek Salt Field includes, but is not limited to, the following Acts (and associated Regulations):

- *Coast Protection Act 1972*
- *Fire and Emergency Service Act 2005*
- *Dangerous Substances Act 1979*
- *Work Health and Safety Act 2012*.

11.3.12 Environment Protection and Biodiversity Conservation Act 1999 (Cth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's primary environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as matters of national environmental significance.

The nine matters of national environmental significance protected under the EPBC Act are:

- world heritage properties
- national heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mines)
- a water resource, in relation to coal seam gas development and large coal mining development.

The only matters relevant to the Dry Creek Salt Field are listed threatened species and ecological communities, and listed migratory species. Approval will be required from the Commonwealth Environment Minister for any actions in this PEPR / MOP that are likely to have a significant impact on these matters. BDC has submitted a self-assessment for the Holding Pattern and will update this at intervals during the Holding Pattern to account for new information from monitoring and the implementation of the Holding Pattern.

A referral for closure activities was submitted in January 2015. On 14 February 2015, the delegate of the Environment Minister determined that the activities required approval and will be assessed on preliminary documentation.

11.4 Other Relevant Policies and Plans

11.4.1 South Australia's Strategic Plan

South Australia's Strategic Plan was first released by the South Australian Government in 2004 and was last updated in 2011. The plan's targets reflect South Australia's aspirations through to 2020. It guides government actions and priorities, and sets seven strategic priorities:

- Creating a vibrant city
- Safe communities, healthy neighbourhoods
- An affordable place to live
- Every chance for every child
- Growing advanced manufacturing
- Realising the benefits of the mining boom for all
- Premium food and wine from our clean environment.

The Strategic Plan will be considered in future land use planning for the site.

11.4.2 The 30-Year Plan for Greater Adelaide

The *30-Year Plan for Greater Adelaide* was released in 2010 and outlines how the South Australian Government proposes to respond to population growth, demographic change (such as an ageing population and more single person and couple households without children) and an evolving economy.

The plan indicates that during the next three decades, Greater Adelaide could experience:

- steady population growth of 560,000 people
- construction of 258,000 additional dwellings
- creation of 282,000 new jobs
- economic growth of $128 billion.

The plan is a volume of the *Planning Strategy for South Australia*, which guides land-use planning throughout the State.

The plan designates Section 1 of the salt field as a future urban growth area. Parts of other Sections are also shown as investigation areas for future urban growth, dependent on a feasibility investigation study by SA Water. The plan also notes an indicative corridor for the Northern Connector as a potential primary freight road.

The plan will also be considered in future land use planning for the site.

11.4.3 Adelaide International Bird Sanctuary

In 2014, the South Australian Government released a vision for an Adelaide International Bird Sanctuary along a 60 kilometre stretch of the Gulf of St Vincent coastline from the Barker Inlet to the township of Port Parham, incorporating parts of the Dry Creek Salt Field (Figure 11-1). The sanctuary's focus would be on protecting significant migratory shorebirds, enhancing water quality on Gulf St Vincent, contributing to a more liveable and sustainable city, and providing ecotourism and indigenous employment opportunities.

Areas to be included in the proposed sanctuary will be confirmed with the State government in future land use planning for the salt field.

11.4.4 Northern Connector

The Northern Connector project is part of the 78 km North-South Corridor identified as the major transport route for north and south bound traffic (including freight vehicles) running between Gawler and Old Noarlunga. The Northern Connector will be a non-stop motorway connecting the already complete Northern Expressway and South Road Superway links and will provide an unimpeded 43 km journey from Gawler to Regency Park. The new 15.5 km road, to the west of Port Wakefield Road, will extend from the new Northern Expressway Interchange with Port Wakefield Road at Waterloo Corner to the Port River Expressway and South Road Superway Interchange at Wingfield. The project is underway and is due to be completed by mid-2019.

The originally proposed rail component of the Northern Connector project (31 km rail track and 4 bridges connecting with the existing rail line at Kings Road, Virginia and the Outer Harbour line at Dry Creek) has been deferred following determination that freight rail line improvements are not required in the shorter term.

The proposed route for the Northern Connector is shown in Figure 11-2. The implications of construction of the Northern Connector for the Dry Creek Salt Fields are discussed at Chapter 11.5.

Figure 11-1: Proposed Adelaide International Bird Sanctuary (shown in green) and other protected areas

Source: DEWNR

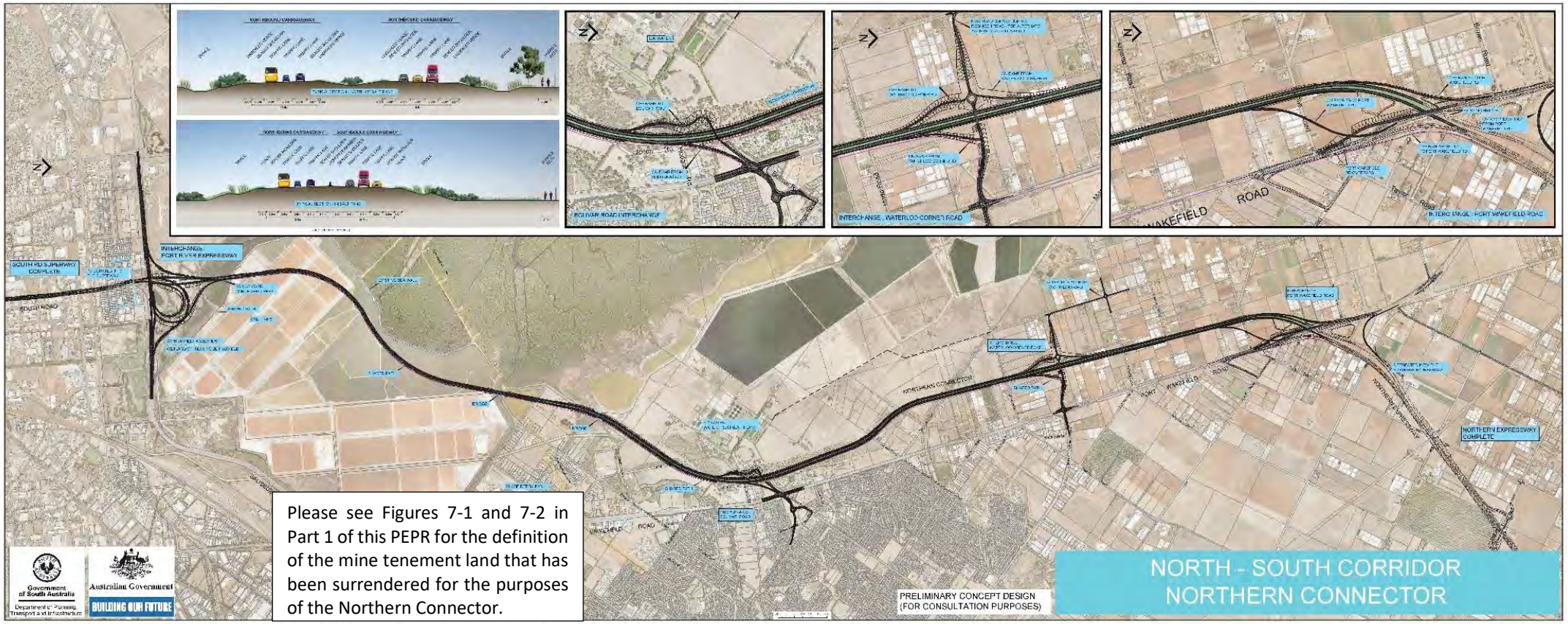


Figure 11-2: Proposed Northern Connector route

Source: Department of Planning, Transport and Infrastructure

11.4.5 Development Plans

Development Plans have been prepared under the *Development Act 1993* for each of the four councils that include the salt field. The main zones in these development plans that apply to the salt field and surrounds are shown in Figure 11-3 and summarised below in Table 11-1. A number of policy areas also apply over and around the salt field reflecting the low-lying nature of the land and presence of acid sulfate soils.

Table 11-1: Development Plan Zones

Development Plan	Zone Name	Objective
Salisbury Council	Coastal Conservation	The conservation of coastal features and scenic quality, enable appropriate public access and ensure that development is not subject to coastal hazards.
	Coastal Settlement	The protection of the natural coastal environment from inappropriate development.
	Deferred Urban	Accommodate a restricted range of uses that are not prejudicial to development of the land for urban purposes and maintain the appearance of the zone.
	Mineral Extraction	Mining and quarrying of minerals in a sustainable manner.
	Open Space	Preserve open space character to provide a visual contrast to the surrounding urban area and accommodate a range of public and private activities in an open and natural setting.
Port Adelaide Enfield	Metropolitan Open Space System	Accommodates a range of public and private activities, including passive and active recreation land uses, habitat conservation and restoration, in an open and natural setting.
	Industry	Accommodate a wide range of industrial, warehouse, storage and transport land uses.
Playford	Mineral Extraction	Mining and quarrying of minerals in a sustainable manner, including extraction of salt
	Metropolitan Open Space System	Accommodates a range of public and private activities, including passive and active recreation land uses, habitat conservation and restoration, in an open and natural setting.
	Primary Production	Economically productive, efficient and environmentally sustainable primary production
Mallala	Coastal Conservation	Enhance and conserve the natural features of the coast, including visual amenity, landforms, fauna and flora.
	Conservation	Conservation and enhancement of the natural environment and natural ecological processes for their historic, scientific, landscape, faunal habitat, biodiversity and cultural values.
	Primary Production	Economically productive, efficient and environmentally sustainable primary production

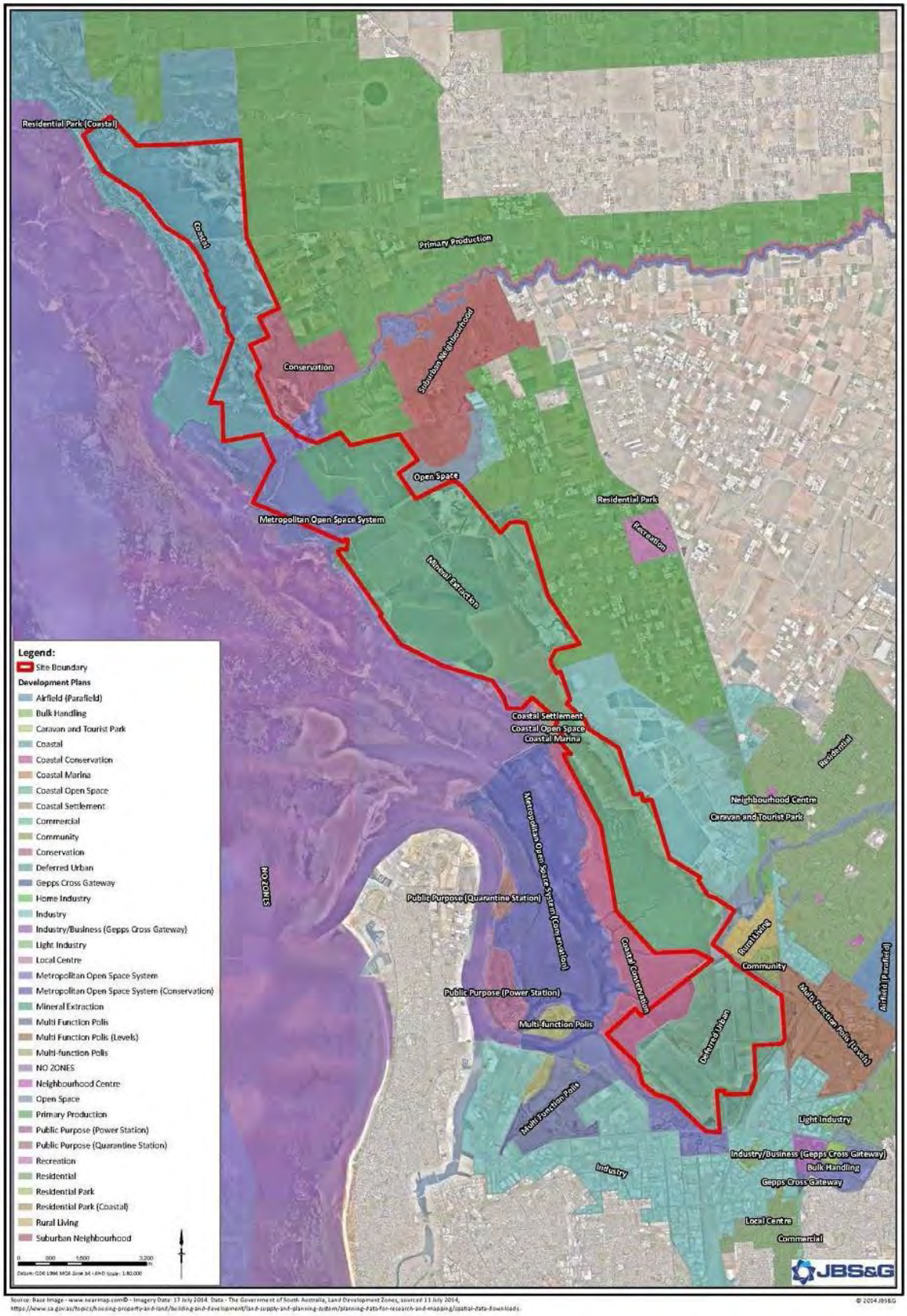


Figure 11-3: Land use zoning

11.5 Future Land Use Context

In 2014 the prior owner of the salt field, Ridley Dry Creek Pty Ltd, and the South Australian Government initiated an expression of interest process to identify a short list of feasible future land uses and proponents for each part of the salt fields. The process entailed advertising and publicity to seek out organisations wishing to express interest and be considered.

The aims were to:

- help Ridley to adjust the scope and timing of its closure works to achieve mine completion in such a way that expedites mine completion, and facilitates these feasible future land uses
- help the South Australian Government assess the site's residual environmental risks at mine completion in the light of these feasible future land uses
- help the South Australian Government and Ridley manage the land transactions needed to transition Crown and freehold land to these feasible future land uses
- help the South Australian Government with the economic, planning and environmental assessments of these feasible future land uses.

That process resulted in the sale of Ridley Dry Creek Pty Ltd, and freehold land, crown leases, and its mining tenements. Ridley Dry Creek Pty Ltd has been renamed Buckland Dry Creek Pty Ltd (BDC).

BDC is now exploring the options for future land uses in the different parts of the salt field. As of the date of preparation of this PEPR Revision, the following can be stated.

11.5.1 Section 1 - South of Dry Creek

The western part of Section 1 is being taken over by DPTI for the construction of the Northern Connector. Once the construction is complete, it is understood that land that is surplus to the requirements of the Northern Connector will be transferred back to Renewal SA.

Renewal SA owned land and BDC owned land that are covered by mining tenements (and that are not required for the Northern Connector) will be the subject of mixed use urban development. To this end Renewal SA and BDC are collaborating on the Master Planning for that development

Those intertidal parts of mining tenements in Section 1 that lie outside and west of the sea wall that forms the western boundary of what was the operational salt field in Section 1 will stay with or be returned to the Crown.

11.5.2 Section 2 – Dry Creek to St Kilda

<u>North of Dry Creek to PA6 (South)</u>

The mining tenement land associated with PA12 and between PA12 and PA11 is being taken over by DPTI for the construction of the Northern Connector.

The mining tenement land associated with PA11 is partly owned by the Crown and partly by BDC. This land does not yet have an identified future land use.

SA Water is conducting trials in Section 2 to investigate the feasibility of denitrification of effluent from its Port Adelaide treatment facility. If the trials are successful, it is understood that SA Water may want to use PA10, PA9, PA8, PA7 and the southern part of PA6 for long term denitrification operations.

Other options for future uses of these ponds PA11, PA10, PA9, PA8, PA7 and the southern part of PA6 are also being explored.

Those intertidal parts of mining tenements in in this part of Section 2 that lie outside and west of the sea wall that forms the western boundary of what was the operational salt field in Section 2 may:

- Either continue to be leased and managed by BDC from the Crown; or
- Be returned to the Crown for its management.

PA4, PA5 and PA6 (North)

Salisbury Council is investigating the feasibility of the concept of using PA4, PA5 and PA6 to help manage stormwater discharges from Edinburgh Park North and the land that is generally west of there. If that concept proves feasible, then these ponds may become used for stormwater detention and treatment wetlands, discharging into tidally flushed wetlands.

Other options for future uses of these ponds PA4, PA5, PA6 (North) are also being explored.

It is likely that those intertidal parts of mine tenements in this part of Section 2 that lie outside and west of the sea wall that forms the western boundary of what was the operational salt field in Section 2 2 may:

- Either continue to be leased and managed by BDC from the Crown; or
- Be returned to the Crown for its management.

Section 3 – St Kilda to Port Gawler (North of PA4) and Section 4 – Port Gawler to Middle Beach

Ideas for future land uses in these parts of the salt field are being explored to establish what combinations may be feasible and desirable. These include:

- shorebird and waterbird habitat conservation
- solar energy production
- carbon sequestration by biological processes
- stormwater management
- horticulture / agriculture
- aquaculture
- salt production.

12 Overview of Site and Context

12.1 Overview of Site and Surrounding Land Uses

12.1.1 Section 1 – South of Globe Derby Park

General Description

This southern-most portion of the salt field, essentially encompassing the salt crystallisation pans, is situated adjacent to the northern industrial precincts of Dry Creek and Wingfield. The Barker Inlet and Aquatic Reserve border the salt pans to the west and expansive wetlands generally border the southern and eastern portions of the land, traversing the Salisbury Highway (which extends from the southern boundary and along the eastern side of the land), to connect to Port Wakefield Road.

The land to the south and south-east forms part of Adelaide's major industrial precinct and includes the suburbs of Wingfield, Regency Park, Dry Creek and Cavan. This industrial precinct is also well serviced by major transport routes, is in close proximity to the Dry Creek rail yards and has direct access to the Port of Adelaide. To the west is the Gillman Resource Recovery Precinct and the future Gillman Industrial Estate (of some 200 Ha).

Development to the east and on the opposite side of Port Wakefield Road is residential and includes the suburbs of Mawson Lakes and Parafield Gardens. Port Wakefield Road provides a natural development barrier and buffer, as do the wetlands.

The configuration of land ownership in this sector is delineated in Figure 12-1.

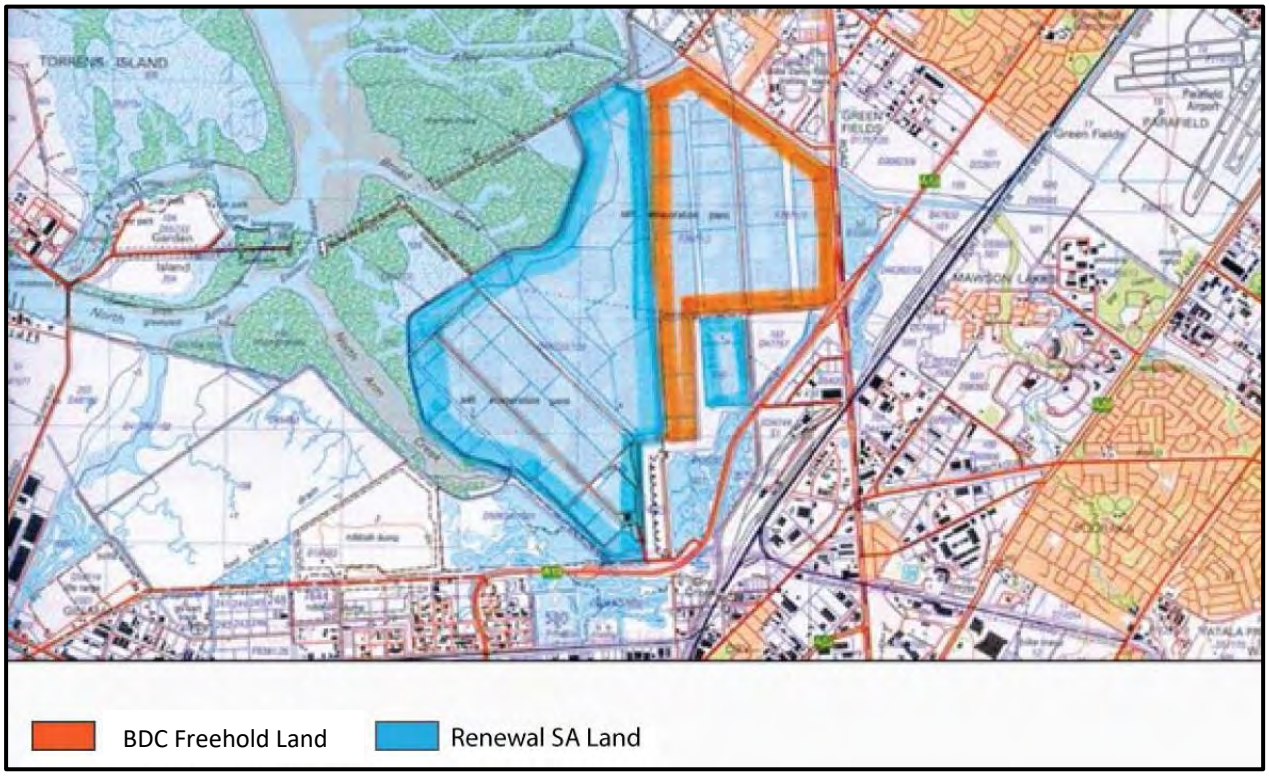


Figure 12-1: Land tenure – Section 1 (south of Globe Derby Park)

Land Use

Most of the land within this section is operational salt field production land, provided for the final crystallisation, harvesting, processing and transporting of the end-product to the Osborne factory. Three hundred and four hectares of this land is freehold land owned by BDC.

Built improvements comprising the site office and stores are constructed on Crown land. Other improvements are generally specialised salt production related, such as pumps, levees, roadways and ponds. A series of levees protect the saltpans land from uncontrolled flooding from either the sea or the adjoining wetlands.

The freehold land has Private Mine tenements and the Crown land has Mining Leases, however, there are generally no other occupancy rights over the Crown land.

The land is primarily within the City of Salisbury (with a small incursion into Port Adelaide-Enfield) and, under the current Development Plan, is mostly within an MFP zone, with portion being in a MOSS (Recreation) zone. The MFP zone is a redundant zone, which was intended to underpin a comprehensive and staged urban development accommodating 30,000 to 50,000 people. The zone extends into Gillman to the west. A Development Plan Amendment, rezoning the Gillman land to Industry or similar, is expected in the near term.

The 30 Year Plan for Metropolitan Adelaide defines the desired directions for future development and also provides a basis for private sector development through local government Development Plans. The future use and development of the land will be determined within the framework of this strategy. To this end, the land is referred to in the Plan as having potential for future urban development, although the nature of that development remains to be determined.

The MOSS (Recreation) zone is primarily intended as a zone in which a predominantly open space character is preserved and enhanced to provide a visual contrast to the urban area; and as a zone accommodating district and regional open space for a range of passive and active public recreational activities. The zone is to provide cycle and walking paths within an integrated system of open spaces linking adjoining land uses, development in appropriate locations of non-intrusive recreation, tourist, education and research activities, and an open and natural landscape featuring native plantings and watercourses.

12.1.2 Section 2 – Globe Derby Park to St Kilda

General Description

Extending north for approximately seven kilometres, this Section comprises a series of salt evaporation ponds generally hugging the eastern side of coastal mangrove land owned by the Crown and otherwise designated Aquatic Reserve. The land abutting the east of the salt operation comprises, in the main, the Bolivar Waste Water Treatment Plant, which has its own extensive evaporation and holding ponds running parallel to the salt evaporation ponds.

This land is generally within the suburb of Dry Creek. It has a small industrial pocket to the south, centred on Churchill Road, while the balance is largely undeveloped swamp, mangrove, wetlands and low lying land, some of which is subject to inundation.

The freehold land and Crown land for this sector of the salt field operation is delineated in Figure 12-2.

As shown, there is only a small area of freehold land at the southern end.

Figure 12-2: Land tenure – Section 2 (Globe Derby Park to St Kilda) = BDC freehold = Crown land

Land Use

The operational portion of this land is concentrated to the north, gradually tapering along the eastern boundary to evaporation ponds adjacent to Globe Derby Park, comprised in a small freehold parcel. The balance of Crown land is non-operational and is part of the 'Barker Inlet and St Kilda Aquatic Reserve' which comprises significant mangrove reserves.

The freehold land has a Private Mine tenement and the Crown land has a Mining Lease, however there are no other occupancy rights over the Crown land. The ratio of both operational freehold to operational leasehold land and total freehold to total leasehold land is very low.

The land is within the City of Salisbury and, under the current Development Plan, is essentially within an Extractive Industry (EIn) zone, with small portion being in a MOSS (Recreation) zone. The primary objective of the EIn zone is for the mining and quarrying of minerals. The current use appears to accord with the intentions of the zone.

12.1.3 Section 3 – St Kilda to Port Gawler

General Description

This Section comprises expansive salt evaporation ponds extending for approximately ten kilometres along the coast, from St Kilda in the south to the Gawler River at Port Gawler in the north. It also comprises Crown land along the western strip and freehold land to the east. Essentially the whole of the freehold land in this stretch is utilised for condenser ponds. All land in this stretch is low lying and subject to inundation. It may require some fill or remediation for alternate development.

The land is within the suburb of Buckland Park, a large portion of which (to the east of the BDC land) is low- lying and marginal grazing land. A large part of the land east of the BDC land is owned by Walker Corp and is proposed for residential development in the near to medium term.

The freehold land and Crown land for this sector of the salt-field is delineated in Figure 12-3.

Figure 12-3: Land tenure – Section 3 (St Kilda to Port Gawler) **= BDC freehold** **= Crown land**

Land Use

The majority of land within this section is operational and there is a relatively even split between freehold land and Crown leasehold land. A few narrow strips of the Crown leased land abutting the coast are not operational and would most likely revert to reserve if not controlled by BDC. The freehold land has a Private Mine tenement and the Crown land has Mining Leases, however, there are generally no other occupancy rights over the Crown land.

This section comprises the most significant area of operational condenser pans. Both the northern and southern portions taper to provide connectors across the Gawler River flood plain and St Kilda Beach environs respectively.

The land is essentially within the City of Playford and under the current Development Plan, is primarily within an EIn zone, with small portion being in a MOSS (Recreation) zone. The EIn zone is intended as a zone comprising both solar evaporation pans for the extraction of salt and development compatible with core horticulture activities (e.g. irrigated and greenhouse horticulture and hydroponics) within the Horticulture West Zone; and as a zone for the mining and quarrying of minerals.

12.1.4 Section 4 – Port Gawler to Middle Beach

General Description

This section comprises a stretch of condenser ponds spanning approximately nine kilometres of coastline, from Port Gawler in the south to Middle Beach in the north. It incorporates both Crown land and freehold land, with the freehold land being to the east of the coastal reserve land and mangroves. Middle Beach provides the sea water inlet for the whole of the salt making operation, this installation being situated on Crown land.

Crown land portions are generally low lying whilst freehold portions are slightly higher. The south-western portion borders on the environmentally sensitive Gawler River floodplain, whilst the north-western portion borders on the equally sensitive Salt Creek floodplain. The land is within the Buckland Park and Port Gawler area, which generally comprises low lying marginal grazing land.

The freehold land and Crown Land for this section is delineated in Figure 12-4.

Figure 12-4: Land tenure – Section 4 (Port Gawler to Middle Beach) = BDC freehold = Crown land

This section comprises mostly operational salt evaporation pans, the significant proportion of which are on freehold land. There are two parcels of Crown land, one to the north and one to the south, separated by the freehold land. Both the freehold land and the Crown land have a Mining Lease tenement. There are no occupancy rights beyond this over the Crown land to the south, while BDC holds Licences to Occupy over the Crown land to the north.

The northern parcel of Crown land, adjacent to Middle Beach, incorporates the salt water inlet supply for the whole of the salt field operation. The northern portion, both freehold and Crown land, encroaches onto the environmentally sensitive Salt Creek floodplain.

The southern parcel of Crown land incorporates condenser pans on the eastern side that channels to the south to connect to the Gawler River floodplain crossover. The balance and majority of the southern Crown land comprises mangroves and low lying land subject to inundation.

Land abutting to the east is marginal grazing land.

The land is essentially within the Mallala District Council and, under the current Development Plan, is within a Coastal (Cst) zone. This zone comprises the strip of land of approximately three kilometres in width, which abuts the Gulf St Vincent coast. The zone includes the localities of Port Gawler, Middle Beach, Light Beach and Port Prime. Parts of the zone are liable to flooding from storm, tidal or river water inundation. The primary objectives of this zone are for the retention in a natural state of environmentally and ecologically significant features, particularly Samphire swamps and sand dunes; and for agricultural and aquacultural activities carried out in a manner which conserves the coastal environment and has regard to proper management practices. There is a specific restriction on extensive or intensive near coastal, recreation and camping activities.

Other objectives include continuation or extension of extractive industry operations only where the impact on the environment is minimised and of an acceptable level; protection of the scenic amenity and appearance of the coastal landscape; and land division enabling security of tenure for existing dwellings on Crown land.

12.2 Topography and Landscape

The Dry Creek Salt Fields lie on the Northern Adelaide Plains within the Flinders Lofty Block IBRA region (Environment Australia, 2000).

The topography of the site is flat low lying supratidal land. Large salinas (the former operating ponds of the salt field) cover most of the area south of Middle Beach. West of the salinas, a band of saltmarsh and mangroves occupies the intertidal zone. Through the salt field, there is less than 5 m of topographic relief.

Agricultural land abuts the eastern side of the salt field leases. These areas have been extensively levelled and sometimes filled. General elevations are higher than the salt field salinas.

12.3 Adjoining Reserves and Sanctuaries

The proximity of the salt fields to a number of conservation reserves can be seen in Figure 11-1. This also shows the location of the salt fields relative to the proposed Adelaide International Bird Sanctuary. The reserves are described below.

12.3.1 Adelaide Dolphin Sanctuary

The Adelaide Dolphin Sanctuary covers a total of 118 km^2 from the inner Port Adelaide region to Port Gawler, and incorporates the Barker Inlet and St Kilda - Chapman Creek Aquatic Reserves; and the Port Gawler Conservation Park. The estuarine habitat and population of transient and resident dolphins, including Indo- Pacific Bottlenose Dolphins (*Tursiops aduncus*), are protected within the sanctuary area.

Objectives of the sanctuary include the recognition of indigenous and other cultural and historical relationships, fostering local interest and participation in the management process, and the promotion of public awareness and ecological importance. The sanctuary is also a popular tourist attraction with activities including dolphin cruises, kayaking, and boating.

12.3.2 Barker Inlet and St Kilda – Chapman Creek Aquatic Reserves

The Barker Inlet Aquatic Reserve is the southern component of two connected aquatic reserves in the salt fields area, and extends from North Arm Creek to the St Kilda Boat Channel. The reserve provides for the conservation of seagrass and mangrove communities, as well as the protection of nursery areas for key recreational and commercial fishing species. The use of fishing devices and removal of marine organisms are restricted within the area, whilst boating and swimming are permissible.

The St Kilda – Chapman Creek Aquatic Reserve ranges from the boat channel at St Kilda to Chapman Creek to the north and is connected to the northern boundary of the Barker Inlet Aquatic Reserve. The reserve protects productive areas for marine food, as well as sheltered marine ecosystems and breeding areas. Boating and the removal of fish by rod and line is permitted within the reserve.

The habitat types within the Barker Inlet and St Kilda-Chapman Aquatic Reserves, including Samphire flats, intertidal mangroves, and intertidal sand and mudflats, are listed in the *Directory of Important Wetlands in Australia* (Environment Australia 2001).

12.3.3 Port Gawler Conservation Park

The Port Gawler Conservation Park covers a range of landform features including mangrove forest, tidal flats, Samphire swamp, intermittent sand dunes, and estuarine habitats. The conservation park protects the nursery and habitat areas of commercially important fish and crustacean species. Recreational activities including boating, fishing and crabbing are popular within the Port Gawler area.

12.3.4 Buckland Park Lake

Buckland Park Lake is a shallow and ephemeral freshwater lake formed by damming of the mouth of the Gawler River. The freshwater habitat provided by the lake is listed in the *Directory of Important Wetlands in Australia* as Nationally Important being the only substantial freshwater habitat on the Adelaide Plains and the single most important breeding habitat for a range of waterfowl within the Adelaide region. It attracts an extremely wide variety of waterbirds that use the lake and associated swamps for feeding, breeding and roosting. (Environment Australia 2001

12.4 Climate

The climate on the Northern Adelaide Plains is described as Mediterranean, with cold, wet Winters and hot dry Summers, averaging 420 mm of rain annually. Rainfall occurs between May and September. Strong south- westerly winds occur during Autumn and Spring, with hot northerly winds occurring during Summer. In Winter a light northerly breeze (the hibernal breeze) blows in the early mornings. Lightning storms occur throughout the year, but with higher intensity in mid to late Spring. Dry Creek Salt Field's weather station records are summarised in Table 12-1.

Table 12-1: Climate statistics

Weather Aspect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual total	Annual Daily Average
Av Monthly rain (56 yrs) (*mm*)	19.3	20.8	20.7	36.9	53.0	52.7	57.1	48.7	2.6	40.4	23.7	23.6	420.4	
Av Daily Max temp (10yrs) (*°C*)	26.0	27.8	26.1	21.6	18.5	15.6	14.5	15.5	17.9	20.9	23.6	25.6		21.1

Weather Aspect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual total	Annual Daily Average
Av Daily Min temp (10yrs) (°*C*)	15.9	15.6	15.0	11.8	9.6	8.4	7.1	7.6	8.9	11.1	13.2	15.0		11.6
Av Daily Vapour Pressure (10 yrs) (*mmHg*)	12.0	11.3	10.7	9.7	9.1	8.4	7.9	8.1	8.6	8.9	10.1	11.2		9.7
Av Daily Wind Speed (7 yrs) (*km/hr*)	5.7	4.3	4.0	3.5	3.4	4.1	4.4	4.7	5.6	5.7	5.1	5.3		4.6
Av Monthly Gross Evap. (56 yrs) (*mm*)	302	217	217	133	82	56	56	76	109	164.9	274	273	1960	
Av Monthly Nett Evap. (56 yrs) (*mm*)	283	197	196	97	28	3	-1	27	86	125	250	250	1539	

Source: Bureau of Meteorology

12.5 Air Quality

Ambient dust levels vary throughout the extent of the salt fields. The northern areas are relatively arid and contain unsealed roads which experience a range of vehicular movements. Some adjacent operations (e.g. composting works, biosolids plants, horticultural field preparation) produce visible dust loads in defined areas. In the southern crystallising areas, much of the surrounding land has been developed or is vegetated, resulting in relatively low ambient dust levels.

Ambient air quality is also variable. Odours and smoke are produced from some neighbouring industries such as the Bolivar Sewage Treatment Plant, Jeffries composting plant (green waste and biosolids) and Inghams chicken meat processing plant. Naturally occurring odours also occur from vegetation decay in the adjoining mangrove forests and tidal streams.

Despite the proximity of residential areas, there has only been one complaint received in the last three years regarding air quality impacts. This related to odour impacts from Pond XC2S following a 1 in 100 year rainfall event in February 2014 and was satisfactorily resolved. When Calsit was formerly stockpiled in the crystallising area, complaints were received from local residents about dust. In addition, the Tramway Museum had raised concerns about foam being blown onto tracks and causing corrosion.

12.5.1 Applicable Legislation and Standards

The *National Environment Protection (Ambient Air Quality) Measure* (NEPM) sets standards for exposure of human receptors to particles such as dust less than PM_{10} (particulate matter with an equivalent aerodynamic diameter of 10 micrometres or less). Advisory reporting standards are set for $PM_{2.5}$. These standards are set for protecting human health and well-being.

The *Environment Protection (Air Quality) Policy 1994* sets air quality criteria at the source of emission. These criteria are relevant where the emissions are from point sources where control measures can be applied. This is does not apply to the fugitive emissions at this site.

There are no specific regulatory standards for odour. Under the Environment Protection Act, odour is a pollutant. The 'general environmental duty' states that one must not undertake an activity that pollutes or might pollute the environment. In addition, the EPA Odour Assessment Guidelines (EPA

2007) state that 'causing an odour may constitute environmental nuisance, an offence under section 82 of the Act'.

12.6 Flora and Fauna

12.6.1 Habitats

The Dry Creek Salt Fields provide an area of significant habitat value for migratory and resident shorebirds, protection of mangrove and saltmarsh areas from urban incursion, and the absorption of carbon dioxide. This value has been recognised by the inclusion of the area into two wetlands listed in the *Directory of Important Wetlands in Australia* (Environment Australia 2001).

The salt fields are recognised by bird watchers and ecologists as an important site for shorebirds. Several stakeholders, such as DEWNR (as evidenced by inclusion of the area in the proposed Adelaide International Bird Sanctuary) and BirdLife Australia value the salt fields as habitat for migratory birds. BirdLife Australia has undertaken a number of bird counts in the area.

The habitat types forming and surrounding the salt fields are summarised below. The main habitat types are mapped in Figure 12-5, Figure 12-6 and Figure 12-7. Further detail is provided in Appendix 5.

Intertidal Mangrove

One species of mangrove is present in South Australia; Grey Mangrove *(Avicennia marina*). They grow to a height of 3~ 5-metres with aerial roots projecting from the substrate that allows periodic inundation. Understorey species are limited and diversity is low. The most prevalent understorey flora is Samphire species.

Intertidal Saltmarsh (Samphire)

South Australian saltmarshes typically occur behind open coastlines in protected gulfs and are often associated with grey mangrove. Large tracts of saltmarsh occur beyond the limits of where mangrove can grow. The predominant species associated with saltmarsh are samphire (*Sarcocornia* sp.); saltbush, chenopods, salt tolerant grass, Australian salt-marsh grass (*Puccinellia stricta)* and sedges (*Ghania* sp.).

Low Shrubland (Lignum)

This community is associated with large floodplains and, low lying swamps of Gawler River. The community is dominated by Lignum (*Duma florulenta)*. The upper storey consist of trees 3m height or greater (*Eucalyptus* sp.) and a mid-storey of medium sized trees and shrubs (*Acacia* sp. and *Myroporum* sp.). The understorey is dominated by salt tolerant shrubs and herbs.

Samphire / Atriplex / Grassland

This community was considered a complex in the transition zone (ecotone) between Supratidal / Stranded Tidal Samphire and Low Shrubland. The figures below indicate the location and extent of the above vegetation communities based on aerial interpretation.

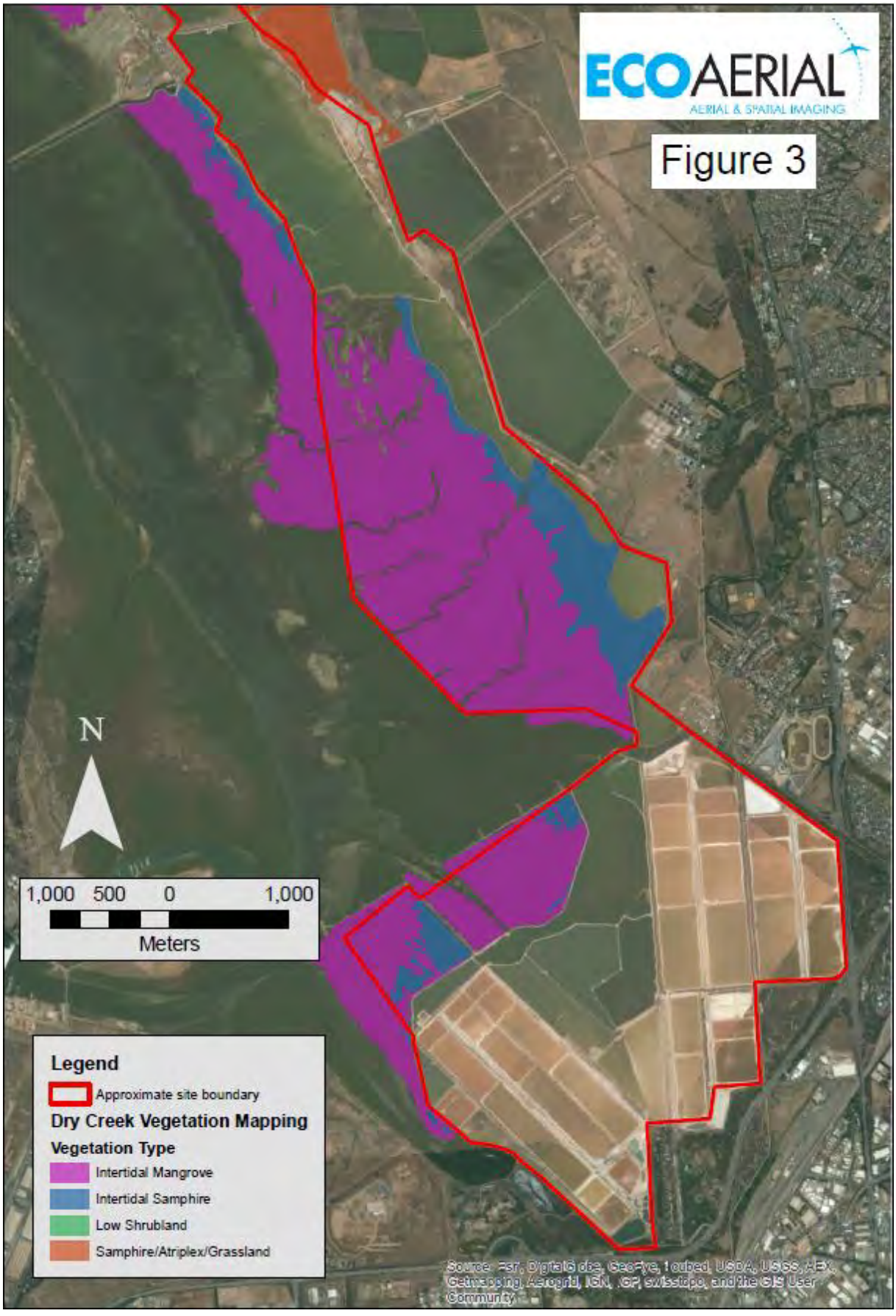


Figure 12-5: Vegetation mapping - southern salt fields

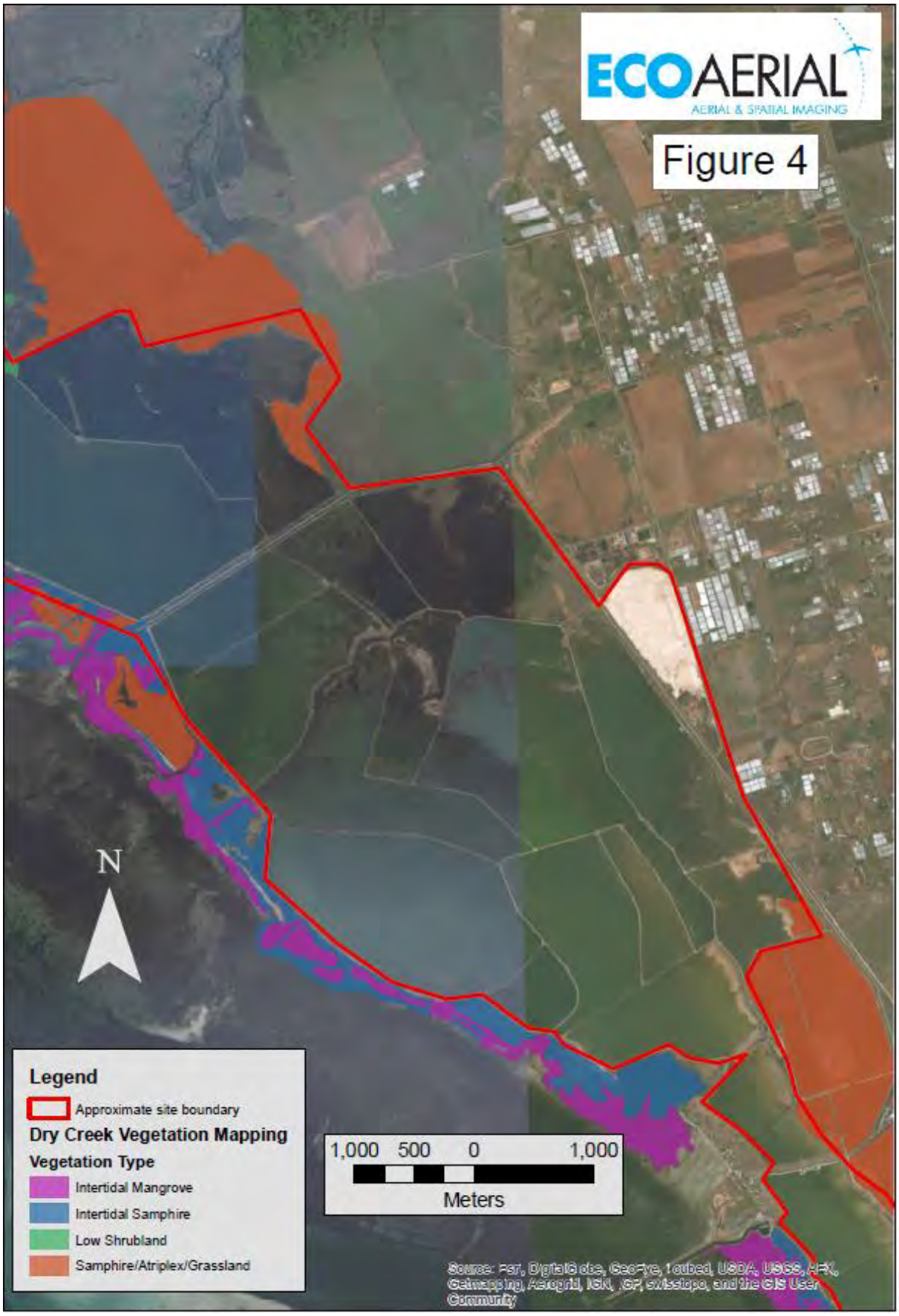


Figure 12-6: Vegetation mapping - central salt fields

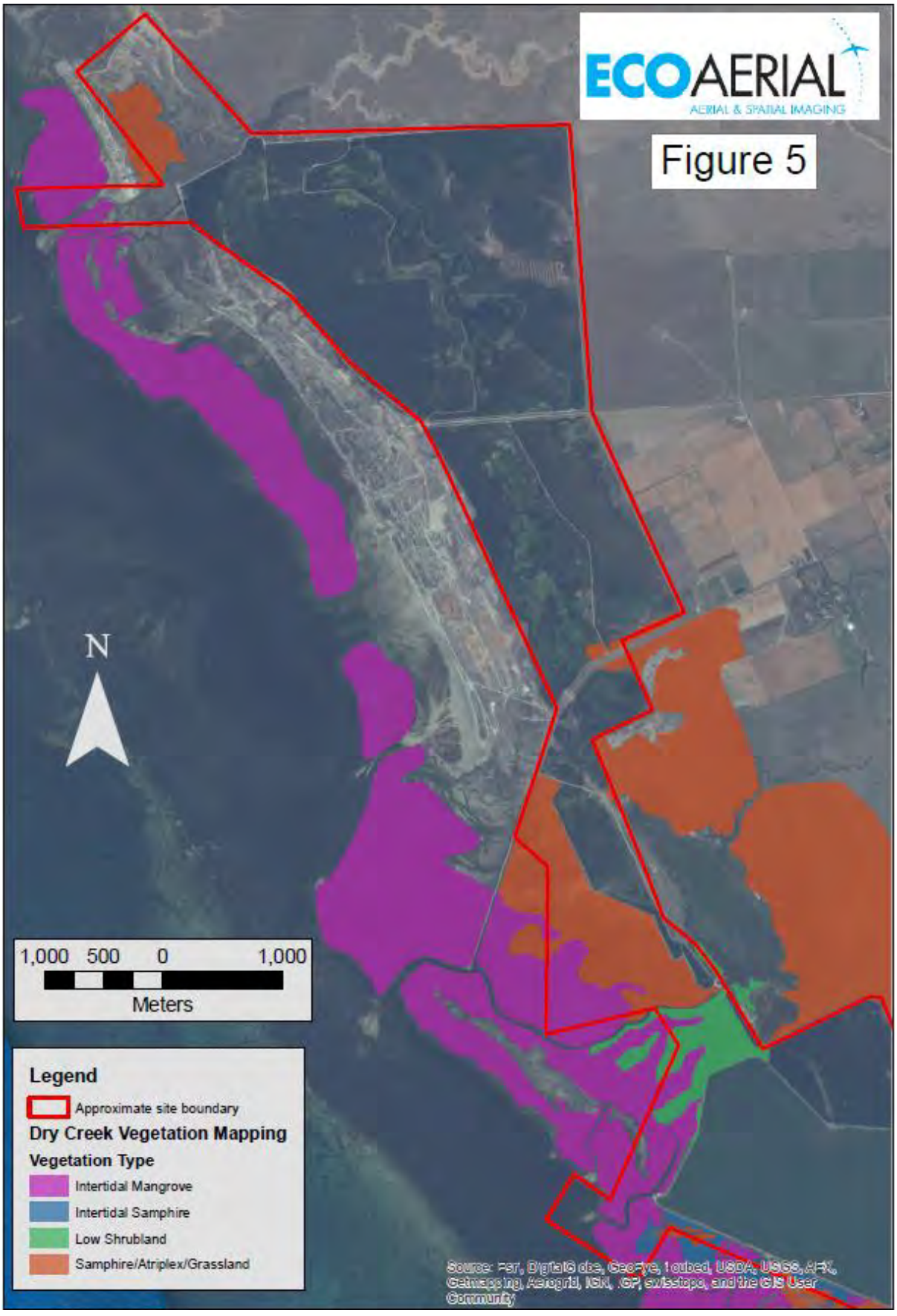


Figure 12-7: Vegetation mapping - northern salt fields

The breakdown for each vegetation community within the leasehold is as follows:

Vegetation Community	Area
Dryland Samphire	39ha
Intertidal Mangrove	600ha
Intertidal Saltmarsh (Samphire)	356ha
Intertidal Samphire / Atriplex	98 ha
Planted Sheoak	3.4ha
Samphire / Atriplex / Grassland	65ha

12.6.2 Flora and Fauna Species

Flora species

Twenty-three terrestrial flora species with conservation interest occur, or have the potential to occur within, or near the salt field (BL&A 2014a). Seven species are listed under the EPBC Act and 22 are on the National Parks and Wildlife Act (NPW Act). No EPBC Act listed flora species have been recorded on the salt field.

The listed Vulnerable Bead Samphire (*Tecticornia flabelliformis*) has been recorded to the north and on the coast to the west of the salt fields. EcoAerial (2015) undertook a targeted survey for the Bead Samphire and identified 10 patches with a combined area of 12.7 ha. The largest patch (10.7 ha) was located north of Middle Beach Road in Section 4.

EcoAerial (2015) concluded): '*Where the species was found to be present within the salt field boundaries, it was confined to the coastal side of the westerly bunds in Section 3 and the coastal side of the northerly ponds in Section 4 and not in the operational areas of the salt field. As such, the current staged operational shut down of the Dry Creek Salt Fields does not constitute a significant impact on Bead Samphire under the EPBC Act'.*

A further two species are protected at the State level: Barren Cane-grass (*Eragrostis infecunda* - Rare) and Southern Saltbush (*Atriplex australasica* - Rare) (BL&A 2014a). The remaining species are significant, or of interest, at the regional level.

One ecological community (Subtropical and Temperate Coastal Saltmarsh) is listed as Threatened under the EPBC Act. This community requires some form of ongoing connection to the tidal regime and the bunds on the salt fields provide a physical separation from tidal influence for saltmarsh on the salt field (BL&A 2014a).

EcoAerial (2014) found: '*Where the community was deemed to present within the salt field boundaries, it was confined to the coastal side of the westerly bunds and the undeveloped lease north of Middle Beach Road and, not within the decommissioned operational areas of the salt field*'.

Native fauna

A review of existing information indicated that 84 fauna species (73 bird, eight mammal and three reptile species) listed under the EPBC Act or NPW Act may occur within the salt field and surrounding area (BL&A 2014a). The eight mammal species includes four whale species, one fur-seal species and two

bat species. None of these species would be using the habitats available in the salt field. The same applies to the three listed reptile species which all occur in the sea (BL&A 2014a).

Two terrestrial birds listed as Threatened under the EPBC Act are considered to have suitable habitat or have been recorded in the salt fields. These are the Australasian Bittern (*Botaurus poiciloptilus* – Endangered) and Australian Fairy Tern (*Sternula nereis nereis* – Vulnerable). All records for the Australasian Bittern were from outside the ponds, predominantly to the south of the salt fields in the freshwater wetlands. The species prefers permanent water bodies with tall dense vegetation and habitat on the salt fields is not suitable (BL&A 2014a). The Australian Fairy Tern has been recorded 20 times on the salt fields between 1999 and 2011.

The salinas of the salt fields provide significant feeding and roosting habitat for birds. In total, 62 EPBC Act listed migratory bird species have been recorded in the area or are considered likely to occur. This includes 32 listed Migratory shorebirds. Birds are most abundant in Ponds XE1-3. Significant seasonal fluctuations occur in shorebird numbers with counts from 1978 to present ranging from 2112 birds to 58,124. This is primarily due to changes in wider, regional habitat such as water levels at Lake Eyre as well as population trends generally among shorebird species within the East Asia-Australian Flyway (BL&A 2014a).

The use of the salt field by birds can be summarised as follows (BL&A 2014a):

- Crystallisation ponds in Section 1 provide little habitat for shorebirds or waterbirds. This is corroborated by Purnell et al. (2012) who assessed this area as being low priority for shorebirds (Priority 4).

- Hypersaline ponds in Section 2 have a poor range of biota, dominated by Brine Shrimp and planktonic microalgae, thereby providing few foraging opportunities for shorebirds and waterbirds. Purnell et al. (2012) found that the southern areas of Section 2 had a low priority for shorebirds, whilst the northern ponds were of high priority due to some suitable habitat characteristics being present.

- Section 3 comprises a mosaic of low and moderate priority hypersaline ponds. These support a diversity of fish, molluscs and plankton, along with larval stages of brine flies, thereby providing a valuable food source for shorebirds. High numbers of shorebirds and waterbirds have been reported in this Section (Coleman 2013) with peaks exceeding 16,000 birds in the shallower and more saline ponds (Purnell et al. 2012). However, some sections of ponds are not suitable for shorebirds and would be favoured by waterbirds. This Section is particularly important as a high tide roosting and foraging site, when the tidal flats cannot be accessed by the shorebirds. The diversity of habitats present is reflected in the pond prioritisation presented in Purnell et al. (2012) which ranges between high and very high priority (Priority 1 and 2).

- Section 4 is primarily dominated by salt ponds that have a similar salinity to intertidal wetlands and most resemble marine ecosystems, compared with ponds in the other Sections. It supports all or most of the macro- and micro-organisms that would be expected to occur in a natural marine environment. Furthermore, some of the northern-most ponds experience some marine influence during particularly high tides or storm surges. These ponds also support seagrass meadows and fish populations, with some of the ponds having been colonised by mangroves. The western ponds were assessed by Purnell et al. (2012) as being Priority 1 habitat, whilst the eastern ponds were Priority 3 and were considered less important for shorebirds. Existing reports suggest high waterbird numbers in Section 4, compared with other bird species/groups (Purnell et al. 2012; Coleman 2013).

Bird surveys have been undertaken at the individual pond level in the spring / summers of 2013 / 14, 2014 / 15, 2015 / 16, and also in 2016 /17. BLA 2015, found that comparisons of data between the surveys completed by end summer 2015 show that the shorebird and other waterbird numbers are within the range of natural variation before and since implementation of the holding pattern. The evaluation of data from the surveys of 2015 / 16 is nearing completion (February 2017) and it is understood that evaluation is confirming that finding.

The fish populations in the Dry Creek salinas are derived from wild fish in Barker Inlet and continue to receive eggs and larvae from wild populations in the gulf and tidal mangrove creeks via seawater pumps. Fish biodiversity is representative of species found locally in Barker Inlet (CEE 2013).

Exotic flora and plant pathogens

Weeds occur sparsely over the extent of the salt field's mineral tenements. The most common noxious species include African Boxthorn (*Lycium ferocissimum*), Calomba Daisy (*Oncosiphon suffruticosum*), Artichoke Thistle (*Cynara cardunculus*) and Horehound (*Marrubium vulgare*). Several other environmental weed species including Sea Lavender are widespread, or occur in defined locations (*Juncus acutus* and *Casuarina glauca*). No occurrences of plant pathogens such as Phytophthora have been recorded within the salt field.

Feral animals

Feral animals at the salt fields include resident foxes and rabbits, occasional dogs and cats, and deer that reside on DEWNR land at Buckland Park and that enter the salt fields to browse in the mangrove and saltmarsh areas when green pick is scarce. Procedures for the control of feral animals are detailed in the company's *SOP-SC-A008 Environmental Management Plan*.

12.6.3 Applicable Legislation and Standards

Actions that are likely to have significant impacts on listed threatened species or ecological communities, or listed migratory species, may require approval under the EPBC Act. The Department of the Environment and Energy has published a number of guidelines to assist in determining whether a proposed action is likely to have a significant impact on a matter of national environmental significance. Of particular note are:

- Significant Impact Guidelines 1.1 - Matters of National Environmental Significance
- Significant impact guidelines for 36 migratory shorebird species - Migratory species: EPBC Act draft policy statement 3.21.

As noted at Chapter 11.3.12, a referral for closure activities in inundated ponds in Sections 3 and 4 was submitted in January 2015. On 14 February 2015, the delegate of the Environment Minister determined that the activities required approval and will be assessed on preliminary documentation. A draft charter has been created in 2015 following discussions between DoEE (Cth), DSD, DEWNR and Ridley (as the then owner and proponent). That charter describes the process for that assessment – with that process to use a future revision of this PEPR / MOP as the preliminary documentation. That revision will address the closure plan and outcomes for these inundated ponds. A copy of the draft Charter is attached in Appendix 15.

BDC may also be required under the Native Vegetation Act to provide an offset with a significant environmental benefit for any clearance of vegetation.

12.7 Soil Quality

12.7.1 Context

Topsoils in the salt fields are typical of saltmarsh / mangrove depositional areas. The soils vary from sandy areas (chenier ridges and sand berm deposits) to a brown silts and clays. Much of the soil is saline or sodic, due to its origin. The underlying soils in the area are historic estuarine muds and sands of an area that was, until recent times, part of the extensive tidal flats bordering Barker Inlet. Much of the site appears to be the natural surface sediment with very little introduced fill, other than the salina embankments, compared to other nearby areas.

The salt field has been mined since the 1930s. While the soils underlying much of the area contain potential acid sulfate soils (PASS), the permanently ponded nature of the salinas reduces the risk of these soils being oxidised into actual acid sulfate soils (ASS). ASS are discussed in Section 12.7.2 below.

Over the period of the salt fields' operation, community and legislative standards relating to the disposal of old building materials have changed. The use of pits for disposal of old masonry and wood is no longer practiced, and all pre-existing pits have been closed and revegetated. The age of the salt field means there is potential for some pipes and building materials to include asbestos containing materials. It is not intended to excavate or remove this material under this integrated PEPR / MOP unless it presents an unacceptable occupational health and safety hazard.

12.7.2 Acid Sulfate Soils

Acid sulfate soils (ASS) is the term applied to soils that contain elevated concentrations of metal sulfides which generate acidic conditions when exposed to oxygen. The principal sulphide minerals are pyrite (Fe_2S) or monosulfides in the form of iron sulphide (FeS). Acid sulfate soil materials include potential acid sulfate soil material (sulfidic material) and / or actual acid sulfate soil material (sulfuric material), both of which can occur in the same soil profile.

The definitions of acid sulfate soil materials used in this report are those adopted by the Acid Sulfate Soil Working Group of the International Union of Soil Sciences and are set out in Table 12-2 below.

Table 12-2: Acid sulfate soil materials definitions

Material	Definition
Potential Acidity	
Sulfidic material	Soil materials containing detectable sulfide minerals: hypersulfidic – potential to produce acidic soils with pH of less than 4 hyposulfidic – soils buffering capacity maintains pH greater than 4. monosulfidic material (FeS) – soils / sediment contains monosulfides. Monosulfidic materials are submerged or waterlogged organic-rich materials that contain considerable concentrations of monosulfides. Monosulfidic black oozes (MBOs) are specific materials characterised by their gel-like consistence (see Plate 12-2).
Actual and Retained Acidity	
Sulfuric material	Soil material that has a pH less than 4.

Acid sulfate soils form in the coastal, estuarine and mangrove swamp environments of Barker Inlet and the Gulf St Vincent as these waterlogged environments are ideal for the formation of sulfide minerals,

predominantly iron pyrite (FeS_2). A conceptual model and descriptions of ASS types and sub-types in the region is shown in see Figure 12-8.

Ponds in the Dry Creek saltfields have been maintained at a stable depth over time, and as a consequence substantial amounts of pyrite, iron monosulfides and gypsum have built up in the subaqueous (submerged) acid sulfate soils in the ponds. The cessation of salt production will require draining of numerous hypersaline ponds which has the potential for development of ASS.

BDC has undertaken studies to assess the presence / absence, and spatial and temporal extent / variation of the main types of ASS materials (see Table 12-2) present in a range of locations across the saltfields. The acid sulfate soil assessment reports discussed below are at Appendix 3.

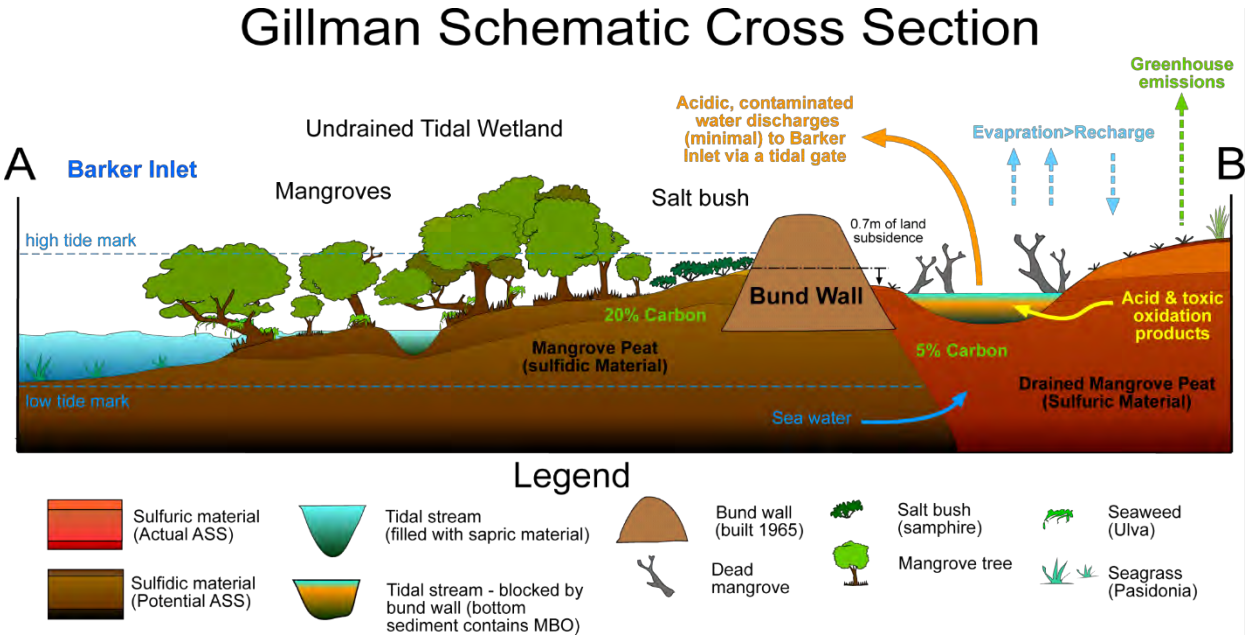


Figure 12-8: Conceptual model and descriptions of ASS in the region

(Source: Acid Sulfate Soil Centre (University of Adelaide) / CSIRO Land and Water)

Section 1

Section 1 occupies what was intertidal and supratidal estuarine land. As plans are created for the closure and redevelopment of Section 1, investigations will be conducted to assess acid sulfate conditions.

The potential for adverse risks from acid sulfate soil conditions in Section1, during the Holding Pattern and Residual Operations is considered negligible because:

1. Inside the sea wall, the majority of the original natural soil surface has been covered for decades by fill, and then the operational surfaces, viz:
   - Engineered floors of the crystallisers and salt stacking bays
   - The floors of the final areas
   - Engineered access and haul roads
   - Table drains in the fill.

2. The historic and current storage and movement of brine in Section 1 has resulted in salt deposits on the surfaces of the crystallisers, final areas and interconnecting drains.

3. The groundwater levels beneath Section 1 are likely slightly elevated above the natural soil surfaces in what were originally intertidal areas, because of the storage and movement of brine. As a result, it is considered that natural soils in these areas would have been and continue to be kept saturated.

4. In what were the supratidal areas, it is less likely (by comparison with the intertidal areas) that the original surface soils would be potentially acid sulphate.

5. The saturation levels of salinity coupled with the nature of the operations of Section 1[1], mitigated against the production of monosulphidic black ooze, as occurred in the condenser ponds in Sections 2 to 4 of the salt field. Therefore, this potential source of acid sulfate materials is unlikely to exist in Section 1.

Section 2

Sampling was undertaken at sites for ponds PA3 to PA12 and the adjacent drains, over a 3 month period from December 2013 to March / April 2014 (which included extensive reflooding and drying events). Ponds PA3 to PA12 in Section 2 are mostly covered by a gypsum crust of varying thickness (see Plate 12-2). In some locations, there are low-lying areas where water has remained or the soil is mostly saturated. To the east, there is a sequence of shallow drains adjacent to ponds PA3 to PA12 and situated below ponds PA3 and PA11. The ponds are bounded on the west by the coastal mangrove swamps and samphire. The Section 3 ponds are located to the north.

The soil classification indicated at the time of the field survey in March / April is summarised as follows (Fitzpatrick et. al 2015; Appendix 4):

- *Ponds PA3 to PA12*
  - hypersulfidic and hyposulfidic subaqueous sandy/shell grit soils with monosulfidic material
  - hyposulfidic and hypersulfidic hydrosol loams over clays with monosulfidic material
- *PA7a*
  - hyposulfidic subaqueous hydrosol loams over clays with monosulfidic material
  - hyposulfidic hydrosol loams over clays with monosulfidic material (wet)
- *Drains*
  - hyposulfidic subaqueous hydrosol loams over clays with monosulfidic material
  - sulfuric and hyposulfidic hydrosol loams over clays with salt efflorescences.

The formation of monosulfidic material is promoted by:

- the highly depositional environment (closed evaporation ponds)
- high organic matter concentrations
- low iron and carbonate concentrations (precipitated early in the salt production process); and
- low re-suspension (due to very slow seawater inflow / throughflow velocities and more sheltered nature of the bunded ponds).

The acidification hazard was assessed as medium for the western segments and low for the eastern segments of ponds PA3 to PA12. The malodour hazard was assessed as medium for both sections. The acidification hazard was assessed as low and the malodour hazard was assessed as medium for the southern segments and low for the northern segments of pond PA7a.

[1] These operations had the purpose of producing pure salt; i.e. not contaminated by algae or other organic matter.

Plate 12-1: Gypsum crust – Pond PA7 Section 2 December 2013

(Source: Acid Sulfate Soil Centre – University of Adelaide)

Plate 12-2: Hyposulfidic clay soil with monosulfidic material – Pond PA4d March 2014

(Source: Acid Sulfate Soil Centre – University of Adelaide)

Section 3

Section 3 ponds generally do not have gypsum crust surfaces and are permanently ponded with saline water and therefore predominately comprise subaqueous acid sulfate soils.

Each pond in Section 3 West is likely to have a unique distribution of ASS sub-types which include:

- hypersulfidic and sapric materials due to widespread and complex distribution of 'dead mangroves'
- hypersulfidic and sapric materials due to widespread and complex distribution of 'shell-grit ridges and layers'
- widespread and complex distribution of subaqueous topography ('small islands' when ponds are partially drained)

Further surveys, sampling and data acquisition are proposed for this section.

Section 4

Ponds XF2 and XE4

Sampling was undertaken at sites for ponds XF2 and XE4 between November 2013 and June 2014 following extensive reflooding (from extremely high rainfall events) and drying events. Pond XF2 is situated on the north-eastern side of the saltfield and is bounded to the north by native samphire and salt bush, in the east by farmland and on the western and southern side mostly by pond XF1. Pond XE4 is located below ponds XF1 and XF2 on the north eastern side of salt field and is bounded to the north by ponds XF1 and XF2, in the east by farmland and on the western side mostly by pond XE3.

At the time of the November survey, the ponds were generally dry with some wetter areas, mostly due to seepage from the adjacent ponds. The soil classification at the time of the field survey (June 2014) is summarised as follows (Fitzpatrick et al 2014; Appendix 3):

Pond XF2:

- sulfuric, hypersulfidic, hyposulfidic and monosulfidic (MBO) materials
- subaqueous soils, hydrosols (saturated to a depth of 50 cm below the mineral soil surface), and unsaturated (to a depth of 50 cm below the mineral soil surface)
- clays, loams and some sands.

Pond XE4:

- hyposulfidic and hypersulfidic clays (dominant)
- hypersulfidic and hyposulfidic subaqueous soil subtypes with high amounts of mostly wet monosulfidic material.
- clays, loams and some sands.

In general, soil profiles in XF2 comprise sulfuric, hypersulfidic and hyposulfidic clayey soils with high (mostly) to low acidification hazard ratings (see Figure 12-9 below). Profiles in XE4 comprises mostly hyposulfidic and minor hypersulfidic clayey soils with low acidification hazard ratings.

Pond XF1

During investigations in January 2015 Pond XF1 was permanently ponded with saline water and sampling identified mostly hyposulfidic materials (hyposulfidic subquaeous clay soils) with only one sample containing sulfuric material (sulfiric subaqueous clay soil). Most of the profiles sampled encountered thick (0-30 cm) black, organic-rich monosulfidic black ooze materials, which occurred in thicker amounts (>30cm) on the western boundary due to seepage into the drainage trench and also from the adjacent pond. The southern part of pond XF1 is bounded to the west by the coast with sand

dunes, native samphire and mangrove swamps. To the east, pond XF1 is immediately adjacent to pond XF2.

The final soil survey campaign conducted in February 2016 (13 months after the commencement of draining of pond XF1) again identified a wide range of acid sulfate soil subtypes and associated features. In summary, most of pond XF1 was still dominated by the occurrences of hyposulfidic clay soils, which occurred on the more elevated segments on the eastern side of the pond. All the hyposulfidic hydric clay soils occurred in the slightly lower lying segments whereas the hyposulfidic clay soils were restricted to the higher elevated segments of the pond (i.e. along the eastern border). The monohyposulfidic hydrosol clay with organic-rich mat remains restricted to the lowest lying segment of the pond along the western edge of the pond. (Fitzpatrick et al 2016; Appendix 3).

Quarterly monitoring following pond drainage showed that only in the south-west corner of pond XF1 did the pond acidification and malodour hazard ratings status changed with time, i.e. parts of the shallow, thin layer of acid sulfate soil materials changed from hypersulfidic to sulfuric after 13 months as this soil dried, especially during summer. The drainage from this part of XF1 remained alkaline however – indicating sufficient neutralising capacity in the soils in the walls and floor of the drains conducting this drainage. The clay soils below the thin layer of acid sulfate - sulfuric soil materials also have alkaline pH and their low permeability would inhibit seepage to groundwater. Therefore, short term risks from this acidification are considered low and manageable by keeping this part of XF1 well drained. However, the risks would need to be dealt with in the eventual plan for closure of this pond.

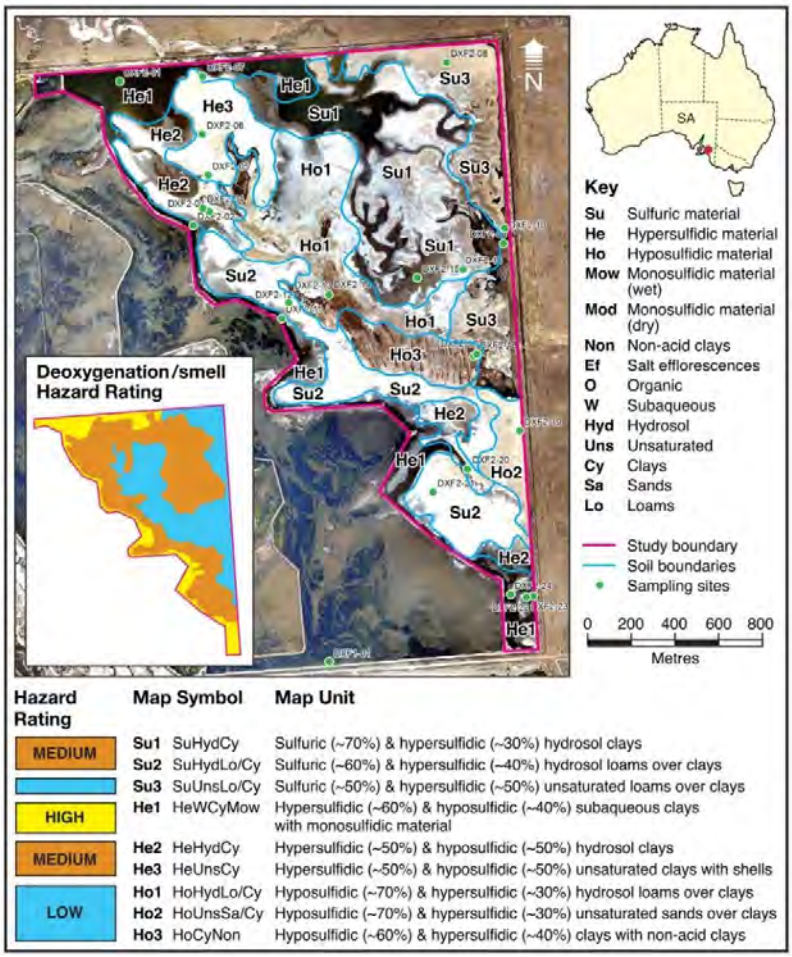


Figure 12-9: Acid sulfate soil classification and acidification hazard rating - pond XF2

12.7.3 Applicable Legislation and Standards

The Environment Protection Act has substantial penalties for causing environmental harm to air, land, surface water and groundwater.

EPA Guideline 638/07 – *Site contamination—acid sulfate soil materials* (November 2007) provides information to those involved in activities that may disturb acid sulfate soil materials (including soil, sediment and rock), the identification of these materials and measures for environmental management.

If excavation or disturbance of acid sulfate soil material is unavoidable, an Environmental Management Plan must be prepared to the satisfaction of the EPA in accordance with the *EPA Guideline: Environmental management of on-site remediation.*

When determining the sampling density for the assessment of acid sulfate soil materials, reference should be made to Schedule B2 of the *National Environment Protection (Assessment of Site Contamination) Measure* (1999) and *Australian Standards AS 4482.1 Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds.*

Approaches to remediation of acid sulfate soil material for the Barker Inlet and Gillman physiography are set out in *Coastal Acid Sulfate Soil Management Guidelines, Barker Inlet SA Version 1.2* (Thomas et al 2003).

12.8 Surface Water

The operating salinas are permanently filled with saline water. Natural ephemeral watercourses, sea and land- based floodwaters and stormwater from nearby residential and agricultural areas are channelled through flood gaps that pass around and between the salinas. Surface water drainage lines and flood gaps in the southern salt field are shown in Figure 12-10.

Seepage drains around the salina ponds are used on the landward side of the ponds to ensure the head of water in the ponds does not cause 'mounding' of the groundwater in the surrounding areas, as the salt field is underlain by several shallow, hypersaline aquifers in the St Kilda Formation. The brines gathered in these drains, composed both of salina seepage and discharge from the subsurface hypersaline water table from the higher lands to the east, are recycled back into the salina ponds.

12.8.1 Applicable Legislation and Standards

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* provide an authoritative guide for setting water quality objectives required to sustain current, or likely future, environmental values (uses) for natural and semi-natural water resources in Australia and New Zealand. These guidelines are currently under review.

In South Australia, the guidelines are incorporated in the *Environment Protection (Water Quality) Policy.* The main objective of the Water Quality Policy is to achieve the sustainable management of waters, by protecting or enhancing water quality while allowing economic and social development. The policy aims to achieve this objective by:

- setting environmental values and water quality objectives for streams, rivers, oceans and groundwater
- establishing obligations for industry and the community to manage and control different forms of pollution
- encouraging better use of wastewater
- promoting best practice environmental management

- promoting within the community environmental responsibility and involvement in environmental issues
- setting discharge limits for particular activities.

Schedule 1 of the Environment Protection Act specifies 'Prescribed activities of environmental significance' that require environmental authorisation from the EPA. This includes discharge to marine or inland waters. As noted at Chapter 11.3.2, BDC has a licence that enables discharge of bitterns and saline water.

12.9 Groundwater

The underlying Tertiary sediments contain several aquifer systems that exhibit significant variations in thickness, lithology, salinity distribution and yield. There are two main deep aquifers that act as the primary source of irrigation water in the region (Northern Adelaide and Barossa Catchment Water Management Board (NABCWMB 2000).

12.9.1 T1 Aquifer

The shallowest Tertiary aquifer, known as T1, is the main source of irrigation water in the area south of Waterloo Corner. The top of the aquifer is approximately 60 metres below ground and is composed of Dry Creek sands and Port Willunga limestone. It is wedge shaped with an average thickness of 70 metres in the south, thinning out as it nears the Gawler River.

Underground water salinity ranges from 600 mg/L to 2000 mg/L with lower salinities recorded near the Little Para River to the south. The aquifer is hydraulically connected to the overlying Quaternary aquifer (Q4), which has a salinity ranging from 1820 to 4850 mg/L, and is separated from the underlying aquifer by a layer of impervious clay to sandy, silty clay, which extends over the entire region south of the Gawler River.

12.9.2 T2 Aquifer

The second underlying Tertiary aquifer known as T2 occurs throughout the entire region. It consists of a large, water bearing layer of well-cemented lower Port Willunga formation limestone which has a thickness between 80 and 120 metres. Salinity levels range from 600 mg/L in the Gawler River area to greater than 3000 mg/L to the north and south. The T2 aquifer is generally not used for crop irrigation purposes in areas south of Waterloo Corner due to high salinity levels and the depth of the aquifer in that region (NABCWMB 2000).

The T1 and T2 aquifers provide freshwater for the local horticulture industry and several other users, including the Dry Creek Salt Field. Freshwater from the salt field bores in the T1 aquifer was used in the dissolving operation at Dry Creek. Bores 1, 2, 4 and 5 are located in the Northern Adelaide Plains Proclaimed Wells Area and have a combined allocation of 1,177,255 kL per year. Total dissolved salts in these bores varies between 1500 mg/L and 2300 mg/L. Two bores (6 and 7) are located within the Dry Creek Prescribed Wells Area and have an allocation of 850,000 kL per year. These two bores were also used for the dissolving operation.

12.9.3 T3 and T4 Aquifers

Two other deeper water bearing aquifers (T3 and T4) have been identified in the area. However, underground water salinity in these saturated sediments exceeds that in T1 and T2 and has been as high as 80,000 mg/L, which is totally unsuitable for any form of crop irrigation use (NABCWMB 2000).

The T3 aquifer provided a flow of saltmaking brine into pond XB3 near Chapmans Creek. The brine from the T3 bore is approximately twice seawater salinity (50g/L). The brine quality suited its use in 'rebalancing' the water quality in the salina, which had suffered from increased nutrient inputs as a result of the nearby discharge point for the Bolivar WWTP.

Details of all production bores in the Dry Creek Salt Fields are provided in Table 12-3 below. The locations of bores within the salt fields are shown in Figure 12-10.

Table 12-3: Production bore details

Cheetham Bore Number	Departmental Bore Number	Location (Datum GDA, Zone 54)	Aquifer	PWA	Allocation
1	6628_19184 Replaced 6628_04370	Middle of 'A' row 277797 E, 6144588 N	T1	Northern Adelaide Plains Prescribed Wells Area	1,177,255 kL
3	6628_10427	South end of 'G' row 279812 E, 6145153 N	T1	Northern Adelaide Plains Prescribed Wells Area	
4	6628_04356	North end of 'D' row 278658 E, 6144972 N	T1	Northern Adelaide Plains Prescribed Wells Area	
5	6628_13020 Replaced 6628_03438	North end of 'F' row 278862 E, 6146789 N	T1	Northern Adelaide Plains Prescribed Wells Area	
6	6628_13170	Magazine Rd 278756 E, 6142936 N	T1	Dry Creek Prescribed Wells Area	850,255 kL
7	6628_18042	200m West of No6 278322 E, 6142918 N	T1	Dry Creek Prescribed Wells Area	
T3	6528_2005	Chapmans Ck 267417 E, 6158688 N	T3	Northern Adelaide Plains Prescribed Wells Area	1,200,000 kL

12.9.4 Quaternary Aquifer Systems

Aquifers in the shallow Quaternary sediments comprise mainly of clay and silt with thin layers of sand which form minor unconfined and semi confined systems. Salinity towards the coast is high (up to 15,000 mg/L). The aquifers are not generally used for commercial irrigation purposes because of the high salinity and low yields (NABCWMB 2000). Environmental values at the Salt Field would be expected to relate only to supporting any groundwater dependent ecosystems, which would need to be salt tolerant.

12.9.5 Applicable Legislation and Standards

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* provide an authoritative guide for setting water quality objectives required to sustain current, or likely future, environmental values [uses] for natural and semi-natural water resources in Australia and New Zealand. These guidelines are currently under review.

In South Australia, the guidelines are incorporated in the *Environment Protection (Water Quality) Policy.* The main objective of the Water Quality Policy is to achieve the sustainable management of waters, by protecting or enhancing water quality while allowing economic and social development.

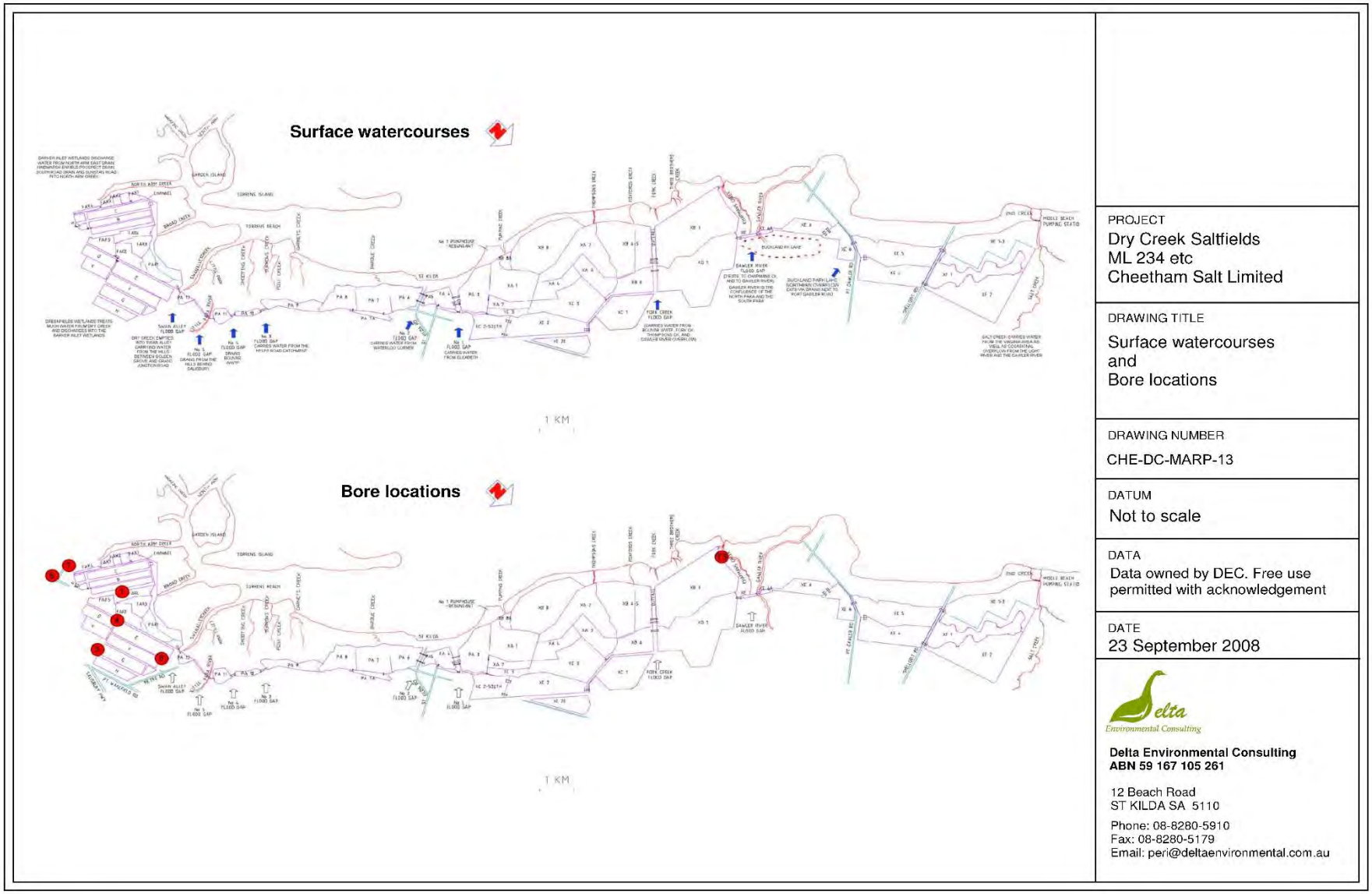


Figure 12-10: Surface water and bore locations

12.10 Noise

The mineral tenements are extensive and occur in areas ranging from remote to localities adjacent to highways. The salina operations occur in rural areas and contribute little to no extra noise to ambient levels. The harvesting operation occurred adjacent to Port Wakefield Road and the Port River Expressway and rarely, if ever, exceeded the ambient noise from those roads.

The proximity of adjoining residents and other sensitive receptors is described at Chapter 12.1.

12.11 Heritage

Items of heritage significance have been recorded in the salt field area. They include an aboriginal artefact scatter behind the K Row crystalliser stacking bays, the remains of an Explosives Jetty in ML 702, small remnants of the Explosives Tramway and several shipwrecks. The salt field itself has a rich heritage, much of it recorded in photographs maintained at the Dry Creek offices of Cheetham Salt Limited.

There is a current Native Title application over Crown land within the mineral tenements. The claim is the Kaurna Peoples Native Title Claim, which covers an area of approximately 8160 km^2 on the eastern side of Gulf St Vincent.

Remnants of the Tramway from Broad Creek to the Explosives Magazine exist mainly within the Magazine complex outside the salt fields, but some small lengths remain within ML702 alongside the old explosives jetty in Broad Creek. The items at Broad Creek are gradually becoming inundated as the mangrove zone subsides and sea-level increases.

Barker Inlet has a rich shipping history and has been used as a ships' graveyard since European settlement. In several areas marked ship's graveyard interpretive trails exist and the DEWNR keeps a database of all wrecks in the area (DEWNR 2016). Several wrecks are located within, or immediately adjacent to, the salt fields:

- Wreck 1087, the No1 Hulk, is the explosives barge on the seawall of ML702
- Wreck 412, the Dorothy S, is inside ML702 at the intersection of Broad and Bream Creeks
- Wreck 1140, an unknown vessel, is on the western boundary of ML 235, on the same northing as the gap between PA10 and PA11
- Wreck 505, the Florence Maud, is also on the western boundary of ML 235 or just outside it, on the same northing as the gap between PA10 and PA11.

Mapping of shipwreck locations, in relation to the salt field, is shown in Figure 12-11.

There are no known sites of geological significance within the salt fields. Given the salt field has been part of Adelaide's landscape for over 70 years, they may have heritage value in their own right.

12.11.1 Applicable Legislation and Standards

The *Heritage Places Act 1993* makes provision for the identification, recording and conservation of places and objects of non-Aboriginal heritage significance. The *Aboriginal Heritage Act 1988* provides for the protection and preservation of Aboriginal heritage.

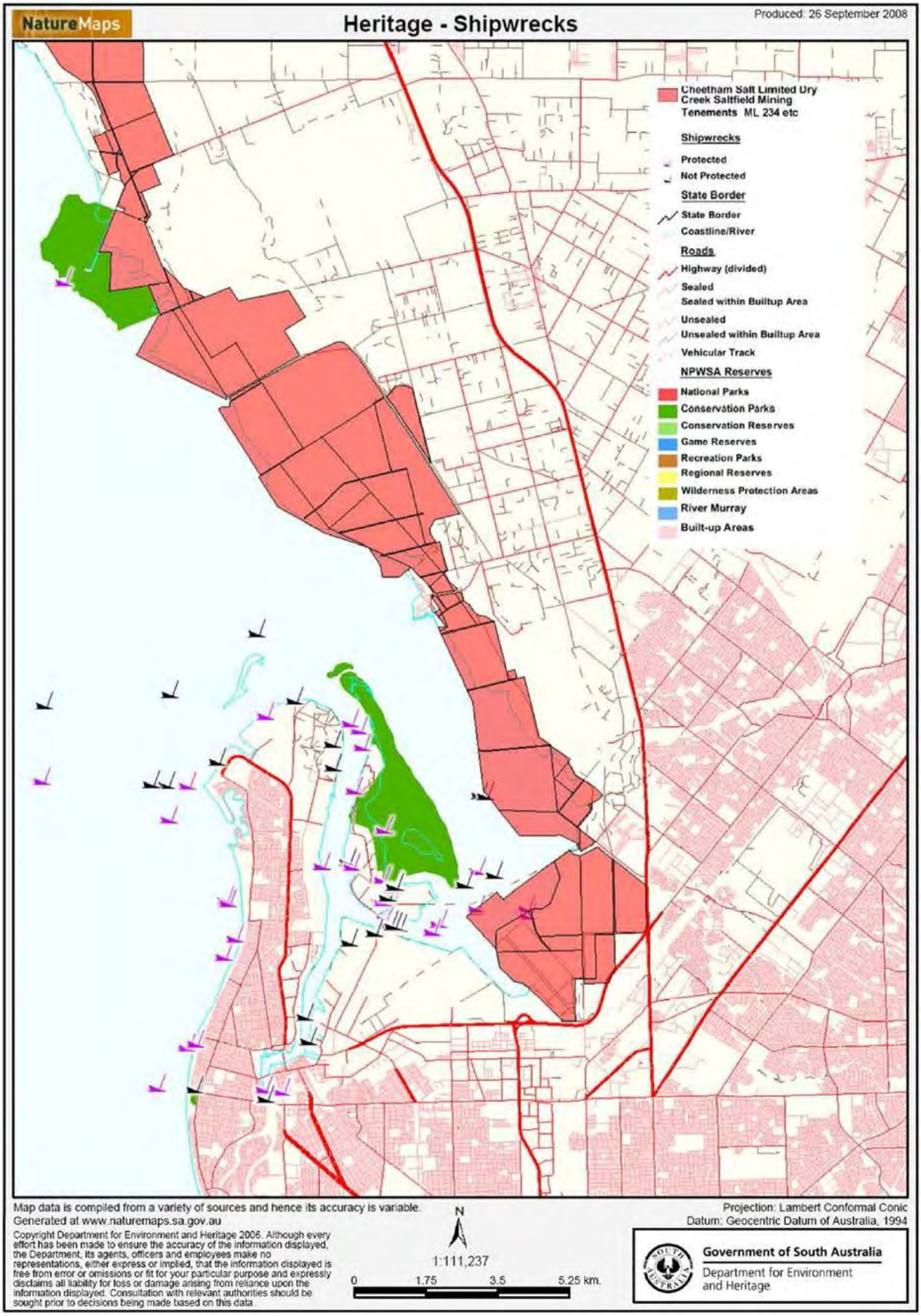


Figure 12-11: Location of shipwrecks

13 Description of Historical Operations

This section describes the historical salt production operations. This is to provide background context for the proposed works to put the operations and the salt field into 'care and maintenance' prior to rehabilitation and closure.

13.1 General Description and Summary

Dry Creek Salt Fields was a sequential concentration, series flow crystallisation solar salt operation. The operational (southern) salt field occupies approximately 4000 ha of the mineral tenements. Seawater (35g/L TDS) was pumped into the salinas at their northernmost point, near Middle Beach. The brine flowed slowly southward, gradually concentrating through evaporation. By the time brine reached Dry Creek (about 18 months after it was pumped into the northern ponds), its salinity had increased to about 300g/L TDS. The southernmost area contained the crystallising pans, where the saturated brines deposited common salt crystals onto a prepared bed for harvesting.

13.2 Product and Market

13.2.1 Geological Environment and Reserves

The salinas and crystallisers were formed on a mud base. In the salinas, where the brines were initially concentrated, this tended to be the natural surface, while the prepared crystallising pans usually had a compacted and smoothed base made of imported clay.

The approximate composition of sea water is sodium chloride 2.68%, magnesium chloride 0.32%, magnesium sulfate 0.22%, potassium chloride 0.07%, calcium chloride 0.12%, other salts 0.01% and water which is 96.58%. After evaporation and crystallisation, the typical material obtained from a solar salt operation was 'natural sea salt', which is a simple compound of sodium chloride (NaCl).

As the salt is not harvested from a finite deposit, the volume produced was primarily determined by the area of crystallisers and concentrating salinas, combined with the available evaporation. The total volume of salt that the mine may have produced was dependant on the longevity of the mineral leases. The concept of ore reserves is not useful in solar salt facilities fed by ocean waters, as sea salts are constantly being created on land by the weathering process on rocks, and are transported to the sea via the slope and fluvial systems.

13.2.2 Market

The mine gate product was brine. The market for this product was soda ash production at the Osborne Plant. Annual production averaged 750,000 tonne per annum (tpa) which produced 640,000 tpa of usable salt. With weathering and purification losses, this resulted in sales of approximately 600,000 tpa.

Dry Creek Salt Field produced salt for this market, profitably, for over 70 years.

13.3 Historical Mining Operations

13.3.1 Sequence of Historical Operations

The salt field relied on the natural evaporative process of the sun and wind to produce salt. Seawater was pumped into shallow evaporation ponds in the northern part of the system and flowed slowly southwards, becoming concentrated in response to evaporation. Seawater was pumped into the initial

ponds during the months when the 'effective evaporation' was positive (the 'making season'). In general the 'making season' at Dry Creek extended from September to May, as shown in Figure 13-1.

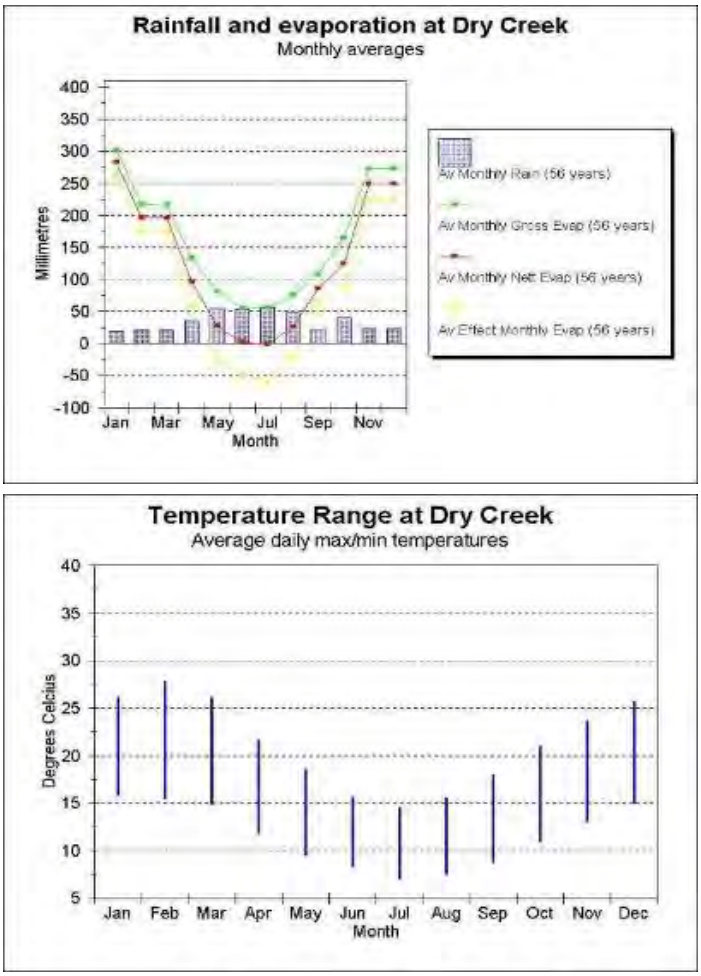


Figure 13-1: Weather statistics that define the salt-making season

The flows through the salt field were generally managed through gravity, however, in some locations, the degree of fall required did not exist, or a watercourse intervened and, in these cases, pumping was used to move the brines. The process flow for the salinas is shown in Figure 13-2 and the distribution drains of the crystallising pans shown in Figure 13-3.

Every compound has a maximum solubility concentration in water at any given temperature. When that maximum point is reached the solution is said to be 'saturated' with that compound. As seawater evaporates, some compounds precipitate prior to common salt. Calcium carbonate precipitated in small amounts in the early salinas. Calcium sulfate (gypsum) had a long precipitation pattern starting with the dihydrate form, which started to precipitate in ponds with a specific gravity of 1.080, and ending with the anhydrate form, which precipitated in ponds that were nearly saturated for common salt. The saturation point for common salt occurs at an approximate specific gravity of 1.216. Saturated brine ready for the crystallisation of salt is known as 'maiden brine'.

Maiden brine was held in a relatively deep 'stock paddock' or 'pickle pond' from whence it was distributed to the crystallising pans by a series of drains. At Dry Creek, there were about 390 hectares of prepared crystallising pans, located on ML389, ML390, ML 391, ML5908 and PM248. Further evaporation saw sodium chloride depositing on the floor of these pans to build a thick, hard layer of

interlaced crystals of salt. Residual brine (known as bitterns) was discarded from the last pan in each row of pans once the majority of common salt had precipitated. The initial pans were fed with fresh maiden brine throughout the making season.

The layer of salt was harvested towards the end of the making season. During harvest, the crystallisers were drained one at a time to accept the machinery. Self-propelled harvesters separated and lifted the layer of salt from the crystalliser floor and deposited the harvest onto an electric powered conveyor and stacker system. The conveyors and stacker progressed along each row of crystallisers, depositing salt into a stack parallel to the crystallisers. The stacks (camelles) were formed from a series of overlapping cones of salt.

Salt stacks ran north-south along the length of each crystalliser, and reached 12 metres in height. The salt rapidly 'crusted' and became very hard, ensuring no entrainment of salt into breezes. Rain water percolated through the stacks, removing any residual magnesium salts and dissolving a portion of the common salt. This process is called 'weathering' and was the main purification method used to produce a saleable product.

Most salt underwent no further movement after placement into these stacks during the harvesting process, until it was dissolved for sale. A small amount of salt (approximately 18000 tonnes pa) was removed from the stacks using a front end loader and truck, to supply the salt baskets at the brine reservoirs.

A number of factors affected the amount of salt produced. Warm sunny weather was needed to provide sufficient solar energy and large amounts of land were required. Rains diluted the brine, slowing production and also dissolved harvested salt. These factors affected the annual production, which ranged from 300,000 to 900,000 harvested tonnes per annum.

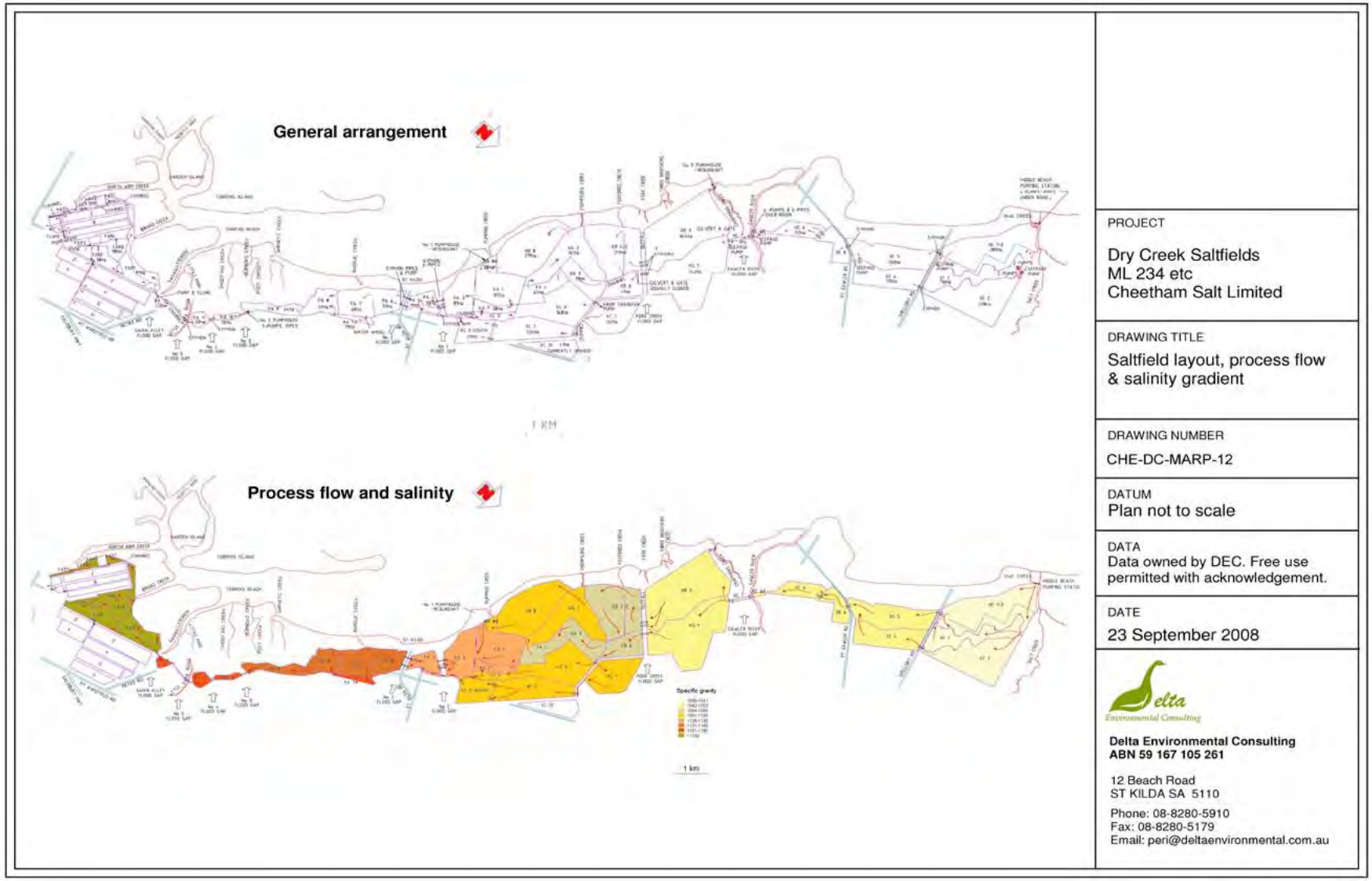


Figure 13-2: Salt field layout, process flow and salinity gradient (historical operations)

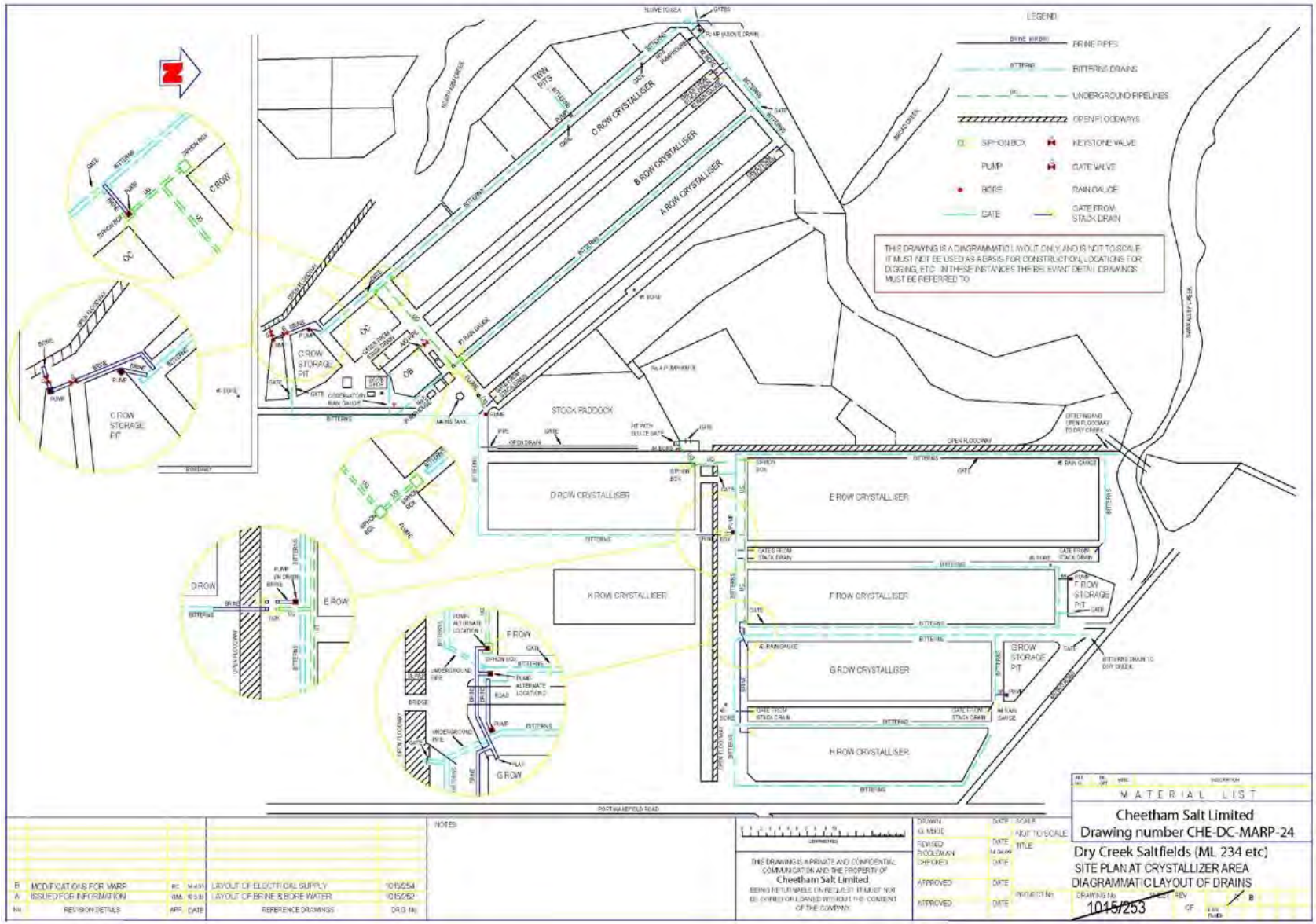


Figure 13-3: Crystalliser pans drainage

13.3.2 Modes and Hours of Historical Operations

The operating (southern) salt field operated on a continuous basis throughout the year. Pumping into and through the salinas started in early Spring each year and continued until late Autumn or early Winter. At the same time as the salinas started to operate, the crystallising pans were prepared for flooding by smoothing the pan bases to make a proper 'bed' for the salt. The crystallisers were flooded sequentially as each was repaired. Harvesting of the crystallisers occurred in late Autumn and Winter. Salt was harvested over about 10 weeks. During harvest, leftover crystalliser brine was assessed and either placed into deep storage ponds to overwinter or disposed to sea if its salt content was exhausted. After harvest, the crystallising pans were rain or seawater 'washed' to collect any unharvested salt and this brine stored. The washed pans were then left to dry until they were ready to be prepared in Spring for a new crop.

The salt field was manned from 7:30 am to 3:45 pm Monday to Friday and 7:00 am to 3:00 pm on weekends and public holidays. The production pumps operated automatically throughout the twenty-four hour cycle. During harvest (March – July), operations on the crystallisers (ML389, ML390, ML 391, ML5908 and PM248) were conducted for an extra hour each day.

13.3.3 Type of Equipment for Historical Operations

Equipment used in day to day operations included, but was not limited to: utilities, cars, graders, trucks, front end loaders, bulldozers and tracked vehicles.

Pan preparation utilised articulated tractors and towed agricultural-type implements. Harvesting operations included:

- 3 custom designed tracked, hydrostatically driven salt harvesters powered by Caterpillar 3208
- 9 electrically powered conveyors
- 1 stacker / generator set, generating 600 KVA
- 1 mobile lunch van
- Diesel fuel tank on trailer: 2 X 1000 litres
- Excavator: Hitachi EX220.

13.4 Processing for Historical Operations

13.4.1 Processing Plant

As the product supplied to the salt fields' customer was crude brine (a relatively pure solution of NaCl), processing at Dry Creek included dissolving salt from the stacks, mixing it at a central reservoir and pumping it from the crude brine pumphouse into the brine main for transfer to the Penrice Osborne Plant. Dissolving was accomplished with a sprinkler system using borewater. Crude brine was transferred using portable and in-situ pumps through a common reticulation system. The operation produced no dust and no nuisance noise levels.

13.4.2 Hours of Operation

The dissolving and transport pumps operated automatically throughout the twenty-four hour cycle. The pumps were monitored remotely to allow response to failure during 'out of hours' operations.

13.4.3 Type of Equipment

Dissolving equipment included:

- up to 5 mobile and permanent electric pumps (collectively 6000m^3 per day capacity)

- hoses and sprinklers for use in the stacking bays
- underground power lines with outlets along each stack to operate the mobile pumps
- bore lines along each stack to provide dissolving water
- brine lines along each stack to transport brine back to the central reservoir.

Reservoir and brine pumping plant included:

- above ground reservoirs for mixing and storing crude brine
- salt baskets for 'sweetening' weak brines
- brine line from the dissolving points to the reservoir and crude brine pump house
- 2 electrical pumps at the crude brine pump house
- brine main (HDPE 450 mm and steel 392 mm main) from crude brine pump house to the boundary of ML390.

13.5 Wastes from Historical Operations

13.5.1 Mine Wastes

Solar salt production produced minimal wastes. Seawater is water with a small percentage of salt. It is concentrated by evaporation to produce 'maiden brine' that will precipitate and crystallise common salt.

The spent brine remaining after salt crystallisation is called 'bitterns' and contained some remnants of common salt along with magnesium sulfate, magnesium chloride and smaller amounts of other elements (Figure 13-4). This spent brine was drained from the final crystallisers of each row of pans and returned to the sea via the crystalliser drains. The Dry Creek Salt Field was, and is still, authorised by the EPA to discharge bitterns into the tidal portions of Dry Creek and North Arm Creek. The material is released in accordance with the licence conditions and as specified in the company's *SOP-SC-A008 Environmental Management Plan, SOP-SC-A012 Waste Management* and *SOP-SC-C005 Marine Discharge* instructions. The bitterns discharge locations are shown in Figure 13-5.

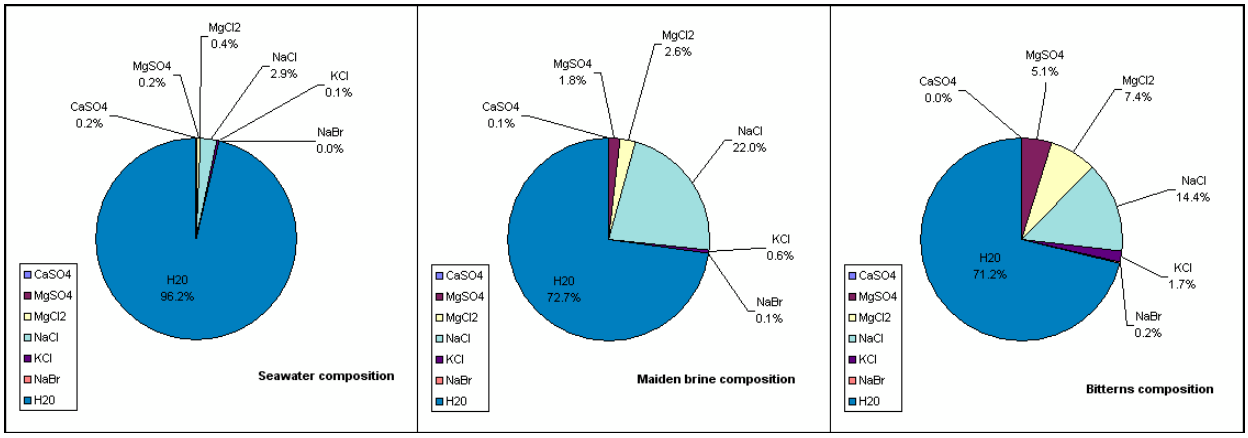


Figure 13-4: Composition of seawater, maiden and bitterns

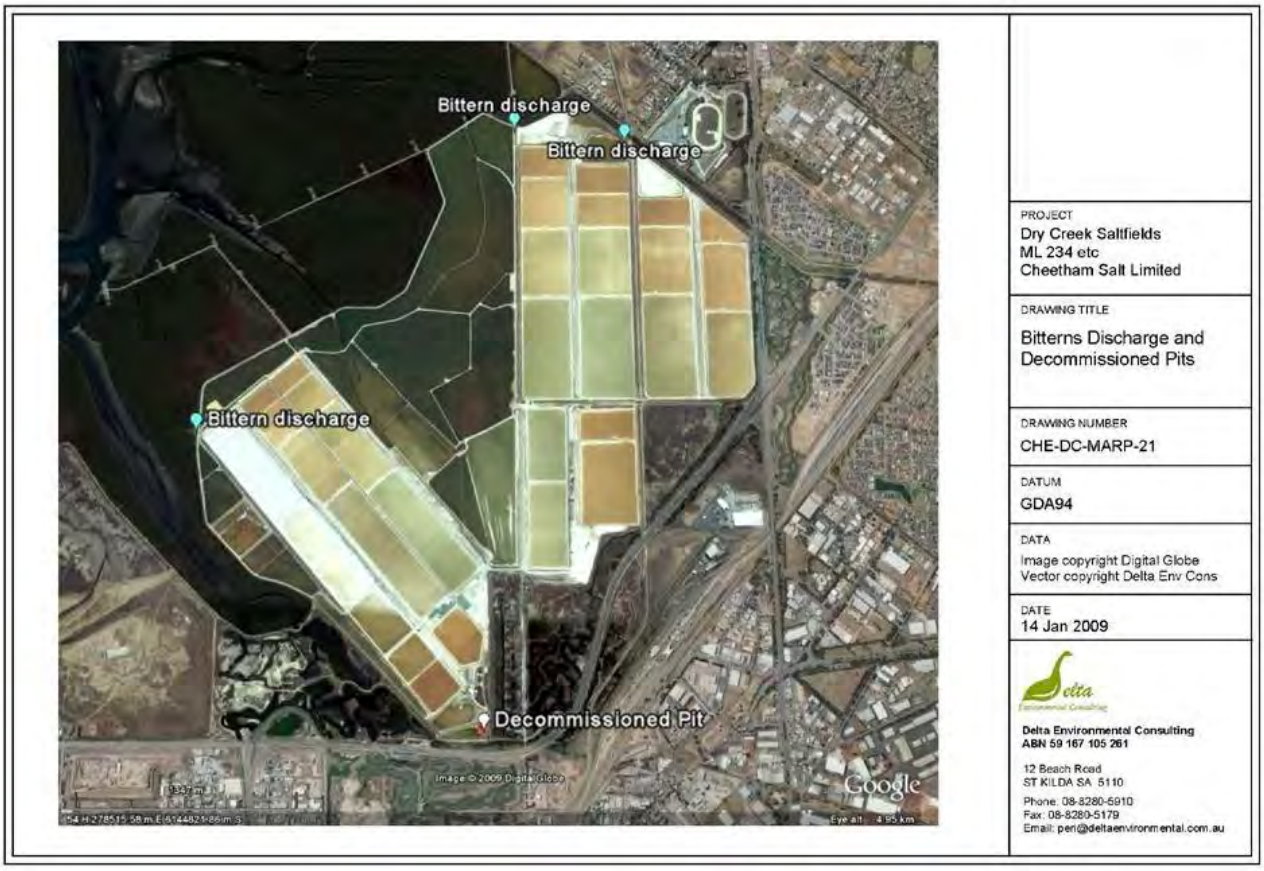


Figure 13-5: Bitterns discharge points

13.5.2 Processing Wastes

The stacks of salt produced weak brine during rain weathering and this was discharged to sea through the drains along with the rainwater runoff. The runoff was similar in composition to estuarine water, and had a low turbidity compared to the stormwater-affected receiving waters.

During active dissolving processes little brine was wasted. The stacks of salt contained a small percentage of mud and this, along with remnant undissolved crystal salt, remained in the stackbay on completion of dissolving. This was placed into the final concentrating ponds, where the salt eventually redissolved and the fine muds gradually worked their way across the pond floor, filling any low spots and helping maintain a good seal.

Crude brine for sale to the customer was stored in the reservoirs prior to being pumped through a brine main to Osborne. This pipeline was an operation-critical element of the customer's business and was monitored remotely to detect failure. Procedures were in place so manage spillage of crude brine through brine main failure.

13.5.3 Industrial and Domestic Wastes

Industrial waste was recycled where possible or collected by licensed contractors. The dissolvers' laboratory had a separate sealed tank that received sink waste and was pumped out by a licensed contractor. It also generated out of date chemicals and empty chemical containers. These were collected by licensed contractors. Other waste included office wastes and wastes from the maintenance workshop. These continue to be produced.

14 Stakeholder Engagement and Consultation

Table 14-1 identifies the key Stakeholders. The prime purposes of the consultations and engagement activities are to demonstrate that all key stakeholders in the closure and completion of the mine have been apprised of what is planned, had their views taken into account, and are broadly accepting of the way in which the mine will be closed and completed.

It is anticipated that the Government (State and Local) and proponents of future uses of the closed and completed mine will be undertaking separate and distinct consultation and engagement activities. Those are beyond the scope of this PEPR.

To date the planning of the closure and completion of the mine have not advanced to the stage where regular consultation and engagement with other than key adjacent land owners, Councils, and State Government Agencies has been merited. Nonetheless Ridley and now BDC have and continue to engage with community organisations and individuals with proximate interests in the site – for the purposes of explaining what has been happening during the Holding Pattern and Residual Operations period, and to listen to and understand complaints and concerns that have been raised.

BDC also maintains a complaints register, which records the details of the complaint, the initial response, reporting to State agencies, further action taken and information on how and when the complaint was resolved. There has only been one complaint received in 2014 relating to odour impacts.

14.1 Previous Consultation and Engagement

In early 2013 Ridley initiated communications and engagement with DSD, DPTI and other State Government agencies to explore and chart an agreed pathway towards closure of the site.

By early 2014, the following had been achieved:

- Agreement on a base case closure strategy, with a target program for its investigation, design, approval processes and then implementation.
- Approvals for the residual operations in Section 1, and care and maintenance operations and closure design investigations / trials investigations in Sections 2 to 4.

The communications and engagement since early 2014 is summarised in the Key Communications and Engagement table (see Table 14-2). The focus has been on engaging with:

- local resident groups – to ensure odour concerns are appropriately addressed and to make them aware of the closure planning
- local councils – to brief them on the Holding Pattern and closure planning and discuss potential future land uses
- State Government – through the formal mechanisms described in the Table and meetings on specific issues
- Commonwealth Government – on obligations under the EPBC Act
- Birdlife Australia – on bird monitoring and impacts of migratory birds.

A workshop in July 2014 developed agreed strategic goals for the development, investigation and design of the Dry Creek Migratory Bird Conservation Area; and clarified regulatory requirements. This involved representatives from DEWNR, the Adelaide Mt Lofty Region NRM Board, Department of the Environment, Coastal Protection Board, Birdlife Australia and SA Water.

Table 14-1: Stakeholder roles, interests and BDC's vehicles for consultation and engagement

Stakeholder				Vehicles for Consultation and Engagement			
Group	**Role**	**Identity**	**Interests**	**STAG** Meeting each month	**Direct Meetings** As required	**Group Meetings with other stakeholders** As required	**EOI proponents** Meetings as required by EOI process
Owner and Operator of Salt Field	Freehold land owner; lessee of Crown land; holder of Mining Leases	BDC Land Corporation	▪ Closure of site to enable handback of Mining Leases; release of Crown leases; and sale of freehold land. ▪ Achievement of the above in shortest reasonable time, while minimising costs and residual liabilities.	Y	Y	Y	Y
State Government	Crown land owner / manager with economic, environmental, social interest in this land	DEWNR	▪ Administers several licences to occupy that are part of salt field ▪ Responsible for Bird Conservation Park being established to west and north of the salt field which will eventually include the salt field's bird conservation area created by closure ▪ Administers the Adelaide Dolphin Sanctuary, Port Gawler Conservation Park and Buckland Park, which share boundaries with salt field ▪ Has saltmarsh transects in Crown land of the mine, where the effects of rising sea levels are monitored ▪ Maintains several Crown benchmarks in the field	Y	Y By either party on future use of Crown land, commercial matters etc	Y On future use of Crown land	Y On future use of Crown land

Stakeholder				Vehicles for Consultation and Engagement			
Group	**Role**	**Identity**	**Interests**	**STAG** Meeting each month	**Direct Meetings** As required	**Group Meetings with other stakeholders** As required	**EOI proponents** Meetings as required by EOI process
			▪ Oversights AMLNRM and Coast Protection Board				
		Renewal SA	▪ Responsible for strategic planning and implementation of State sponsored urban renewal and urban development projects	Y	Y By either party on future use / planning for Section 1	Y By either party on future use / planning for Section 1	Y By either party on future use / planning for Section 1
	Regulator / Planning Authority	DSD	▪ Administration of Mining Act via PEPR process until site closed under this Act and Mining leases handed back ▪ Coordinates STAG	Y	Y To advance PEPR, no less frequently than monthly. Site inspections for compliance checks each 3 months	Y On closure of salt field	On taking over mining leases; On clarifications re closure process
		EPA	▪ Licensing of site operations, include discharges to external environment	Y	Y To address Licence matters and post closure environmental regulation. Site Inspections for compliance checks monthly	Y On closure and post closure environmental regulation	Y On closure and post closure environmental regulation
		PIRSA	▪ Administration of Fisheries Management Act in respect of discharges from the site into the marine environment; and		Y On exemption matters for	Y On closure and post Closure	Y On closure and post closure

Stakeholder				Vehicles for Consultation and Engagement			
Group	**Role**	**Identity**	**Interests**	**STAG** Meeting each month	**Direct Meetings** As required	**Group Meetings with other stakeholders** As required	**EOI proponents** Meetings as required by EOI process
			in respect of fish management within the site		closure and for post closure	environmental regulation	environmental regulation
		DPTI	▪ Responsible for strategic planning, development approvals and zoning	Y	Y For strategic planning, DA's and zoning for freehold land post closure	Y On strategic planning, DA's and zoning for freehold land and Crown land post closure	Y On strategic planning, DA's and zoning for freehold land and Crown land post closure
	Adjacent land owner and prospective land purchaser / occupier	SA Water	▪ Site neighbour. Operates Bolivar Waste Water Treatment Plant. Interested in opportunities to use some of the site for its purposes. Provides permission for access to outfall for site brine discharge			Y Each 6 months on closure process and progress on future use of Crown and freehold land	Y As needed for EoI process
GBE	Prospective land purchaser / occupier	Flinders Ports	▪ Potentially interested in opportunities to use some of the site for its purposes.				Y As needed for EoI process
Local Government	Planning, stormwater management, urban environment management	City of Salisbury, City of Port Adelaide – Enfield, District Council of Mallala	▪ Councils rate salt field land and some councils have other interests – CoS provides treated storm water from their wetlands for dissolving and has an agreement to use land at the Little Para for saltmarsh retreat. ▪ St Kilda Mangrove Interpretive Centre built partially within the mining leases, seaweed St Kilda				Y As needed for EoI process

Stakeholder				Vehicles for Consultation and Engagement			
Group	**Role**	**Identity**	**Interests**	**STAG** Meeting each month	**Direct Meetings** As required	**Group Meetings with other stakeholders** As required	**EOI proponents** Meetings as required by EOI process
			Mangrove Interpretive Centre built partially within the mining leases, seaweed from beach cleaning is stored temporarily on leases				
Commonwealth Government	Regulator	Department of Environment and Energy	▪ Administers the EPBC Act. ▪ Interested in protection of migratory birds that use the site; and in other matters of national environmental significance. ▪ In process of negotiating delegation of EPBC regulatory role to the State.		Y Each 3 months on progress and more frequently as needed on PEPR on EPBC process matters, including submissions		
Commonwealth, State and Local Government Politicians	Constituent and political party representatives	Susan Close Member for Port Adelaide (SA) (Fed) Leesa Vlahos Member for Taylor (SA) Zoe Bettison Member for Ramsay (SA) Mark Butler Member for Port Adelaide (Fed)	▪ Representatives of the interests of people and organisations in their electorates. If Minister of a regulatory authority that has jurisdiction over the site or its activities, then responsible for the administration of the relevant legislation		Y Each 6 months on closure process and progress. Y On future use of Crown and freehold land		

Stakeholder				Vehicles for Consultation and Engagement			
Group	**Role**	**Identity**	**Interests**	**STAG** Meeting each month	**Direct Meetings** As required	**Group Meetings with other stakeholders** As required	**EOI proponents** Meetings as required by EOI process
		Nick Champion Member for Wakefield					
Site Neighbours		Rural landholding neighbours	▪ Rural neighbours have an interest in the salt field as may impact on programs of weed and feral animal control. Likewise illegal shooters and off-road vehicle users who become bogged can cause loss of stock and capital improvements			Y As and when agreed with STAG - on closure process and progress on future use of Crown and freehold land	
		Urban and coastal township neighbours (represented by St Kilda Progress Association and St Kilda and Surrounds Development and Tourism Association	▪ Opportunities presented by future land uses at the site and how these may benefit their communities socially, environmentally and economically. ▪ Safety of houses and land east of the existing field is a potentially significant stakeholder issue for future land uses at the site. Several residential areas have been developed since the salt fields were constructed. Some of these developments are on land which was historically subject to tidal inundation. Some landholders have installed additional protection measures; however complete				

Stakeholder				Vehicles for Consultation and Engagement			
Group	**Role**	**Identity**	**Interests**	**STAG** Meeting each month	**Direct Meetings** As required	**Group Meetings with other stakeholders** As required	**EOI proponents** Meetings as required by EOI process
			removal of the seawalls may adversely affect some properties.				
		St Kilda Tramway	▪ Tramline runs along land donated by the salt field, between the ponds. The Tramway have concerns about foam on tram tracks.				
		Jeffries Compositing Works	▪ Interested in salinity of groundwater under their operation. Salt fields have concerns about nutrient-rich composting dust and odours that can emanate from composting works				
		Aerial farms, radars and communication towers	▪ DSTO has an aerial farm and reflection pad for the Jindalee OTH radar at St Kilda. ▪ Uni has an aerial installation at Shellgrit Rod, Civil Aviation has an aerial at Light Beach				
		Dublin Balefill Tip	▪ Adjacent to salt fields in northern leases. ▪ Balefill operators monitor groundwater to reassure neighbours regarding balefill leachate				
		South Australian Rifle Association	▪ Rifle range at Light Beach has an overshoot template (exclusion zone) in Light River				

Stakeholder				Vehicles for Consultation and Engagement			
Group	**Role**	**Identity**	**Interests**	**STAG** Meeting each month	**Direct Meetings** As required	**Group Meetings with other stakeholders** As required	**EOI proponents** Meetings as required by EOI process
			Delta, across salt field tenements				
Special Interest Groups	Bird Habitat Observation and Monitoring	Ornithologists	▪ Interested to protect bird habitat afforded by the salt field. ▪ Passes to 'birdwatching zone' between St Kilda and Port Gawler are provided to bona fide birdwatchers			Y With DEWNR - on future use of Crown land	
		BirdLife Australia	▪ Interested to protect bird habitat afforded by the salt field. ▪ Provides monitoring services and advice to DEWNR under Commonwealth and State funded programmes				
	Honey production	Beekeepers	▪ Several beekeepers lease 'sites' for their hives from the salt fields				
Boards (responsible to DEWNR)	Responsible for delivering programs and projects to manage, protect and restore the region's natural resources	Adelaide Mount Lofty Ranges Natural Resource Management Board	▪ Is a source of grant monies for habitat restoration purposes		Y With DEWNR - on progress with closure and on future use of Crown land and freehold land		
	Responsible for protection, restoration	Coast Protection Board	▪ Carries out works, acquires and deals with coastal land. Also		Y With DEWNR - on progress		

Stakeholder				Vehicles for Consultation and Engagement			
Group	**Role**	**Identity**	**Interests**	**STAG** Meeting each month	**Direct Meetings** As required	**Group Meetings with other stakeholders** As required	**EOI proponents** Meetings as required by EOI process
	development and management of the coast and related research		provides funding towards coastal projects.		with closure and on future use of Crown land and freehold land		
Other Third Parties	Potential future land owners / occupiers / managers	Identities to be found by EoI process	▪ Economic, environmental and social value of the land				Y As needed for EoI process

Table 14-2: Key Communications and Engagement 2014 to October 2016

Organisation / Group	Activities 2014 to October 2016	Issues Arising from Communication / Engagement	
		Issue	**Outcome**
St Kilda and Surrounds Development and Tourism Association and St Kilda Progress Association Residents / property occupiers on east side of Brooks Road Residents of St Kilda Other residents neighbouring the site	Meetings and email correspondence	Concerns about impacts from odours during episodes of high temperature and low wind speeds Concerns about impacts from windblown dusts on people and properties east of Brooks Road, and emanating from XC2, or XC2E when sufficiently hot, dry windy conditions occur Odour and Dust Diary programme Outstanding invitation from each Association to talk about the approach and anticipated sequence of steps to close the salt fields	Odour concerns arose in early 2014. They were investigated and action taken to prevent recurrence. This has been successful in that no subsequent complaints about odours have occurred. We have explained the work we have done to reduce the risk of such dusts occurring. However the risk cannot be eliminated and remains a source of concern. Explanation of the purpose of the programme. Sourcing of volunteer diarists via the associations We have responded that we will be happy to provide a presentation / hold a discussion
Councils (Mallala, Playford, Salisbury)	Meetings, emails, See also STAG	Impacts from Holding pattern on site neighbours	Ideas for use of PA4, PA5 and part of PA6 for stormwater management Engagement of Salisbury in discussions and review relating to development of Section 1.

Organisation / Group	Activities 2014 to October 2016	Issues Arising from Communication / Engagement	
		Issue	**Outcome**
		Possible Mine Closure strategies and opportunities to use different parts of the site for urban stormwater management	
DSD, DPTI, EPA, DEWNR, SA Water	CE Steering Committee Meetings	High level coordination of Government involvement and oversight of the STAG.	Until the sale of Ridley Dry Creek Pty Ltd in 2016, Ridley (as the then mine tenement and freehold land owner) was represented on this Committee. Following that sale, the Committee's focus has changed to be primarily one of coordination within Government of actions arising from STAG deliberations, and so requires no representation from BDC (as the current mine tenement and freehold land owner).
Ridley (to May 2016), BDC (from June 2016), DSD, DPTI, EPA, DEWNR, PIRSA plus SA Water, plus Renewal SA, plus Council representatives	Strategy and Technical Advisory Group (STAG) Meetings	Oversight of implementation of Holding Pattern and of the strategy for closure and future land use identification.	The meetings were initially at fortnightly intervals and are now at monthly intervals. The outcomes so far have included: ▪ Endorsement of Ridley's Base Case Closure Strategy ▪ Collaboration between Ridley and Government on joint invitation for EOI's for future uses of Crown and Freehold land at the site ▪ Agreement for Government and Ridley to share costs of ASS investigations, topographic and bathymetric survey and for the EOI process which led to the sale of Ridley Dry Creek Pty Ltd ▪ Facilitated: o Permitting of Holding Pattern for Sections 2 to 4, with discharge to SA Water outfall from PA5, and trial draining of selected ponds o Approval of initial PEPR for the Holding pattern and for the investigations / trials needed to design closure works o Approval of necessary minor changes and also revisions to the PEPR covering ▪ Facilitated the collaborative review of the master plan for the development of Section 1 that is jointly funded by BDC and Renewal SA ▪ Facilitated surrender of mine tenements over land required by the Northern Connector ▪ Coordinated consideration of strategic options for closure of Sections 2, 3 and 4
DEWNR plus Commonwealth DoE, plus AMLR NRMB, plus CPB, plus BirdLife Australia	Workshop (2014)	In order to assess options, develop the concept for, and design (and obtain durable regulatory approvals for) the mooted Dry Creek Migratory Bird Conservation Area, there need to be a set of clearly stated strategic goals for this Area;	Proposition of the following Strategic Goals: **Landscape scale (Samphire Coast?) strategic goals** 1) Important sites (habitat) continue to support significant numbers of shorebirds at a landscape scale (scale TBD).

Organisation / Group	Activities 2014 to October 2016	Issues Arising from Communication / Engagement	
		Issue	**Outcome**
		and these goals need to be agreed by Ridley (now BDC), DEWNR / AML NRMB and by DoE in order for them to be achievable, sustainable, and able to merit regulatory approvals under the relevant legislation. The goal of the workshop was to *develop agreed strategic goals* that can frame the subsequent: ▪ option development, comparison and selection ▪ the investigation and design of the Dry Creek Migratory Bird Conservation Area; and ▪ the regulatory approach to the assessment of this design for approval decision making.	2) Through an adaptive process, natural and human-induced changes are managed, informed by robust scientifically-based monitoring. 3) Acceptable planning and management arrangements are developed and assured for important sites across private and public land. 4) Security of these measures are assured by statutory mechanisms and other agreements. **Salt field strategic goals** 1) That the site at closure continues to contribute to the landscape-scale mosaic of shorebird habitat and ecological productivity. 2) Site condition assessments at closure and adaptive management plans with clear management objectives will be developed and implemented.
DSD, EPA, PIRSA	Meetings, correspondence, reviews of documents	Various issues relating to operational and compliance matters for the Holding Pattern; or to matters requiring minor changes or revisions to the PEPR	▪ Variations to the EPA Licence covering the Holding Pattern ▪ DSD's agreement on Environmental Outcomes and Measurement Criteria to apply to the Holding Pattern ▪ Approval under the FMAct for the water discharges entailed by the Holding Pattern ▪ Reviews of draft submissions for minor changes and revisions to the PEPR leading to approval of submissions once finalised ▪ Review of the draft PEPR compliance report leading to approval of this once finalised ▪ Reviews of progress and issues arising from trials and investigations conducted under the PEPR
DSD and EPA	Site Inspections (monthly originally and now quarterly)	Check environmental condition of site and status of compliance with PEPR, the EPA Licence and other approvals.	Issues identified are resolved with the necessary documentation.
Renewal SA	Meetings and correspondence	Redevelopment of Section 1.	BDC and Renewal SA are collaborating on a review of the key issues that affect the feasibility of redevelopment of Section 1 for mixed use urban development

Organisation / Group	Activities 2014 to October 2016	Issues Arising from Communication / Engagement	
		Issue	**Outcome**
		Reuse of Brine Main for Brine disposal to Port River	Permission to trial the reuse of the brine main. Renewal SA owns some of the land outside the site and through which this brine main passes. It therefore owns the brine main in that land.
DoEE (formerly DoE)	Emails and Meetings in Canberra, Site Visit by DoEE staff	Impacts from the Holding Pattern on Matters of National Environmental Significance. Mine closure of the inundated ponds in Sections 3 and 4 Coordination of the Commonwealth and State processes to regulate the changes to the inundated ponds in Sections 3 and 4 for compliance with the EPBC Act and the Mining Act respectively	Submission of annual 'self assessments' based on monitoring to demonstrate that the impacts have been negligible A referral of the intention to close these ponds that resulted in a determination that changes from the Holding Pattern conditions in these ponds would be a 'controlled action' to be assessed by preliminary documentation. In that referral, responding to the offsetting / mitigation provisions of the EPBC Act and to provide confidence and certainty is the intent to design closure so that 100% of impacts are mitigated within the site under BDC's control, with no need to rely on offsets outside the site on land not under its control, even if within the International Bird Sanctuary. Agreement on a draft charter for this coordination
BirdLife Australia	Meetings, emails	Impacts from the Holding Pattern and impending closure on bird habitat provided by the site, and especially for the migratory Shorebirds	There has been exchange of bird monitoring data with Bird Life Australia BirdLife Australia provide bird monitoring and other services to AMLR NRMB and DEWNR for the International Bird Sanctuary Area (ie covering the salt field). Birdlife Australia, with AMLR NRMB advise DEWNR in discussions about potential impacts to birds from the holding pattern and from the mooted closure
SA Water	Meetings, emails	Access to SA Water land and outfall for discharge from PA5 Trial in Section 2 of treatment of nutrient removal from water from SA Water's Port Adelaide facility.	Agreement on access The trial has been proceeding, accommodated as a minor change to the PEPR. The trial started in PA9 and PA10 and is being extended to PA8 and PA7a
Flinders Ports	Meetings, emails	Reuse of Brine Main for Brine disposal to Port River	Permission to install a discharge point and trial the reuse of the brine main. Flinders Ports manages the section of the Port River where the brine main passes under.
Port Adelaide Enfield Council	Meetings, emails	Reuse of Brine Main for Brine disposal to Port River	Permission to trial the reuse of the brine main. The Council owns some of the land outside the site and through which this brine main passes. It therefore owns the brine main in that land

14.2 Proposed Consultation and Engagement

The planned further communications and engagement activities relating to this PEPR / MOP include:

1. Ongoing consultations and discussions with agencies in the development of the strategies / plans for future land uses and the consequent specific closure plans for each area of the site. The development of such plans will be informed by investigations and trials being conducted pursuant to this initial PEPR. It is anticipated that such discussions will not just involve regulatory agencies (e.g. DSD, DPTI, DEWNR, EPA, PIRSA, Councils, and Commonwealth DEE) but also extend to:
   - NGO's, like BirdLife Australia
   - AMLR NRMB
   - Coastal Protection Board
   - SA Water.

2. Once (for the purposes of mine closure and completion) strategies / plans for future land uses become defined sufficiently, BDC intends to hold briefings to which site neighbours and the local community will be invited to provide them with information for their consideration and to seek their feedback.

DRY CREEK SALT FIELD PEPR REVISION 3 – PART 3

15 Residual Operations and Holding Pattern Operations covered by this PEPR/MOP

The initial PEPR for Residual Operations and Holding Pattern was endorsed (Revision 1 of this document) in March 2014. Since then there have been an endorsed revision and a number of endorsed minor changes to the PEPR. The following sections in this revision (Revision 3), describe the current Holding Pattern and Residual Operations, reflecting the cumulative effect of these changes.

15.1 Residual Operations in Section 1 as of July 2016

The residual operations in Section 1 are covered by the present EPA Licence (Appendix 1). These comprise:

- pumping bore water from the T1 aquifer and sea water to dissolve or wash salt from stockpiles or in crystallisers
- pumping 'MagBrine' into a tanker for use on site or for transport offsite
- workshop operations for the maintenance and repair of equipment
- storage of waste brine from salt washing or brine from dissolved salt
- recrystallisation of brine in crystallisers
- pumping and storage of stormwater
- maintenance of existing roads and bunds
- environmental management as per the existing management plans and procedures
- operations of the site office.

These operations have the purposes of:

- managing crystallised salt, brine, borewater and stormwater within Section 1
- supporting the Holding Pattern in Sections 2 to 4.

These operations also represent either a continuation, or a reduction, in the scale and scope of historical operations.

Additional operations include:

- Recovery and removal from site of commercially recoverable salt involving:
  - removal of salt from stockpiles and excavation from the crystalliser beds using an excavator and dump truck
  - passing the removed salt through a wash plant using uses bore water to remove soil particles, and other impurities from the salt to achieve a technical specification agreed by the customer for the salt
  - stockpiling the washed salt
  - loading washed salt from stockpile into trucks for transport offsite.

- When permitted by DSD[1], disposal of the salt residues that cannot be recovered for commercial use, by:
  - excavation and disposal into a capped containments in F and G Row pits; and / or

[1] Process trials are being or may be carried out pursuant to existing DSD approvals. Successful trials will lead to either submissions of minor changes or revisions to the PEPR, to gain DSD approval.

  - dilution then discharge into the Port River or other DSD endorsed destinations.

- Functional separation of that land needed for residual operations in Section 1 from that transferred to DPTI for constructing the Northern Connector:
  - movement of No. 8 Pump (Figure 15-1), and the diversion of E Row Flap (Figure 15-2) and its drain (relocation of EPA Licence compliance points for bitterns discharge with no change to criteria)
  - disconnection of brine and bore pipes and electrical power to the Northern Connector land
  - creation of a diverted drain to take brine into final areas (Figure 15-3)
  - DPTI building a separation bund and fence between the Northern Connector corridor and Section 1 (Figure 15-4).

Waste water from the salt washing carries soil particles and the other impurities, and also a percentage of salt into a nearby crystalliser. Presently all the waste water is held within the site and is lost only by evaporation.

The operations to remove, recover and dispose of crystallised salt are likely to continue until 2018/19. These operations are necessary to prepare Section 1 in stages for closure works.

Figure 15-1: Moving no. 8 pump

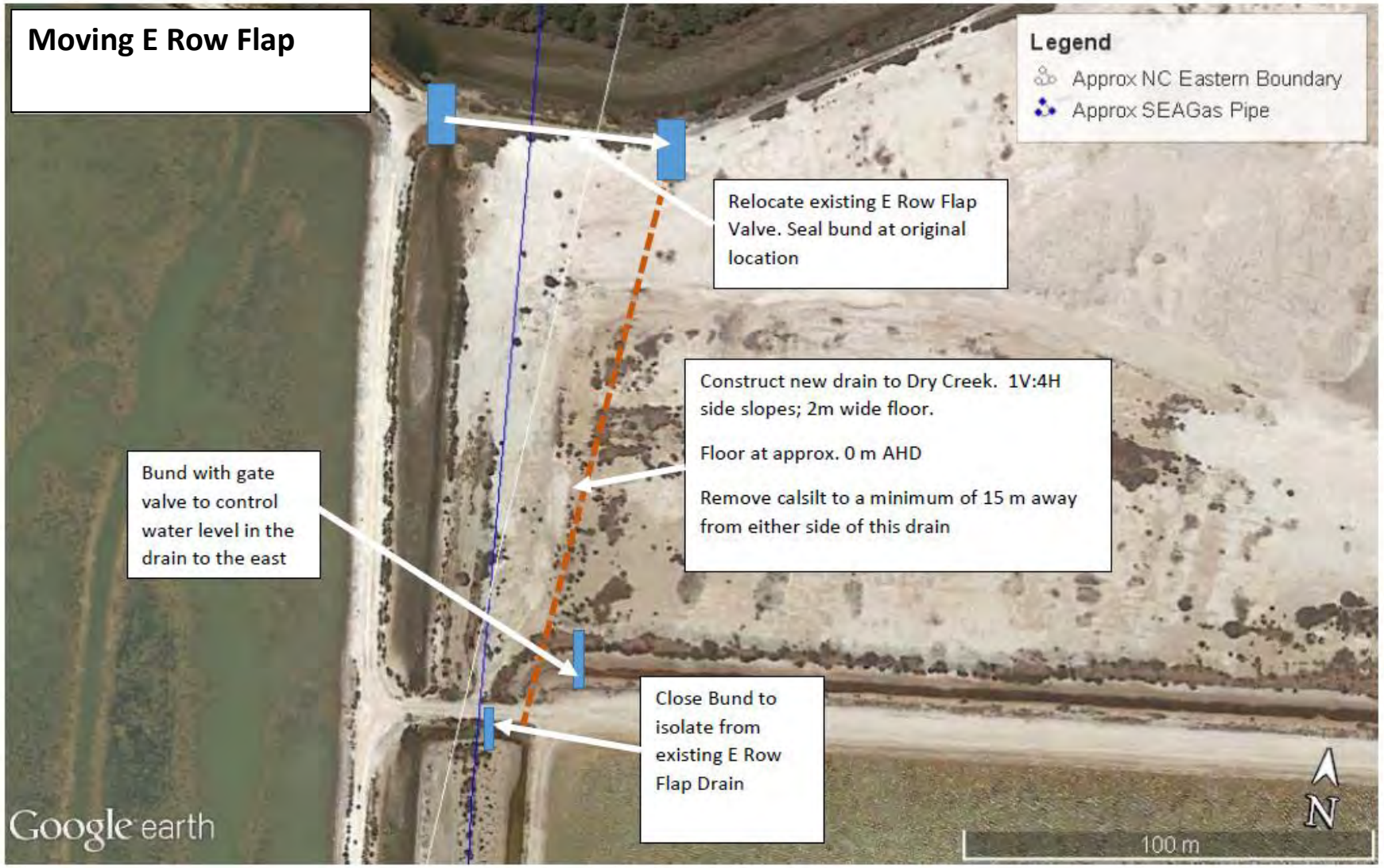


Figure 15-2: Moving E row flap

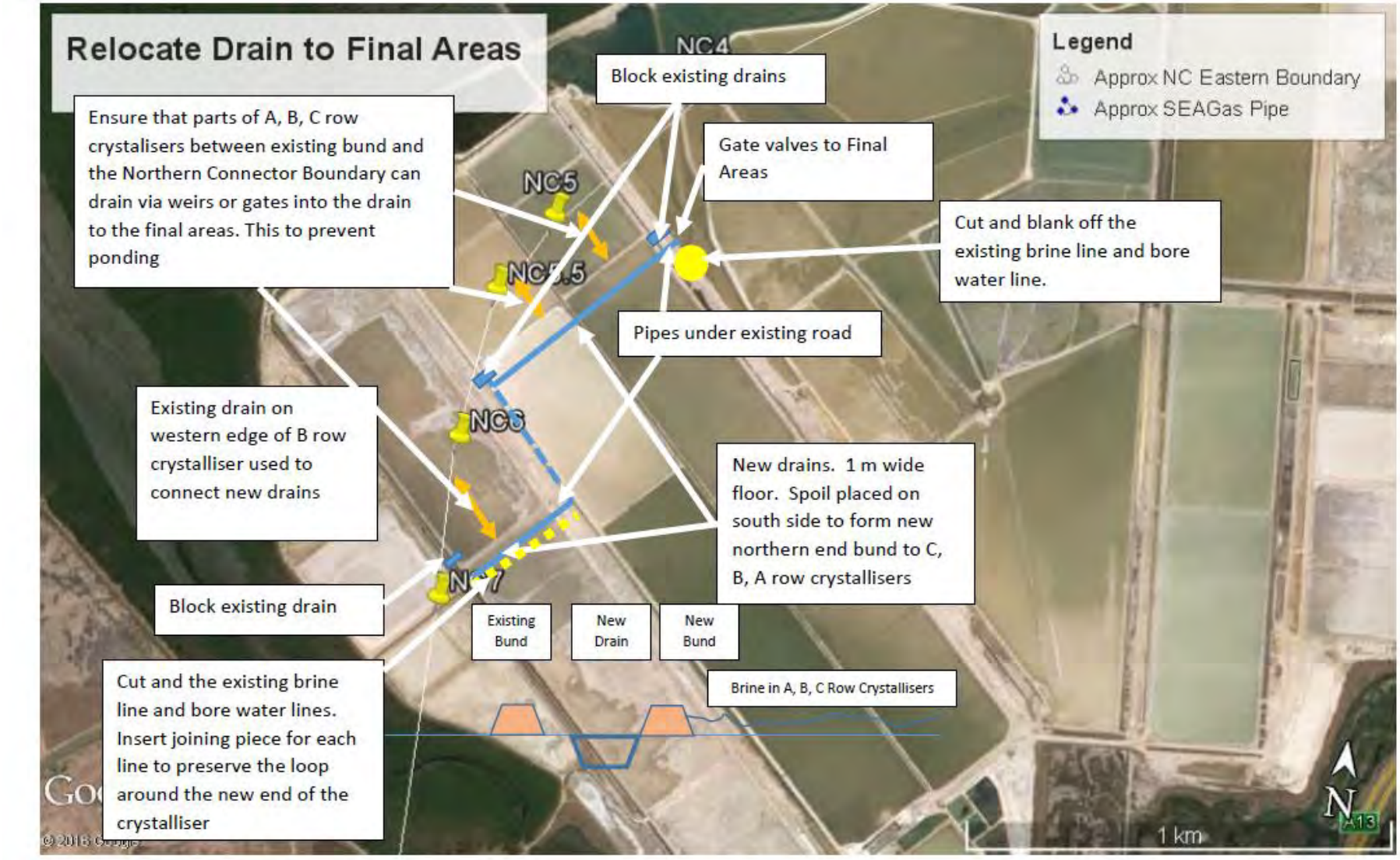


Figure 15-3: Relocate drain to final areas

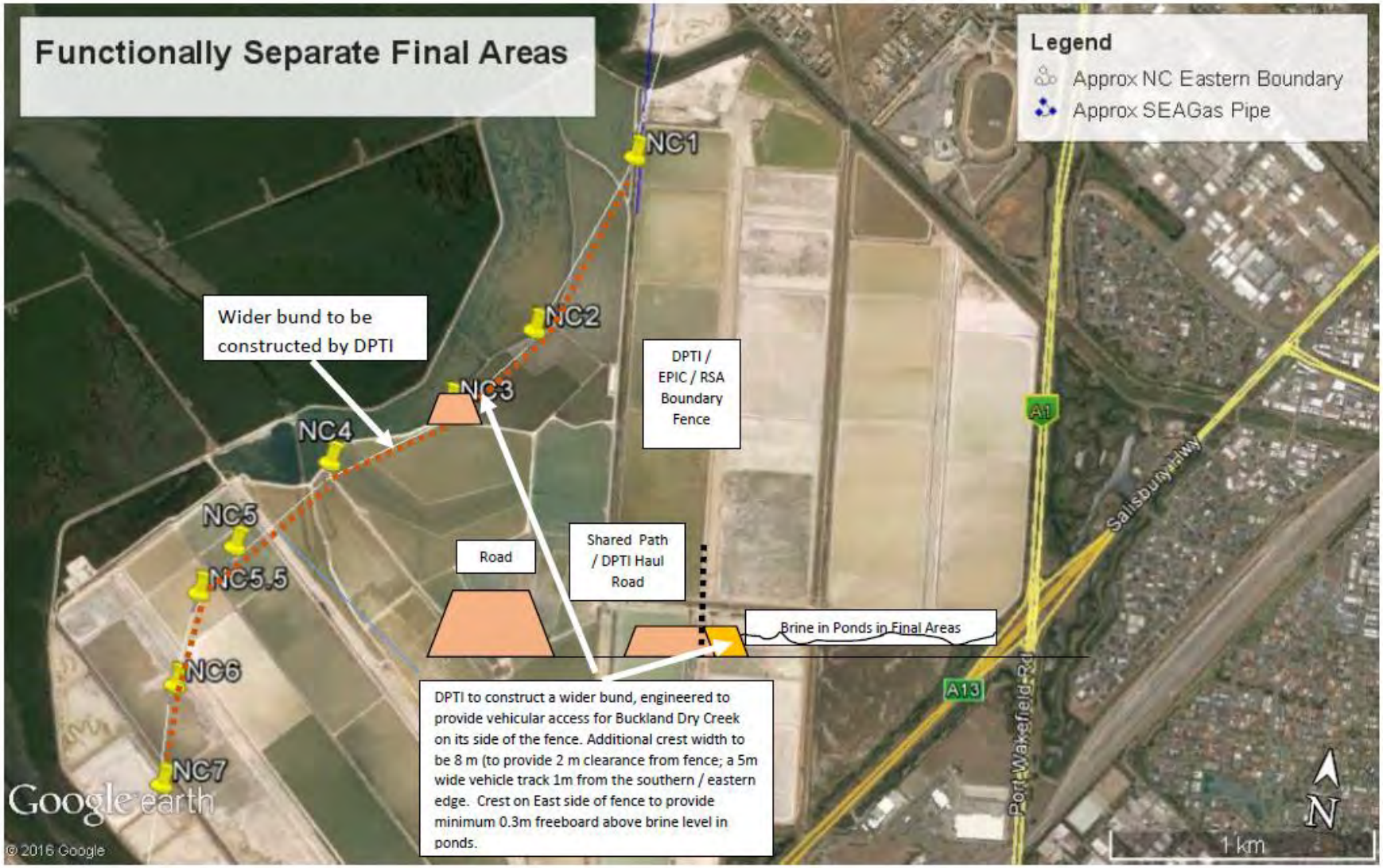


Figure 15-4: Create boundary to Northern Connector Corridor

15.2 Holding Pattern Operations in Sections 2 to 4

The Holding Pattern operations are set out below. The purposes are to:

- stop pumping of brine into Section 1 for salt production
- sustain water quality within inundated ponds (using a combination of managed entrainment and licensed pumped discharge). The aims are to sustain inundated pond water health, inundated pond habitats, and a range of salinities in these ponds between points of sea water entrainment and the ultimate point of discharge that are reasonably analogous to historical operations
- provide opportunities to investigate, in a managed environment, the opportunities and constraints on pond drainage and drying
- provide time for the investigations, trials, studies and design needed to develop the closure plans needed to achieve mine completion in Sections 2 to 4.

15.2.1 Holding Pattern Operations

Holding Pattern operations involve the following:

Water Management

- Continuation of the historic operational seawater entrainment at Middle Beach into Section 4.
- Resuming seawater entrainment at Chapman Creek into Section 3. This was previously the operational entrainment location until superseded by Middle Beach.
- Entraining and discharging sufficient volumes of water, and managing flows of water between ponds to manage water levels and quality within the inundated ponds. Information is provided below about target ranges for water levels. The water quality parameters include Dissolved Oxygen, Temperature, Specific Gravity, and pH. The aim is to stay broadly consistent with values that pertained during normal operations, except to the extent this objective is unavoidably constrained by the point of discharge being moved from PA12 to PA5. The volumes pumped in any week to manage water levels and quality will be adjusted, as in the past, in light of the following:
  - tide levels and durations at the Middle Beach and Chapman Creek pumps
  - quantities of rainfall and evaporation affecting the salt field
  - maximum water level capacities of the ponds
  - water level differences needed between ponds to enable flow through pond connections (gates and siphons)
  - actual flow rates between ponds.

As an aid to expectations, it is envisaged that:

- Over summer months, the total volume of water per ha of inundated ponds entrained in aggregate at Middle Beach pumps and Chapman Creek pumps would be broadly consistent with that entrained at Middle Beach only, during normal historical operations.
- Over winter months, the Holding Pattern would continue entraining water (at a lower rate than in summer). During historical operations, little to no water was entrained.

The following graphs (Figure 15-5 and Figure 15-6) show the pumping volumes (ML/ ha) on a monthly basis and cumulative per year (August to July). The data for 2013 – 2014 and 2014 - 2015 relates to the first two years of the Holding Pattern.

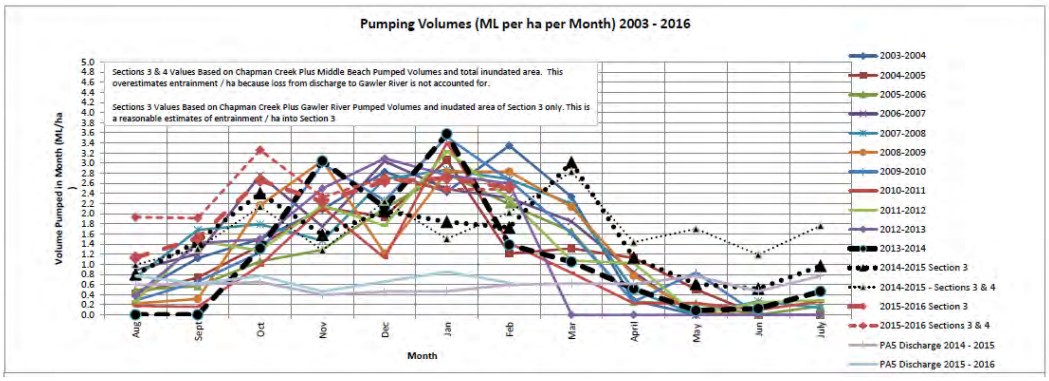


Figure 15-5: Monthly pumping volumes 2003-2016 (Historical and Holding Pattern)

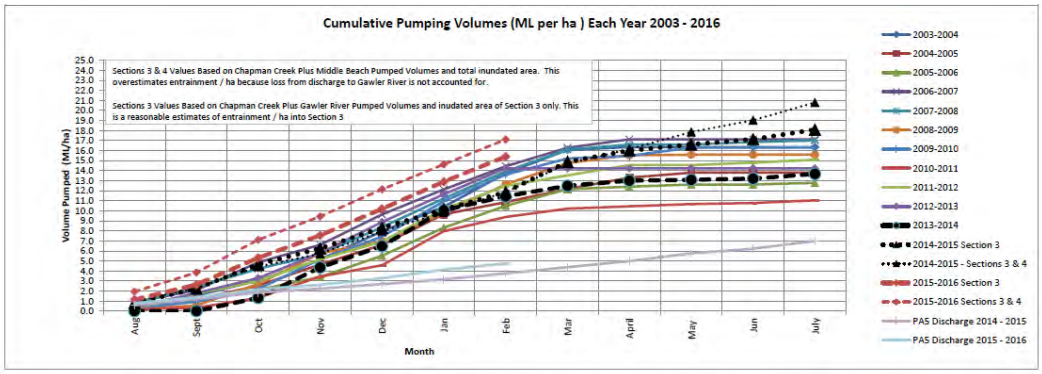


Figure 15-6: Cumulative pumping volumes 2013-2016 (Historical and Holding Pattern)

The Holding Pattern includes:

Flowing the water entrained at Middle Beach through the following ponds (see

- Figure **15-7**):
  - In Section 4:
    - from the pumps through XE1-3 into XE5
    - from XE5 and XE6 to the Gawler River Pumps
  - In Section 3:
    - from the Gawler River Pumps into XE7
    - from XE7 into XD1
    - from XD1 into XB6
    - from XB6 into:
      - XA3 then XA4 to XA1 to PA3
      - XC3 then XA7 to PA3.
- Flowing the water entrained at Chapman Creek through the following ponds:
  - XB3
  - XB 4-5
  - XA2
  - XB8
  - XB8A to PA3.

- Flowing the water that arrives in PA3 from the Middle Beach flows and the Chapman Creek:

  - from PA3 to PA4; and
  - from PA4 to PA5.

- Discharging the water that arrives in PA5 by pump into the SA Water outfall using temporary discharge arrangements

- Keeping the following transfer pump facilities and pond connections inactive but able to be used, in case of need.

  - from Pond XE 1-3 to Pond XF2
  - from Pond XF2 to Pond XE4
  - from Pond XE4 to Pond XE5
  - from Pond XB6 to Pond XC1
  - from Pond XD1 to Pond XB3
  - from Pond XA4 to Pond XA2
  - from Pond XC1 to Pond XC2
  - from Pond XC2 to Pond XC2S
  - from Pond XC2S via the channel to Pond PA5
  - from Pond PA5 to Pond PA6
  - from Pond PA6 to Pond PA7
  - from Pond PA7 to PA8
  - from Pond PA8 to PA9
  - from Pond PA9 to Pond PA10
  - from Pond PA10 to PA11
  - from Pond PA11 to PA12
  - from Pond PA12 into Section 1.

- Managing the volume flows through the inundated ponds with a view to achieving water residence times in the ponds that are reasonably similar to or smaller than those typically achieved during historic operations. This will be achieved by suitable adjustments of:
  - weekly entrainment volumes at Middle Beach and Chapman Creek
  - weekly volumes pumped over the Gawler River
  - weekly volumes pumped through the various other internal pumps
  - settings of the gated connections between ponds to manipulate water level differences between the ponds
  - weekly volumes discharged into the SA Water outfall, consistent with complying with the 45 ppt salinity limit at the outfall's weir.

- If additional water is required (above what can be supplied from the Chapman Creek pumps) for the flow path involving Ponds XB3, XB4-5, XA2, XB8, and XB8A, then using the connections between XD1 and XB3 and between XA4 and XA2 to divert some of the water entrained in Section 3 from the Gawler River Pumps.

- In addition, a permitted connection has been constructed that allows excess flows of low salinity water down Smith Creek to be captured and fed into Pond XC3. This capture can only occur opportunistically (as a response to rainfall events of sufficient magnitude), and because the ability to capture and feed the excess water into XC3 will depend on there being, at the time, a lower level of water in XC3 than in Smith Creek.

As a consequence of the above operations, the water levels in the above ponds fluctuate within a managed range that will:

- keep levels, to the extent practicable, within the range of the historic summer operating water levels in the ponds (maximum water levels)
- sustain sufficient water level differences between the ponds to achieve the desired volume flow rates between ponds and hence the residence times that are compatible with managing water quality
- respond to fluctuations in rainfall and evaporation rates.

The multiplicity of factors that affect water levels in any one pond, coupled with the scale of the overall system, mean that the response of pond water levels to changes in pumping rates and adjustments to pond connections cannot be immediate. The response time for small adjustments is measured in durations of a few to several days, and will be longer for bigger adjustments.

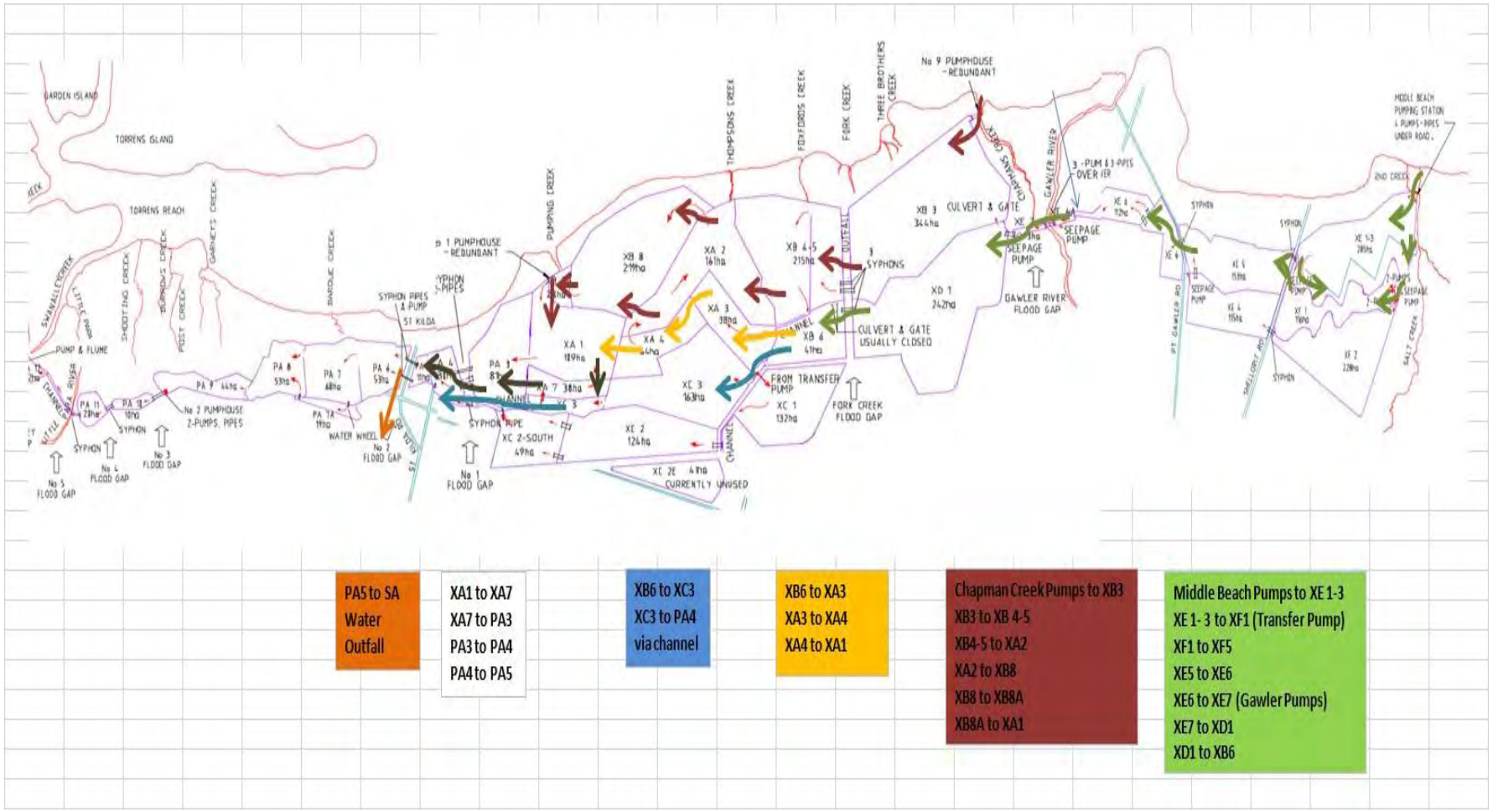


Figure 15-7: Pond layout and Holding Pattern water flow paths

Management of Discharge from PA5

The PA5 discharge mixes with the water from SA Water's Bolivar plant so that its salinity reduces by dilution. Figure 15-8 below is taken from the operations manual for the discharge management and shows the monitoring used to control the discharge. The management of this discharge from PA5 aims to maximise the discharge to the SA Water outfall while keeping 6 hr average salinity at Site 1A/ 3 below 45 ppt. This management needs to accommodate:

- seasonal fluctuations in the flow rate of water from Bolivar. The winter flow rates can be 4 to 5 times those in summer
- episodic reductions in flow rate of water from Bolivar due to operations in the Bolivar plant or due to an increase in the supply of the water to the Northern Adelaide Plains irrigators
- diurnal sewage inflow and rainfall induced fluctuations in the flow rate of water from Bolivar
- seasonal increases in the salinity of the brine in PA5.

The originally endorsed compliance point for the 45 ppt salinity of the discharge was at Weir 2 (see Figure 15-8). As a result of a successful trial (overseen by DSD and EPA), the initial PEPR was revised to adopt Sites 1a and 3 as the points of compliance for the discharge. This change of compliance point enabled the dilution from tidal mixing downstream of the Outfall weir (Weir 2) to be used to reach the 45 ppt criterion. This in turn enabled brine of higher salinity to be discharged from PA5, which had the practical effect of sustaining continuous discharge through and since the summer of 2014/15.

PA5: Water level (mAHD) and conductivity sensor (calibrated to salinity ppt) mounted on pump support. Electric pump (rated to 790 L/s) lifts water from PA5 into poly-pipe where flow is measured by an in-line flow meter positioned 10m downstream of bypass valves. Pump on/off is controlled by CITECT and bypass valves are manually controlled to adjust flow rate.
Outfall: Brine from PA5 is discharged into the Bolivar Channel and mixes / dilutes with SA Water discharge flow. SA Water outfall flow is monitored via CITECT radio link from a flow meter and displayed in DataStream. Flux is regulated using manual bypass valves at PA5.
Bridge: EC sensor calibrated to ppt. If >45ppt 1 hour moving average an alarm is sent to operational staff. If >50ppt 6 hour moving average, pump is automatically turned off at PA5.
Weir 2: EC sensor calibrated to ppt.
Site 2: EC sensor calibrated to ppt.
Site 3 & Site 1a: EC sensors calibrated to ppt. If >45ppt 6 hour moving average, pump is automatically turned off at PA5.

Figure 15-8: Key elements of the PA5 brine discharge monitoring system

(Source: HT 15 6702 MSO manual 2016)

In winter 2016 the rafts and salinity sensor systems at Sites 1a and 3 were damaged irreparably and rendered inoperable by severe storms. From January 2017, they were replaced by a buoy at the following location

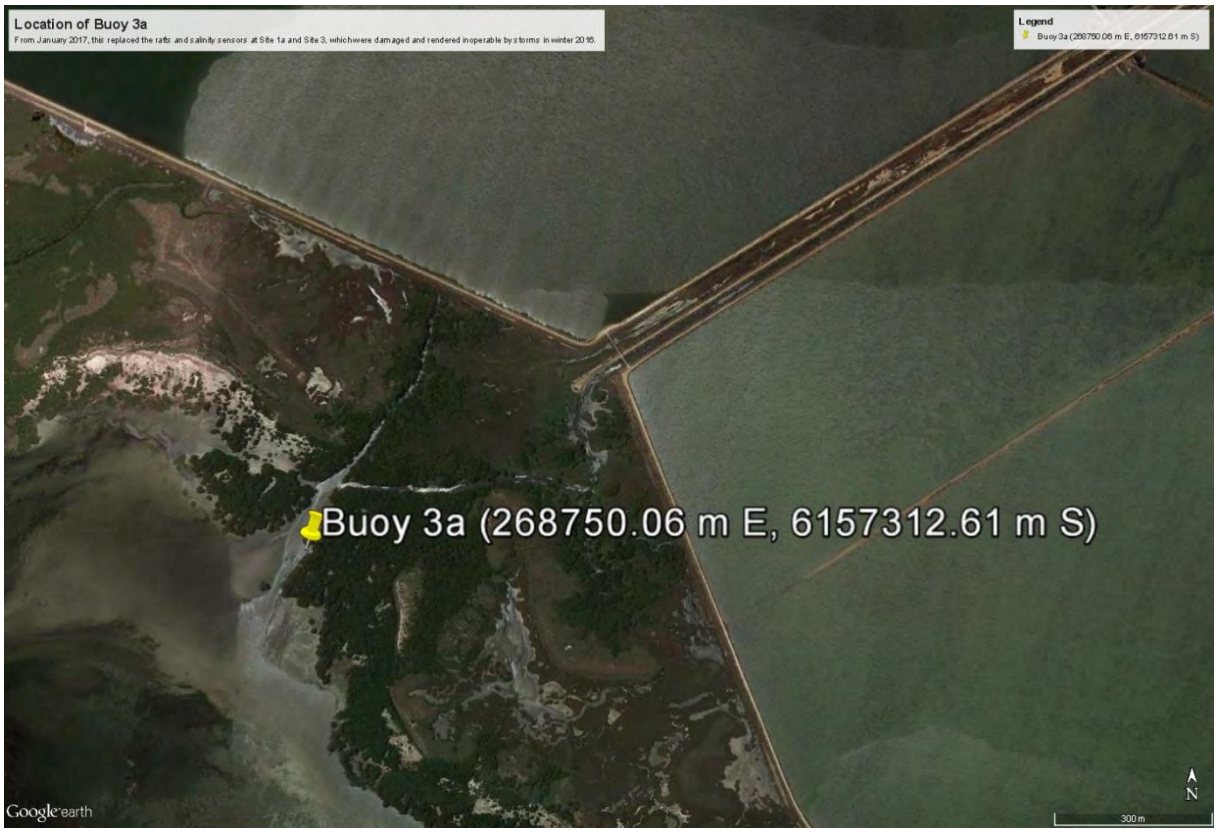


Figure 15-9: Key elements of the PA5 brine discharge monitoring point

Drained Ponds

Subject to continuing favourable outcomes from ASS monitoring, the following ponds will be kept drained / dry for the duration of the Holding Pattern:

In Section 4:

- Ponds XF2, XE4
- Pond XF1 subject to control strategies as discussed below.

Subject to continuing favourable outcomes from ASS monitoring[2], the following ponds will also be kept drained / dry for the duration of the Holding Pattern:

In Section 4:

- Ponds XF1; XF2, XE4

[2] Note that, as of late-2016, the outcomes from ASS investigations and monitoring have been favourable for all these ponds except for the south-western part of XF1. The outcomes indicated a disposition in some shallow and thin subsurface soils slowly to become acid generating, but that there is an abundance of acid buffering capacity. A risk management plan is being implemented to mitigate risk to the environment outside the pond

In Section 3:

- Ponds XC1, XC2, XC2S, part XC3, part XD1[3]

In Section 2:

- All ponds not involved in the SA Water trial (see below) of denitrification of effluent from its Port Adelaide facility. These are currently Ponds PA6 and PA7, and PA11 and PA12[4]. In such ponds groundwater is considered to be keeping the soils below the gypsum cap saturated, by virtue of the relativities of ground levels in the ponds to sea level to the west and to groundwater levels to the east of the site).

- The ponds are kept drained by means of table drains or swales that are connected to the seepage drains outside the ponds. The locations of the discharges for these table drains or swales are shown in Figure 15-10. The discharges into the external seepage drains are via pipes installed through the bunds. Limestone rock filters are placed downstream of the pipes to limit sediment transport and also to provide contingency buffering to keep the pH of the discharged water alkaline.

In the event of unfavourable outcomes from the ASS investigations and monitoring in parts of the above ponds:

- During the Holding Pattern, appropriate and reasonable measures will be taken in the affected ponds to avoid or mitigate risk. These measures will be planned and implemented taking account of discussions with DSD, EPA and DEWNR. This has occurred and is occurring in respect of the south-western portion of XF1 which is the only location where incipient ASS have been identified as a result of monitoring following draining of the ponds.

- Should these measures involve re-inundating these ponds or parts thereof and the risk assessment and monitoring indicate this may need to be sustained in the long term, this will need to be accommodated by the strategies and options for closure and for future (post closure) land uses. BDC's intent, in this situation, will be to discuss with DSD how best to discharge its responsibilities under the Mining Act. BDC and Government recognise that both parties will need to cooperate in this effort in order that closure can be achieved by BDC within a reasonable timeframe and provide an acceptable basis for Government to inherit the management obligations for the affected land.

<u>Drain to Import Excess Water from Smith Creek</u>

In October 2014, approval was granted by the Adelaide Mount Lofty Natural Resource Management Board for the construction and use of a drain to import excess water from Smith Creek to Pond XC3. Following approval from DSD, this drain was constructed in late 2014 as shown in Figure 15-11. It took advantage of an existing syphon under the SA Water outfall, and an existing drain along the north side of pond XC2.

As and when water levels in Smith Creek are higher than those in XC3, and if the salinity levels there would benefit from some dilution, valves can be opened to allow water to flow in. This can only happen

[3] Note that to date it has not yet been necessary, for the purposes of water quality management, deliberately to hold the water levels in XC3 and XD1 below their historical operational ranges, thereby draining the eastern shallower parts of these ponds. This means that there has not yet been a need to investigate and monitor the impact of such draining on soil acidity here.

opportunistically as it requires high water levels in Smith Creek and low water levels in XC3 for water to flow.

Draining of XF1

The purpose of short term (to mid-2017) management of acid sulfate risk in the south-western portion of XF1 is to improve drainage to limit how long runoff collects and to limit the time available for that water to infiltrate to the layer that forms pockets of acidic soil and become sources of acidic lateral seepage.

The control strategies contained in the plan endorsed for the draining of XF1 (Figure 15-12 and Figure 15-13) include:

1. Constructing swale drains with points of discharge from XF1 to XE1-3, or to seepage drains to enable the landscape to drain reasonably freely.

2. Quarterly soil sampling and testing (Jan, April, July 2015) of ASS / MBO conditions.

3. Fortnightly / monthly environmental visual and odour observations of soil conditions.

4. Where drainage passes through a bund into a seepage drain, construct limestone filters on the pond side of the bund and also in the seepage drain downstream of where the drainage enters.

5. The need for and methods / scope of preventive or remedial soil treatment to be decided from the results of the monitoring.

This will be reviewed every 6 months, based on:

- monitoring results
- the nature and timing of future land uses
- a consequent review of risks as per the endorsed plan for the draining of XF1.

One remedial option which will be examined for feasibility, in case of need, is to plough the affected area and mix in a) some carbonate sands from XF2, and b) some calsilt from XC2E. The purpose would be to mix the top two layers together and to amend their physical composition while adding plenty of pH buffering capacity. It would also be to render this part of XF1 more amenable more quickly to revegetation

Such an option would only be deployed if future land uses required this part of XF1 to remain drained.

Location No	Discharges from	Discharges to
1	A drain cut on western side of the northern 1/3 of XF1, leading to the north end of XF1	Seepage drain on north side of XF1
2	A depression in the north-western part of XF2	Seepage drain on north side of XF1
3	A natural drainage course within the north-eastern part of XF2	Seepage drain on north side of XF1
4	A natural drainage course within the north-eastern part of XF2	Seepage drain on north side of XF1
5	The north-eastern corner of XE4, but drains the southern end of XF2 via the syphon to XE4	Seepage drain on north side of XE4
6	A drain cut in the southern end of XF1	Seepage drain on south side of XF1
7	A drain cut in the south-western end of XF1	Seepage drain on south side of XF1
8	A depression in the north-western part of XE4	Seepage drain on north side of XE4
9	A drain cut along the southern ½ of the western side of XE4	Seepage drain on south side of XE4
10	A drain cut along the southern half of the western side of XC2 and connected to the existing drain along the western side of XC2S	Seepage drain on the south side of XC2S

Figure 15-10: Locations of discharge points for drained ponds

Figure 15-11: Location of the drain works between Smith Creek and XC3

Short term (now to mid 2017) management of acid sulfate risk – improve drainage to limit how long runoff collects in this area and to limit the time available for that water to infiltrate to the layer that forms pockets of acidic soil and become sources of acidic lateral seepage.

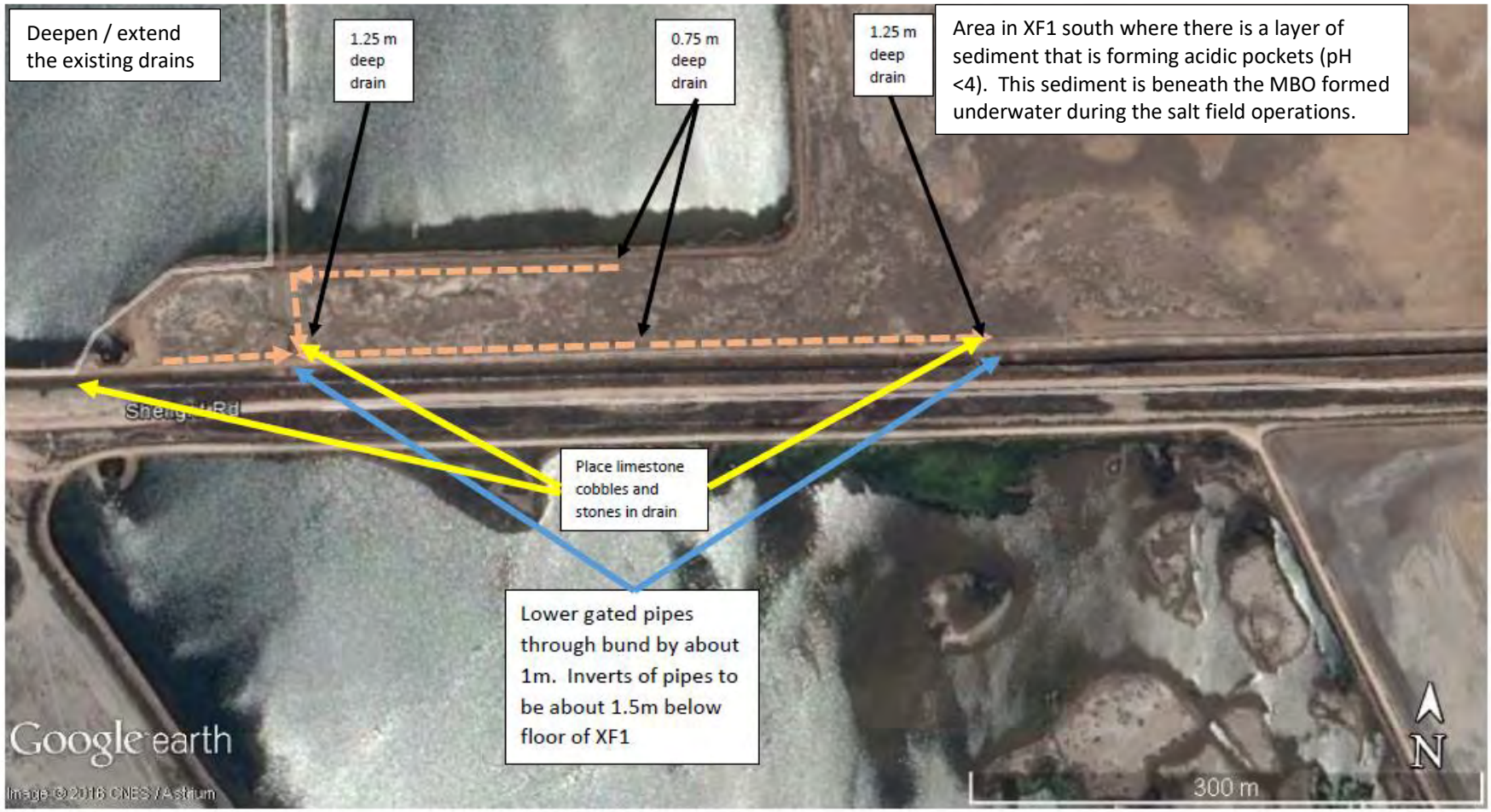


Figure 15-12: Scope of further drainage measures (1)

Figure 15-13: Scope of further drainage measures (2)

Holding Pattern Management and Monitoring for Sections 2 to 4

The routine Holding Pattern management and monitoring tasks are shown in Table 15-1 below. The monitoring and management of trials is in addition to these tasks. The purposes of the management and monitoring tasks are to:

- control the Holding Pattern so that its environmental outcomes comply with the requirements of this PEPR / MOP
- provide the data needed to report and communicate progress with the Holding Pattern operations, and any issues arising
- investigate non-compliance matters if they arise
- provide data for compliance reporting.

Table 15-1: Routine Holding Pattern management and monitoring tasks

Holding Pattern Management Task	Where and When
1. Maximise the discharge to SA Water outfall while keeping 6 hr average salinity at Site 1A/ 3 below 45 ppt.	▪ Controls for PA5 pump, drawing on monitoring of SA Water Outfall flows, PA5 salinity and water levels, PA5 discharge flows, salinities at the Bridge, Weir 2, Site 1a and Site 3.
2. Monitor pond SG, water level each 2 weeks in period April to September.	▪ Section 2: PA3; PA5 ▪ Section 3: XA1; XA3; XA4; XA7; XB3; XB4-5; XB6; XB8A; XC3; XD1 ▪ Section 4: XE1-3; XE5; XE6.
3. Monitor pond SG, water level each 1 week in period October to March.	
4. Monitor pond DO, pH, temp, each 2 weeks.	
5. Environmental observations to produce land condition reports and photos for drained ponds each 4 weeks in period April to September.	Fixed Locations: ▪ XF1 N end; XF1 S end ▪ XF2 NE corner; XF2 SE corner ▪ XE4 NE corner; XE4 SE corner ▪ XC1 NE corner; XC1 SE corner ▪ XC2 NE corner; XC2 SE corner; XC2 ENE corner; XC2 ESE corner; XC2 SSE corner; XC2 SSW corner.
6. Environmental observations to produce land condition reports and photos for drained ponds each 2 weeks in period October to March.	
7. Daily environmental observations to produce land condition reports and photos for selected **targeted** dust prone areas in drained ponds **only** during windy and hot weather (when dust forecast to be likely). Purpose is to collect evidence to use in event of a complaint.	▪ XC2E opposite the capsicum greenhouses ▪ XC2 mid length of E side ▪ other locations as needed.
8. Investigate and close out odour and dust complaints.	▪ Where and when needed.
9. Monthly cleaning and check calibration of sensors at Bridge; Weir 2, Site 1A, Site 3.	▪ As often as tide and wind conditions permit which will on average be monthly.
10. Monthly cleaning and check calibration of sensors at Site 4, Site 5, XE6.	
11. No less frequently than quarterly cleaning and check calibration of sensors at PA5 (salinity and flow).	
12. Repairs and maintenance of sensors , rafts, cables and telemetry systems.	▪ Where and when needed, using Tayton Controls and Hydroterra as required.
13. Maintain the operability of the PA5 pump; the Chapman Creek pumps; the Middle Beach pumps.	
14. Monthly recording of pH of water leaving ponds into seepage drains.	▪ XC2 SSW corner ▪ XF1 N ▪ XF2 N (x2)

Holding Pattern Management Task	Where and When
	▪ XF1 S (x2) ▪ XE4 NE corner ▪ XE4 SW corner.
15. Repairs as needed of bunds (esp. sea walls) to maintain safety.	
16. As directed improvements to drainage of drained ponds.	▪ Current needs are XF1 S to help prevent soil acidity deteriorating
17. Maintain inundated pond water levels within historic ranges.	
18. Maximise flow between XE1-3, and XE6 to keep salinity in XE6 as low as is practical.	Do this by: ▪ keeping XE1-3 full ▪ keeping XE6 level between 2 and 2.1 m AHD; ▪ discharging into Gawler River as much as possible, allowing for need to pump into XE7 / XD1.
19. Keep XB3 full and flowing through to XB8.	Do this by: ▪ pumping from Chapmans Creek.
20. Allow flows from Smith Creek into XC3 when water levels permit.	
21. Conduct annual diver inspection of syphons and remove weed / obstructions to flow as necessary.	
22. As directed by NJW adjust flows in the different flow paths in Section 3.	
23. Keep updated the Ipad environmental monitoring and reporting data sent to DataStream.	▪ water quality (DO, pH, specific gravity, temperature) and water levels in the flooded ponds. ▪ observations and monitoring of the defined locations along the site boundaries (photos, odours, dusts, pooled water discoloration / turbidity, soil discoloration, land condition). ▪ observations and monitoring of selected, defined locations in drained ponds and the adjacent seepage drains (photos, odours, dusts, pooled water (pH, dissolved oxygen, temperature, specific gravity, discoloration / turbidity), soil discoloration, land condition).
24. A programme of investigations of ASS and MBO hazards in the above listed drained ponds: a) Section 4 - Ponds XF1, XF2 and XE4. These investigations have occurred. b) Section 2: These investigations have occurred. c) Section 3 – Ponds XD1, XC1, XC2, XC2S, XC3, and XA7. The scoping stage of investigations has occurred. Further investigations to depend on closure land uses.	
25. A programme of bird monitoring.	This occurs for all inundated ponds, and also takes account of birds observed in ephemeral pools in drained ponds. It takes place annually during the migratory bird season.
26. A programme of vegetation monitoring.	Annually in all drained ponds (as a check on native revegetation) and around the external perimeters of the drained and undrained ponds (where impacts from the ponds on native vegetation are potentially possible).

Trial of Discharges to the Gawler River from Pond XE6

In September 2014, BDC submitted a Change of Process application to enable better management of salinity in ponds during summer months. Included in the operations contained in that application was a trial, with DSD / EPA oversight, of discharges to the Gawler River from Pond XE6. The conduct of that trial was endorsed and it has been in progress since December 2014. It is currently envisaged that the trial may reach completion – subject to review and discussion of its outcomes with DSD/EPA – by mid 2017.

The purpose of the trial is to:

- confirm the feasibility of managing discharges from XE6 into the Gawler River in different seasons
- define the operational procedures and compliance criteria and monitoring regime for that discharge.

Should the trial be successful, BDC will seek the required regulatory approvals from the EPA, PIRSA and / or the NRM Board.

The operation of the existing discharge point is illustrated below in Figure 15-14 and Figure 15-15.

The trial entails:

- controlled discharges via gated pipes into the eastern seepage drain beside XE6, from which water flows into the Gawler River immediately below the dam to Buckland Lake
- monitoring of ecology and salinity in the Gawler River by EPA
- monitoring of ecology and salinity in Chapman Creek by EPA (this Creek provides a reference site without discharge from the salt field)
- trial of a pulsed discharge control procedure developed in discussions between EPA and BDC
- trial of continuous discharge once the salinity of the discharge appears to reduce to or below the seasonal background salinity (without discharge) in the Gawler River
- monitoring of salinity at 10 minute intervals in the Gawler River near the downstream Mining Lease boundary
- monitoring of salinity at 1 minute intervals in XE6
- regular provision of monitoring data to DSD and EPA via updates to the BDC_Regulators DataStream Site and via graphs and spreadsheets of data sent by email and uploaded to the Onehub STAG Documents folder
- meetings with EPA to review results obtained and to adjust operational procedures under trial.

The trial to date has shown that:

- the agreed procedure for discharges has worked well.
- in relation to discharges into the Gawler River (see Figure 15-16 below):
  - the peak summer salinity in XE6 reduced from a peak of about 78 ppt in the summer of 2014 / 2015 to a peak of about 64 ppt in summer of 2015 / 2016
  - the winter salinity in XE6 is now in the range 30 to 45 ppt, lower than the historical operation a salinity of between 50 and 55 ppt (Specific Gravity about 1.037 to 1.041).
- there is seasonal variation in the background salinity (absent discharge from XE6) in the Gawler River near the discharge location, with winter salinities (absent the influence of discharges from Buckland Lake) in the order of 45 ppt, and the peak summer salinity being in the order of 58 ppt – reached in early March
- by reducing the salinity in XE6, discharges to the Gawler River can be made while keeping salinity in the River within its seasonal ranges of variation
- by reducing the salinity of water pumped from XE6 into Section 3, discharges into the Gawler River have helped substantially with the task of managing summer water salinities in Section3, to the benefit of the bird habitats there.

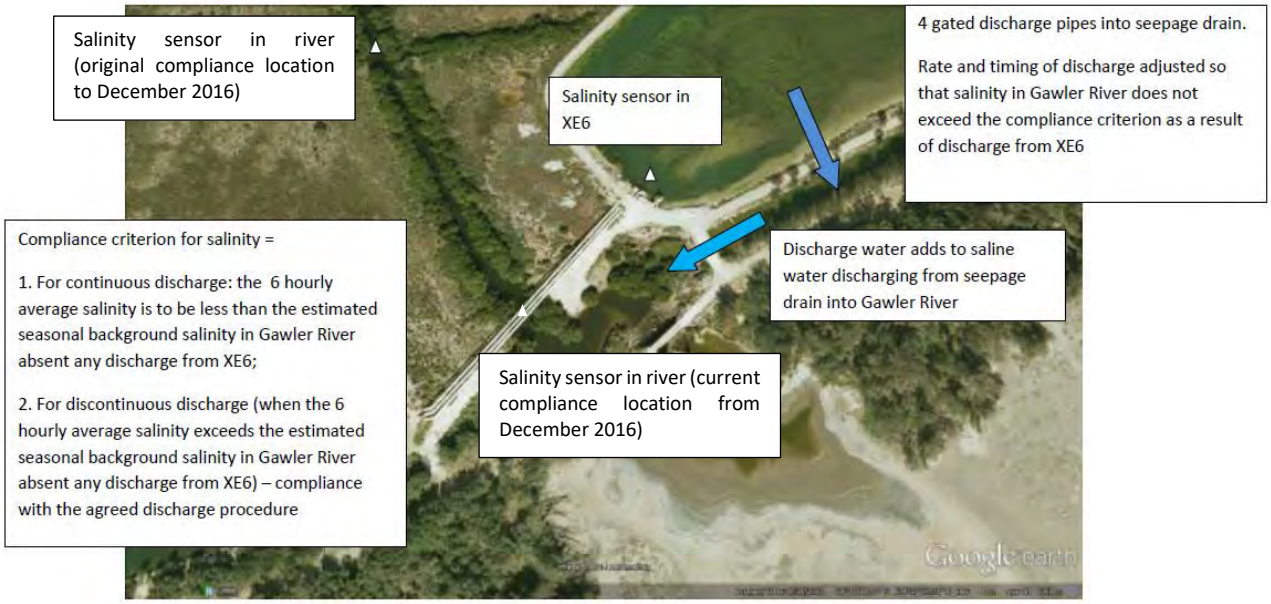


Figure 15-14: Discharge arrangement

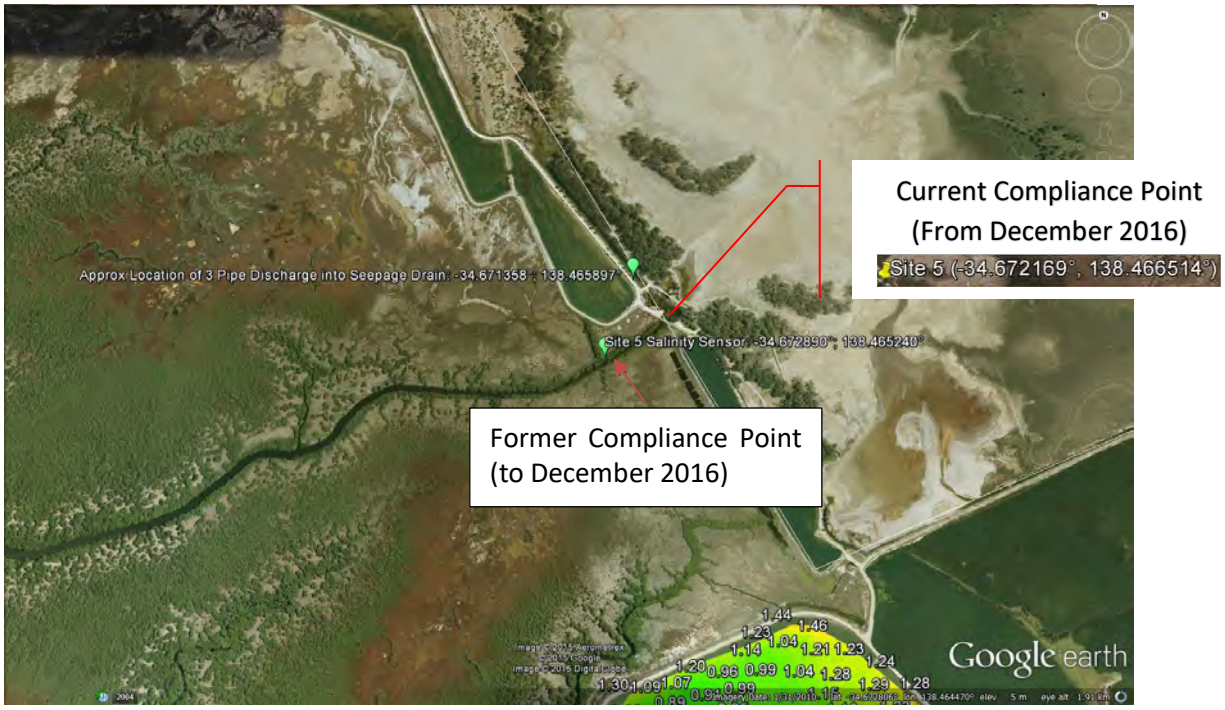


Figure 15-15: Locations of the discharge and the compliance point

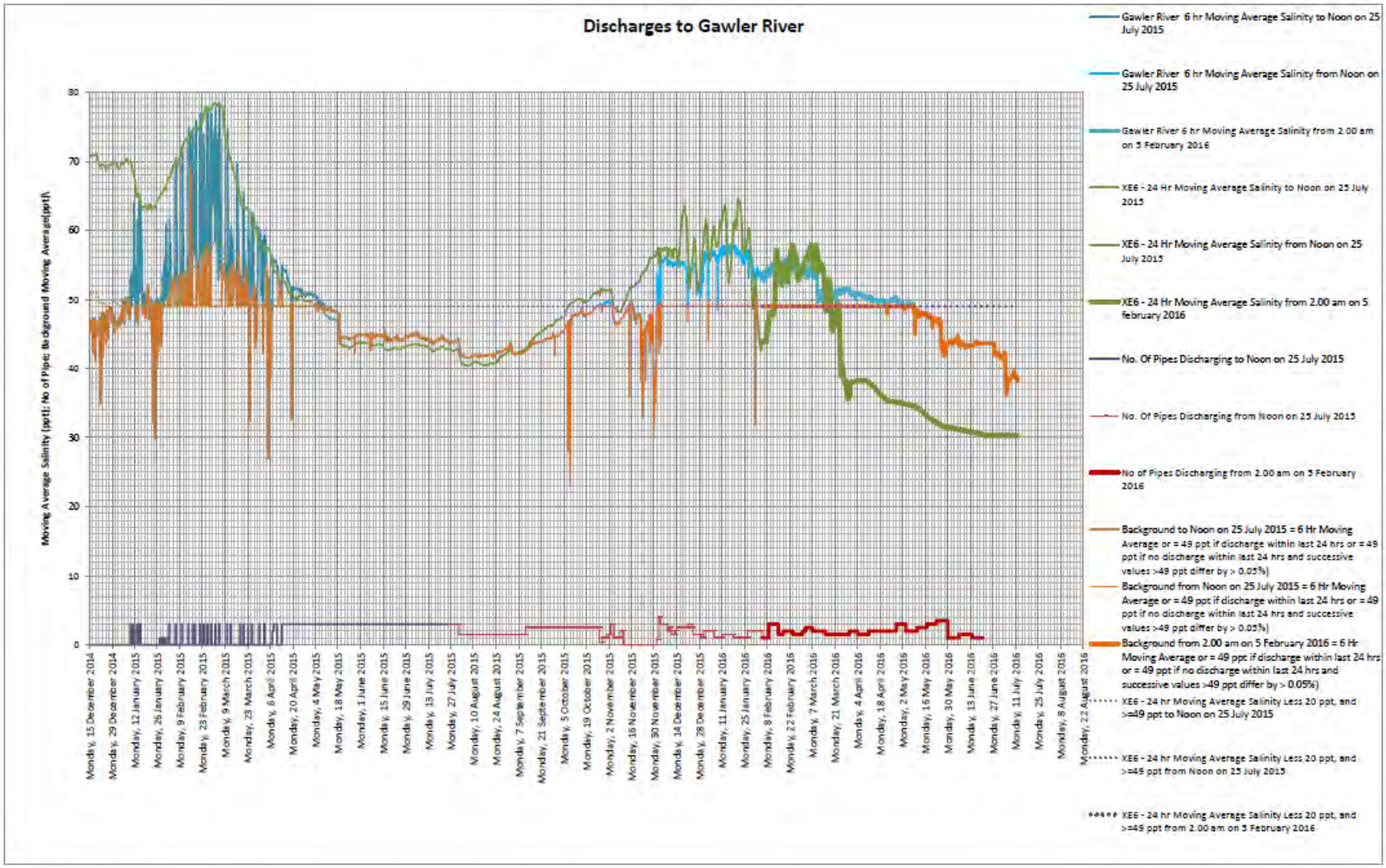


Figure 15-16: Salinities in XE6 and at the monitoring location in the Gawler River

15.3 Investigations and Design Studies for Closure Planning

The investigations and design for closure planning are intended to inform closure works to achieve mine completion. These works will be described in subsequent PEPR / MOP revisions. The scopes of investigation and design will unfold and be adapted in light of the information generated.

15.3.1 Section 1

This PEPR / MOP provides for the following trials to be conducted:

- discharge of diluted brine into the Brine Main within the site - for the specific purpose that it be conveyed outside the site and discharged on a trial basis into the Port River (EPA endorsed, with DSD knowledge, the trial discharge on 25 November 2015)
- discharge of diluted to North Arm Creek and to Dry Creek (DSD endorsed 26 October 2016, EPA Licence amended)
- Pilot Trial for filling of Section 1 with imported fill (DSD endorsed 29 June 2016);
- filling of F and G Row Pits with solid salt residues (DSD endorsed 9 August 2016).

Should a trial be successful, BDC will seek the required regulatory endorsement to enable the activity to continue. The endorsed activity will then come under this PEPR / MOP.

<u>Trial of Discharge of Brine to the Port River (Appendix 6).</u>

The Brine Main is the pipeline that was used to convey brine from the salt field to Penrice's factory at Osborne. The sections of Brine Main outside the mine tenements of Section 1 are not owned by BDC. It is understood that these sections belong to the owners of the land through which the Brine Main passes. The route of the pipeline and land ownership is detailed in Appendix 6.

The purpose of the trial was to test the feasibility of using the Brine Main to dispose 100 ppt salinity brine into the Port River. This brine will be the product of washing of salt for commercial sale, and from flushing to remove salt and brine from the crystallisers and pits in Section 1. It is estimated that between about 168,000 tonnes and 268,000 tonnes of salt may need disposal in waste brines.

The following approvals / endorsements were sought and obtained for this trial:

- Endorsement from DSD for the trial discharge of diluted brine into the Brine Main within the mine tenement;
- Agreement of owners of land outside the mine tenement and through which the Brine Main passed for the trial conveyance of diluted brine in the Brine Main;
- Approval of EPA for the trial discharge of the diluted brine from the Brine Main into the Port River; and
- Agreement of Flinders Ports for the establishment and trial use of a diluted brine discharge point for the Brine Main. This point was on the west side of the Port River.

A detailed description of operations and procedures for the trial was provided to DSD, and EPA in seeking approval / endorsement for the trial. This description (see Appendix 8) includes a time programme and criteria for its success. There was also correspondence and meetings with land owners and Flinders Ports in seeking their agreements.

There were two steps in the trial:

1. To test the ability of the Brine Main to convey the brine under operational pumping pressures without undue leaks. This test is required because the main's condition was not known, as a result of having lain idle since about 2012. The objective of the test was to identify if and where the main has leaks and assess the cost and feasibility of repair. If the cost and feasibility of repairs

are reasonable, then they would proceed. If not, the plan to re-use the Brine Main would be abandoned.

2. To check that the brine, after discharge to the Port River, is diluted sufficiently by the tidal flows in the River. Preliminary calculations suggest that the proposed discharge rates are small compared with the tidal flows in the River and that the proposed discharge at this concentration, if undertaken in a manner that results in good mixing with tidal flows in the River, should result on average in a 1% to 5% increase in salinity of the tidal flows.

The outcome of Step 1 was that the brine main exhibited leaks that appear not feasible to repair. If the trial had been successful, then further approvals would have been sought to allow the discharge of brine to occur over a period of a few years, to help remove salt from Section 1 and prepare the land for closure works. These further approvals sought would have included:

- Regulatory approvals including:
  - DSD endorsement of discharge of diluted brine into the Brine Main for the purposes of its conveyance and discharge into the Port River.
  - an amendment to the EPA Licence so that it includes this discharge point
- Approvals from the owners of the Brine Main outside Section 1, to permit the main's use for this purpose.

Discharge of diluted brine to North Arm Creek and to Dry Creek (Appendix 7).

As indicated above, this trial is required if use of the Brine Main to discharge brine to the Port River proves not to be feasible. The purpose of the trial is to:

- check the feasibility of this alternative mode of brine disposal and to develop operational procedures
- obtain information with which to assess risks from the discharge
- develop appropriate environmental outcomes for ongoing discharge of brine over the next few years.

The proposed locations for the trial discharges are at the relocated No 8 pump (for discharges to North Arm Creek) and the to-be-relocated E Row Flap (for discharges to Dry Creek) (see Figure 15-17). These pump and discharge points have been moved to accommodate the construction of the Northern Connector.

Evidence from monitoring of discharges from PA5 via the SA Water Outfall suggests that a compliance criterion for diluted brine of 45 ppt measured on a 6 hourly average is compatible with no significant or irreversible impacts to the receiving environment for that discharge. It is proposed that this will form the same initial criterion for this trial, measured at monitoring stations at the mouth of each creek.

If measurements indicated that higher concentrations could be discharged without exceeding 45 ppt (6 hourly average) at the mouths of the two creeks, then trials would be undertaken with salinity of discharge batches increased in steps. The purpose is to gather data with which to evaluate how to optimise the mass rate of salt discharge by this method, for different high tide levels and tidal ranges.

Figure 15-17: North Arm / Dry Creek diluted brine trial proposed discharge points

Monitoring will include the following:

- Salinity will be monitored in Torrens Reach between the two Creeks to confirm that salinity in Torrens Reach is not significantly impacted by the brine discharges.
- EPA will monitor impacts from this discharge on the Creek environments
- Procedures for discharge and the initial compliance criterion (45 ppt) will be adjusted in the light of this monitoring.

The trial will initially discharge brine into North Arm Creek only, using the relocated No 8 Pump. However, monitoring systems will be established for Dry Creek to enable collection of information about salinities and rates and durations of outgoing tidal flows. Once confidence has been gained about the control of these discharges and the mass rate of salt discharge (tonnes / month) that could be achieved via this route, the need to use Dry Creek will be reviewed.Further detail on the trial is in Appendix 9.

<u>Pilot Trial of Bulk Earthworks in Section 1 (Appendix 15).</u>

Section 1 of the Dry Creek Salt Field has been identified in Adelaide's 30 Year Plan for urban development. Information on the development of this land is in Part 4 of this PEPR / MOP. To trial and confirm the practicality and feasibility of processes to fill in the Private Mine part of Section 1, BDC is undertaking a pilot trial of the required bulk earthworks. A plan (See Appendix 15) for this pilot trial for land filling in Section 1 was endorsed by DSD on 26 June 2016.

The location of the trial is shown in Figure 15-18. The pilot trial will last approximately 6 months and be conducted:

- With environmental supervision by Mr N. Calabrese of Nicholas Calabrese & Partners
- With geotechnical supervision by Mr L. Sanders of Tonkin
- With oversight by an EPA accredited Auditor, Mr A. Hall of GHD.

This supervision and oversight have the purpose of ensuring that the trial complies with the PEPR / MOP and with relevant EPA and geotechnical engineering requirements.

The Pilot Trial will provide data with which to:

- check constructability
- check engineering performance
- check environmental performance
- provide evidence that would the support the detailed design and specifications for, and implementation of, broad scale bulk earthworks operations.

The initial conceptual design for the trial is shown in Figure 15-19. This will be refined as the trial proceeds.

Figure 15-18: Location of the pilot trial

Figure 1 Proposed Concept Trial Pad

The initial concepts for the fill profile are (from the bottom up):

1. The existing engineered floors of the crystallisers, and other man made ground (roads, bunds drains, final areas) from which as much salt and brine as practicable have been removed without serious damage to the floors themselves. It is expected that some small quantities of salt residues will remain scattered over these floors

2. A 0.3 to 0.5 m thick base layer of Calsilt, with a layer of rubble (from ARR) compressed into the top of this layer to provide a trafficable surface for heavy earthworks plant, or the rubble would be laid on the subgrade first and the Calsilt mix added to it during compaction.

   The trial pads will have two halves each with a different construction of this layer. In one the Calsilt will be spread on the ground before the rubble is embedded into it, in the other the rubble will be laid out and the Calsilt added to it.

3. A minimum 0.5 m thick drainage / capillary break layer constructed of 0.1 to 0.2 m suitably graded granular recycled concrete product from Adelaide Resource Recovery (ARR). The drainage layer will conduct water expressed from the underlying soil and water that has infiltrated through the overlying fill into the water bodies proposed to be constructed in the site. For this purpose the drainage layer will be thicker (deeper) along the lines of the existing open drains within Section1. The grading of this layer will be selected to avoid the need for a separate filter layer or geotextile.

4. A minimum1 m thick cover fill layer of sandy clayey soil (derived from natural soils).

We anticipate that all construction materials, except natural soils, will be sourced from Adelaide Resource Recovery (ARR).

Figure 15-19: Conceptual design for pilot trial of filling

Trial for the Filling of F and G Row Pits with Salt Residues (Appendix 8).

Significant quantities of salt residues will need to be suitably contained within the site. This includes crystalline salt that is either too impure to be commercially feasible to wash or is mixed with soil from the floors of the crystallisers, stacking bays and final areas in Section 1. Two possible containment sites are the pits at the north ends of F and G Row crystallisers (see **Error! Reference source not found.**).

Appendix 8 contains a plan for a staged trial for filling F and G Row pits with salt residues. That staged plan as described in Appendix 8 was endorsed by DSD on 9 August 2016 (DSD letter reference Mo: 6628.055, Rec No: 2016D005286) who advised: 'the staged filling trials will not result in any change to the approval environmental or closure outcomes and compliance criteria for the project'. Consequently, no further approval from DSD was required.

The staged plan sought and obtained authorisation only to conduct Stages 1, 2 and 3 of the trial (i.e. Preliminary Laboratory Characterisation of Salt/Soil, Field Trial in G Row Pit and PEPR / MOP Revision for Phase 2 of G Row Pit Trial and for F Row Pit Trial). Further authorisation will be sought if the trial proceeded to the F Row Pit Trial.

This use of these pits is compatible with the end vision for land uses in the area they occupy. The land occupied by the F and G Row pits is expected to be designated as Open Space in the revised Master Plan for Section 1.

Figure 15-20: F and G Row pits

Figure 15-21 below shows, for the purposes of planning the trial of filling in F and G Row pits, the present illustrative concept for the long term landform. In this concept:

- The present sea wall along the northern side of F and G Row pits would be demolished.
- A new sea wall would be constructed along the southern sides of the pits – and possibly be functionally integrated with an embankment that would carry a road linking Elder Smith Road to an interchange on the Northern Connector.
- Approximately 250,000 m^3 of salt residues will be placed in F Row Pit (up to AHD -2m) and approximately 110, 000 m^3 of salt residues in G Row Pit (up to AHD 3.7m).
- The land to the north of the new sea wall would become an integral part of the Dry Creek corridor. The lower part (over F Row pit) would be landscaped to provide an additional flow path for the Creek and width to accommodate peak water flows. This is envisaged to potentially reduce peak water levels in this part of Dry Creek which are presently constrained by the width of the channel between the existing sea walls. It is also envisaged that, outside tidal flow channels, ground levels of the constructed landform here would favour colonisation by mangroves and samphire, and salt bush. The land over G Row pit would be at higher elevations and rarely experience inundation. It would be landscaped with suitable shallow rooted grasses, and bushes.

Preliminary discussions with Salisbury Council (H Pitrans. pers. comm.) indicate that this form of land use would in-principle be acceptable to the Council.

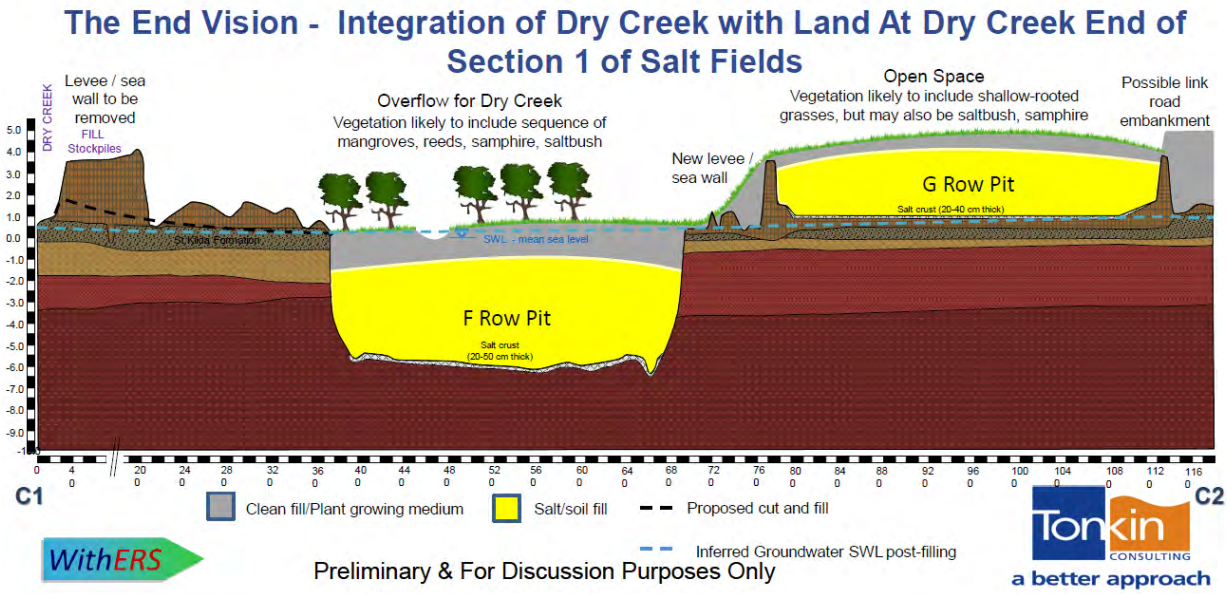


Figure 15-21: Illustrative concept for the long term landform

The objectives of the trial are to:

- understand the dissolution rate and longevity of salt attenuation
- quantify the concentration of salt in the leachate over time
- assess the potential for leachate to impact groundwater and Dry Creek
- quantify the potential settlement and impact post closure use
- complete the conceptual site model (CSM)
- understand the sensitivity of the design to external influences and over the longer term.

The trial will be done in stages to monitor and manage its risks:

- Stage 1: Preliminary laboratory characterisation of salt / soil (and reporting)
- Stage 2: Phase 1 of field trial in G Row pit (and reporting)
- Stage 3: PEPR / MOP revision for Phase 2 of G Row pit trial and for F Row pit trial
- Stage 4: Phase 2 of G Row pit trial and for F Row pit trial (and reporting)
- Stage 5: Preparation of revised PEPR / MOPs for the long term disposal of salt into F and G Row pits, and the 'mine closure' of these pits.

Between each of these Stages are 'hold points' with triggers that:

- require either adaptation of the design or / scope of the next Stage; or
- prevent the next Stage from proceeding.

The purpose of these 'hold points' is to enable both DSD and BDC to be satisfied that the environmental risks from each next Stage are acceptable. In addition, formal DSD approval of a further revised PEPR / MOPs will be required for Stage 4.

15.3.2 Section 2

In Section 2 the following investigations / trials are underway or envisaged:

1. The SA Water trial of denitrification of effluent from Port Adelaide sewage treatment.

2. Salisbury Council is considering the feasibility of using PA4 to PA6 (North 1/3 portion) for detention / treatment / discharge of stormwater from the land to the east including the Greater Edinburgh Park area at some future time. The timing, nature and scope of these possible investigations and trials are not known at this stage. These will be detailed in a future minor change or revision to this PEPR / MOP.

These investigations and trials relate directly to possible future land uses of the Ponds in Section 2. SA Water has indicated that, if its trials are successful, it will likely seek to take over the trial ponds, and convert the trial operations into permanent operations. This would provide a pathway to take the affected mine tenements to closure and completion. The same would apply to the ponds that are in Salisbury Council's considerations.

Should other potential land uses emerge for the ponds in Section 2, there may be a need for other investigations and trials. In that event further revisions to this PEPR / MOP may be required.

SA Water Trials (Appendix 9).

SA Water is using Ponds PA9 and PA10 to trial denitrification of water from its Port Adelaide sewage treatment plant). By agreement between SA Water and BDC, SA Water has responsibility for their trial's compliance with the PEPR / MOP, and for reporting on progress and outcomes from the trial.

SA Water is expanding the trial into PA8 and PA7A in Section 2 of the Dry Creek Salt Fields. This is the third stage of the trial aimed at determining if a large portion of Section 2 can be used in the future to enhance nutrient removal from the Bolivar High Salinity Plant (HSP) water.

A final report on the outcomes of Stage 2 is provided in Appendix 9. Key outcomes to date are listed below.

- Significant nutrient reduction has been occurring within the trial area.
- Salinity within the trial area has been successfully managed.
- Dissolution of the gypsum cap has been minimal, equilibrium was reached quickly after filling and results correlate closely with modelling performed by Water Quality Science.
- No evidence of interaction with local groundwater was found.
- No algal or odour issues developed over the trial period.
- Numerous bird species were observed utilising the pond.
- Minor, short lived presence of a salt tolerant midge species in the first few weeks of the second stage of the trial, probably from the presence of eggs in the sediment and the addition of water to encourage growth. The numbers dropped off within 3 weeks, with very little activity for the duration of Stage 2.

Infrastructure works to facilitate expansion of the trial into PA8 and PA7A have been completed by SA Water, in partnership with Buckland Dry Creek Pty Ltd:

- Repair of the bund along the northern boundary of PA8 as per the following criteria (see Figure 15-22).
  - length approximately 700 m, running in an east west direction across the northern end of PA8
  - cross section vertical height to level with existing bund walls, indicative average height of around 1m
  - cross section width of base 7 m
  - cross section width of top 4 m
  - south side of bund to be lined with 1 metre wide layer of plastic clay

- Installation of discharge pipelines (see Figure 15-23):

- two pipelines were installed to enable the transfer of water from the High Salinity Plant (HSP) pipeline into the salt pans. These pipes consist of 150mm HDPE and are located at two locations, one being into PA7A, and the second at the northern end of PA8. This is shown in Figure 2 (below). These have been installed as per the three existing pipelines that currently service the trial in PA9 and PA10.

Figure 15-22: Location of the proposed bund at the northern end of PA8

Figure 15-23: Location of the two proposed discharge pipelines

The main components of the expanded trial include:

- The trial will cover 124 hectares of salt pans as a result of this expansion.
- The expanded trial area will be filled with HSP water and evaporative losses will be replaced periodically.
- Evaporative losses expected to be in the order of 1.6GL/yr.
- A new monitoring plan has been developed that mirrors the endorsed Stage 2 plan
- Whilst a number of risks have been identified, no risk has a High ranking, and reliable mitigation strategies have been developed for each risk. These have successfully been employed during the first 2 stages of the trial.
- Criteria have been developed that will determine the success or otherwise of the trial. These are based on nitrogen removal and the lack of pest insects, odour etc. developing during the trial.
- The continuation or expansion of the trial will be contingent on Stage 3 reports that will be provided in Spring 2017.
- The next expansion will encapsulate PA7 and the majority of PA6. This will only occur if all stakeholders continue to support the trial.

15.3.3 Sections 3 and 4

Future land uses in Sections 3 and 4 are still under consideration. These sections divide into drained ponds (XC1, XC2, XC2S, XC2E, XE5, XF1, XF2), and inundated ponds (the others).

Changes from the Holding Pattern in the inundated ponds form part of a controlled action under the EPBC Act. These will need to be assessed and endorsed by the Commonwealth Department of the Environment and Energy (DEE). Discussions between the former Department of the Environment, DSD and BDC's predecessor (Ridley Corporation) agreed that the document to be submitted for that assessment and approval would be the PEPR / MoP that contained the closure actions for those ponds. This document would then have to be endorsed both by DSD and DEE.

Changes to the drained ponds do not come under the scope of the controlled action under the EPBC Act.

Table 15-3 lists the investigations / studies / trials that have been conducted and that are in contemplation for the purposes of facilitating closure and completion in Sections 3 and 4. In addition, DEWNR is undertaking a habitat manipulation trial in XB8A.

The DEWNR Trial at XB8A

This trial aims to explore the effectiveness of introducing tidal exchange into Pond XB8A for:

- Reducing the hyper-salinity and monosulfide hazard in Pond XB8A while minimising impacts on adjacent coastal ecosystems
- Improving sediment and water quality conditions to enable recolonisation by benthic invertebrates and native vegetation
- Restoring intertidal mudflat habitat that is utilised by migratory shorebirds.

The key purpose of the field trial will be to restore healthier (less saline, more oxic) sediment conditions in the pond (by reconnecting of the pond to regular tidal flushing with oxygen–rich fresh seawater and exposure to the atmosphere during lower tides. DWENR anticipates that MBO will oxidise in XB8A and precipitate as more stable forms that will minimise export of MBO and metals. Further, introducing aerobic conditions in ponds will promote organic nitrogen mineralisation forming nitrates and improving conditions in the pond and surrounding mangroves.

The expected outcome is that this trial will significantly reduce the overall sediment hazard in the pond. The trial is supposed to last 2 years to inform potential closure strategy.

The tidal restoration trial will be deemed successful if:

- the concentration of salt and monosulfides in the surface sediment layers of pond XB8A decreases significantly
- the water exported from the ponds has acceptable quality (within EPA guidelines),
- benthic invertebrate and terrestrial vegetation abundance and diversity is increased, and
- resident and migratory shorebirds utilise the intertidal mudflat habitat created by the trial.

The trial will involve:

- Isolating Pond XB8A from existing flow path
- Installing tidal gate and monitoring equipment -
  - the gate will be motorised and able to open and close to control water flow as required, including automatic closure in response to water quality triggers that are specified in the monitoring program (e.g. low dissolved oxygen or pH)
- Managing discharges from XB8A in pulses -
  - DEWNR believe the pulsed discharge strategy will create insignificant adverse effects on the current hypersaline creek system, with a view to improving the water and sediment quality once the tidal exchange is fully operational. The results from the current hypersaline creek system (outflow) shows little to no micro-invertebrate activity.
- Restoring tidal cycling in controlled stages

- Monitoring as described in Table 15-2:
  - The water monitoring program at includes a multi-parameter (conductivity, temperature, pH, dissolved oxygen, turbidity) sensor and data logger will be installed at the tidal gate for continuous (15 minute interval) measurement of incoming and outgoing water quality.
  - Water samples will be collected quarterly at 10 sites in pond XB8A and adjacent coastal ecosystem and analysed for turbidity, total suspended solids, electrical conductivity, pH, dissolved oxygen, redox potential, alkalinity, total, dissolved and colloidal metals (Al, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, V, Zn) and metalloid (As), and sulfate-S
- Trial oversight:
  - A project steering committee will be established with Buckland Dry Creek Ltd, DEWNR, AMLR NRM Board and other stakeholder representatives (including DSD). The steering committee will meet quarterly or more frequently if required. Project reporting will occur periodically to the STAG as required.
  - The STAG and Buckland Dry Creek Pty Ltd will be given access to real-time water quality and tidal flow information via an internet login as required.
- Controls on environmental outcomes:
  - The risk assessment (in Appendix 12) includes three levels of actions based in trigger levels, including stopping or discontinuing the trial is outgoing water quality does not meet the required targets.

Table 15-2: Monitoring program for DEWNR trial in XB8A

Monitoring Type	Method	Frequency
Water quality at tidal gate	Multi-parameter (salinity, pH, dissolved oxygen, turbidity, temperature) probe at tidal gate	Continuous
Water level, flow rate and direction at tidal gate	Pressure sensors either side of tidal gate, gauging to determine flow	Continuous
Water quality in pond and Pumping Creek	Field and laboratory measurements of various physico-chemical parameters	Before trial and quarterly after commencement and 5 event-based samplings over tidal cycles
Sediment quality in pond and Pumping Creek	Sediment cores and analysis of various physico-chemical parameters	Before trial and quarterly after commencement
Benthic invertebrates in pond and Pumping Creek	Sediment cores and identification to lowest taxonomic level	Before trial and quarterly after commencement
Seagrass extent offshore of Pumping Creek	Remote sensing – analysis of satellite imagery	Before and at end of trial
Terrestrial vegetation	Photo points and quadrats (when recolonisation observed)	To be determined based on observations

Further details on the trial are in Appendix 10. A detailed risk mitigation and adaptive management strategy has been included to enable pre-determined actions to be developed, planned and endorsed.

BDC has reviewed and accepted the DEWNR plan and procedures for the trial. BDC relies on DEWNR to implement that plan in accordance with its agreement with BDC. BDC proposes to provide oversight to check this occurs and to provide a report to DSD on conclusion of the trial that contains that the results of DEWNR's environmental monitoring and management and of BDC's oversight of this.

Table 15-3: Investigations, studies, trials in Sections 3 and 4

Issue	Investigations / studies / trials	Rationale	Timing / Status (February 2017)
Topography/ bathymetry	A Joint Government and BDC funded program of investigations of: ▪ bathymetric / bottom sediment profile of inundated ponds ▪ topographic investigations and collection of Lidar data of drained ponds The objective is to form an integrated digital elevation model of the land surface levels at the site.	▪ Design drainage works so that inundated ponds are maintained at target levels and unacceptable ponding does not occur in drained ponds. ▪ Inform ASS investigation scoping for inundated ponds in Sections 3 and 4. ▪ Inform the design of the water management regime for closure for the proposed migratory bird conservation area in Section 3 (and possibly Section 4).	Investigations of drained ponds in Section 1 to 4 are complete and reported.
ASS/MBO	Joint Government and BDC funded Investigation of acid sulfate soil and MBO conditions across the salt fields to: ▪ form maps and cross-sections related to land surface levels ▪ develop appropriate targeted risk monitoring and management measures for the various acid sulfate soil and MBO conditions ▪ design and monitor drainage improvements to reduce ponding of water in drained ponds caused by rainfall and / or groundwater seepage – and needed to prevent / mitigate soil acidity risks and odour risks. The field work involves soil sampling by test pit and boring; and installation and monitoring of groundwater wells.	▪ Obtain data on soil conditions and ASS/MBO properties and risks, and to address uncertainties. ▪ Quantify spatial variations of ASS subtypes. ▪ Identify hazards and impacts of ASS to underpin sustainable management options. ▪ Determine the potential, available and retained acidity to support current drying actions.	Reports for Drained Ponds in Sections 2 and 4 are complete. Monitoring of the consequences of draining XF1 is in progress, and have been reported. Depending on future land uses, further ASS / MBO investigations may be needed. Should further ponds (or parts thereof) need to be drained, there may be a need for monitoring of the consequences for ASS conditions.
Odours / dust	Observational monitoring of odours and dust formation using site staff and an offsite 'dust and odour panel'. Trials of dust prevention / mitigation measures ▪ Construction of an earthen wind break along XC2's eastern edge ▪ Spreading of mag brine to form a crust in part of XC2 ▪ Water spraying using water drawn from shallow groundwater beneath dust prone ponds.	▪ Identify where there are areas within the site that are prone to dust emissions or prone to odour emissions. ▪ Inform the design of odour and dust monitoring programs for closure works. ▪ Trial the feasibility of methods of dust prevention / mitigation.	A dust and odour panel of residents adjacent to the site has been formed and provides feedback on a monthly basis through summer months (or more frequently if desired). This supplements the qualitative observations made within the site by BDC on a daily / weekly basis. The earthen wind break was constructed and has been successful at reducing aerial transport of dust from XC2.

Issue	Investigations / studies / trials	Rationale	Timing / Status (February 2017)
			The spreading of mag brine did succeed in crusting the soil surface and reducing dust emissions from the treated area. The longevity of the crust is not yet known. It is possible further treatments may be needed. Concepts for a trial of the water spraying have been prepared.
Migratory birds	Bird Monitoring ▪ Bird surveys by pond, including roosting versus foraging and the location and habitat characteristics of roosting sites ▪ Invertebrate sampling in the three broad salinity classes in ponds that support good numbers of foraging birds ▪ Bird foraging behavioural observations to infer choice of prey. A DEWNR trial of the feasibility and impacts of a tidal water regime being introduced to Pond XB8A (See Appendix 10). An investigation of the feasibility of manipulating water levels using a pumped water management regime in inundated ponds to mitigate the loss of migratory and resident bird habitat including testing technical feasibility and to inform the assessment of operation and maintenance costs (See Appendix 11).	▪ Provide information to satisfy EPBC Act assessment and approval of any 'Controlled Action' within the scope of mine closure works to achieve mine completion. ▪ Identify the relationship between bird usage and pond morphology, salinity and water levels. ▪ Investigate options for mitigating potential loss of migratory and resident bird habitat from future land uses of the presently inundated ponds. This in addition to monitoring the impacts of the Holding Pattern to inform adaptive management of impacts.	Bird surveys have been conducted for 2013 / 2014, 2014 / 2015 and 2015 / 2016 migration seasons. There will be further bird surveys in the 2016 / 2017 migration season. The updating of reports from the surveys to date is in progress.
Infrastructure management	Investigation and design of necessary infrastructure decommissioning and removal works.	All infrastructure must be removed for mine completion except for those items that are needed for future land uses or that DSD agrees can be retained.	Not yet started.
Vegetation	Vegetation mapping and targeted survey for Bead Samphire Assessment of salt marsh against EPBC listed Subtropical and Temperate Coastal Saltmarsh community. Vegetation mapping of revegetation in drained ponds.	▪ Identify ecological values that need to be considered in closure planning. ▪ Confirm relevant matters that need to be considered under the EPBC Act. ▪ Identify areas where revegetation is proceeding	The initial mapping (2014) has been completed and reported. Aerial monitoring has been done in 2015 to provide evidence of changes since 2014. The work has been reported. A further round of this monitoring has been done (October 2016) to assess changes in

Issue	Investigations / studies / trials	Rationale	Timing / Status (February 2017)
		well, moderately well, poorly or not all. ▪ Inform decisions about where closure works need to accommodate or address this progress.	revegetation and to assess the merits of annual monitoring.
Land Management	The design, conduct and monitoring of trials of soil improvements and revegetation approaches. Initial preliminary trials in 2014 to early 2015 involved: ▪ ripping, ploughing and tilling of the surface in plots in XC2S to break up the gypsum's structure and create a suitable surface for seed germination, including using an excavator to break up gypsum blocks ▪ ploughing and harrowing treatments in XC2 to facilitate seed retention and salt leaching ▪ ploughing with the addition of calsilt or shell-grit in XE4 ▪ other trials involving minor earthworks, or re-vegetation works as found necessary from time to time. Future trials could entail improving soil capability by ▪ use of calsilt alone ▪ use of calsilt mixed with other soils and / or with mulch.	▪ Improve land capability in drained ponds for closure ▪ Inform design of revegetation measures for closure.	The initial rounds of trials were completed by early 2015 and showed limited success, probably due to high retained soil salinity at that time. Further trials are in the concept design stage

16 Environmental Assessment and Outcomes

16.1 Approach to Impact and Risk Assessment and Management

The approach taken to impact and risk assessment is consistent with that prescribed in the Ministerial Determination 005. This approach also meets the requirements for a mine operation plan in Reg. 80 of the Mining Regulations. Reg. 80 requires the development of objectives, whereas Ministerial Determination 005 requires proposed outcomes for each environmental component. To avoid confusion, and recognising the integrated nature of the salt field operation, the term 'outcomes' is used in this chapter to apply to environmental objectives, identified in accordance with Regulation 80.

A distinction is made between:

- Events that are planned to occur as part of the project design. An impact assessment considers the expected consequence of such events.
- Events that are not planned but that may occur. These are considered through a risk assessment and reflect either the uncertainties in impact assessment or the potential failure of control and management strategies.

Impact and risk assessment were undertaken jointly. The process identified:

- the existing environment and the views of any affected partiers
- any applicable legislation and standards that must be met for an environmental component
- actual or potential environmental impact events that could occur as a consequence of the activities in this PEPR / MOP. The impact event analysis considered:
  - the source of the impact event
  - the pathway through which a receptor could be impacted
  - the key environmental receptors that could be impacted by the event (an environmental receptor was only considered if it had a recognised environmental value)
  - whether the source, pathway and receptor are all present
  - the factors that limit the impact
  - the control and management strategies that are being or will be employed by BDC
  - the significance of the impact (from table xx), taking into account the proposed strategies.
- limitations in the impact assessment, uncertainties or unplanned events that could result in a higher impact than expected. This includes any uncertainties relating to the effectiveness of the control and management strategies
- the risk associated with a higher than expected impact
- whether a potential or actual impact event requires an outcome to be specified
- the environmental outcomes that BDC proposes to achieve, taking into account stakeholder views and legislation and standards
- the criteria proposed to be used to measure whether the proposed outcome will be met.

An outcome has been proposed for all potential and actual impact events if an environmental receptor is reasonably expected to be impacted by a source.

A full overview of the impact and risk assessment is in Appendix 12. The impact event IDs shown in the impact and risk tables below for each environmental aspect refer to those designated in Appendix 12.

16.2 Rating of Impacts and Risk

Risk assessment considers the likelihood and consequence of an event. As impact assessment considers events that will occur, only an assessment of consequence is required. Consequences of potential or actual impact events are rated as shown in Table 16-1. Table 16-2 shows how likelihoods of risks are rated and risks determined.

Table 16-1: Impact / consequence criteria

Area	Component	Consequence Descriptor				
		Negligible	**Low**	**Moderate**	**High**	**Severe**
Environment	Ecosystem function (terrestrial, aquatic, marine)	Alterations to ecosystem interactions in the localised area not detectable. No conservation or remedial measures necessary	Minor alterations to ecosystem interactions in the localised area are detectable. No conservation or remedial measures necessary	Moderate alterations to ecosystem interactions in the localised area are detectable Effective conservation or remedial measures necessary for a period of 1 to 5 years	Major alterations to ecosystem interactions in the localised area are detectable. Effective conservation or remedial measures necessary for a period of 5 to 10 years	Major alterations to ecosystem interactions in the localised area are detectable and may not be reversible. Effective conservation or remedial measures, if feasible, necessary for a period of at least 10 years
	Flora and fauna communities and species	Loss in numbers of individuals not apparent and no reduction in localised population viability. No conservation or remedial measures necessary	Minor loss in numbers of individuals apparent but no reduction in localised or regional population viability. No conservation or remedial measures necessary.	Moderate loss in numbers of individuals and apparent and minor reduction in localised or regional population viability. Effective conservation or remedial measures necessary for a period of 1 to 5 years	Major loss in numbers of individuals and apparent and major reduction in localised or regional population viability. Effective conservation or remedial measures necessary for a period of 5 to 10 years	Extreme loss in numbers of individuals apparent and impact on localised or regional population viability may not be recoverable. Effective conservation or remedial measures, if feasible, necessary for a period of at least 10 years
	Surface water and ground water quality	Concentrations of chemicals of interest and aesthetic properties within natural variability, impacts unlikely to be detectable. No preventive or remedial measures necessary	Minor excursions of concentrations of chemicals of interest and aesthetic properties outside natural variability may be detectable in a localised or regional area but are short term in nature and require no or minimal preventive or remedial measures that can be completed in < 1 year.	Moderate excursions of concentrations of chemicals of interest and aesthetic properties outside natural variability are detectable in a localised or regional area and are medium term in nature and require moderate preventive or remedial measures that can be completed in 1 to 5 years.	Major excursions of concentrations of chemicals of interest and aesthetic properties outside natural variability are detectable in a localised or regional area and are long term in nature and require extensive preventive or remedial measures that have to be sustained for 5 to 10 years.	Extreme excursions of concentrations of chemicals of interest and aesthetic properties outside natural variability are detectable in a localised or regional area and are long term in nature and require extensive, complex and permanent (> 10 years) preventive or remedial measures
	Air quality					
	Soil quality (contamination, salinity and acid sulfate)					

Area	Component	Consequence Descriptor				
		Negligible	**Low**	**Moderate**	**High**	**Severe**
Engineering	Weather and climate change impacts on engineered systems and structures	Temporary and localised impacts, no or minimal preventive measures or repair / restoration required to sustain functional performance	Short term impacts within localised or regional area, limited preventive measures or repair / restoration required to sustain functional performance	Medium term impacts within localised or regional area, moderate preventive measures or repair / restoration required to sustain functional performance	Long term impacts within localised or regional area, extensive preventive measures or repair / restoration required to sustain functional performance	Catastrophic impacts within localised or regional area, preventive or repair / restoration neither feasible nor practicable
	Geotechnical function (total and differential settlements of structures, stability, bearing capacity)					
Social	Physical amenity (e.g., air, noise, water, visual)	Temporary or no-detectable impacts on amenity. No preventive or remedial measures needed to restore / improve amenity	Short term and minor impacts on amenity. Minor preventive or remedial measures needed for < 1 year to restore / improve amenity	Short term impacts. Limited measures required over a short time period to restore attitudes	Long term and major impacts on amenity. Major preventive or remedial measures needed for 5 to 10 years to restore / improve amenity	Permanent and extreme impacts on amenity. extensive and complex scope and permanent (> 10 years) needed to restore / improve amenity
	Land use amenity (residential, recreational, commercial / industrial, educational, conservation)					
	Stakeholder attitudes	No measurable impact	Short term (days to weeks) limited scale impacts. Limited measures required over a short time period (days to weeks) to restore attitudes	Medium term (weeks to a month) moderate impacts. Extensive measures required over a longer time (weeks to a month) period to restore attitudes	Longer term (months) significant impacts. More extensive measures required over a longer time (months) period to restore attitudes	Permanent or very long term impacts. Very extensive measures required over an extended period to restore attitudes, if attitudes are at all recoverable
	Heritage sites (Aboriginal, historical, maritime)	No measurable impact	Detectable impact only on sites of low significance and without significant impact on heritage values	Detectable impact only on sites of low to moderate significance and with minor and partial impact on heritage values	Detectable impact on sites of moderate to high significance and with major an partial impact on heritage values	Detectable impact on sites of high significance and with complete loss of heritage values

Table 16-2: Risk evaluation matrix with likelihood criteria

		Consequence					
		Negligible	Low	Moderate	High	Severe	Likelihood Description
Likelihood	Almost certain	Negligible	Low	High	Severe	Severe	It is very probable that the risk event could occur in any year
	Likely	Negligible	Low	Moderate	High	Severe	It is more probable than not that the risk event could occur in any year
	Probable	Negligible	Low	Moderate	High	High	It is equally probable that the risk event could or could not occur in any year
	Unlikely	Negligible	Negligible	Low	Moderate	High	It is less probable than not that the risk event could occur in any year
	Rare	Negligible	Negligible	Negligible	Low	Low	It is improbable that the risk event could occur in any year. The risk event is only theoretically possible, or would require exceptional circumstances to occur.

16.3 Air Quality Impacts

16.3.1 Assessment Methodology

Information in this chapter is based on:

- identification of sensitive receptors around the salt fields
- identification of sources of dust and odour in the salt fields and surrounding area
- analysis of meteorological data, including preparation of windroses, and identification of critical wind patterns for odour and dust generation, dispersion and potential impacts
- site and operational experience at the salt fields, including the complaints register.

16.3.2 Sources

Sources of dust include:

- exposed pond surfaces in drained ponds with silty sandy soils that are not vegetated
- exposed ground surfaces in XB8A during the DEWNR trial
- travel on dirt roads in the salt fields
- historically, pan preparation in the crystallising area which caused production of dust loads similar to that produced by horticultural field preparation, during a limited period (late Spring time)
- historically, dust from stockpiling of calsilt in the crystallising area (although only in ambient drought conditions)
- stockpiling of calsilt in Pond XC2E
- loading, haulage, placement and compaction of calsilt and rubble for the fill trial in Section 1.

Sources of odour include:

- pooling of rainwater becoming anaerobic leading to mixed odours from eutrophication processes and from hydrogen sulphide production
- organic matter within the site decaying in anaerobic conditions. This can occur where pockets of organic material accumulate, and where aquatic vegetation and fauna are left stranded when ponds are dried out
- algae blooms from *Synechococcus* and other species (e.g. dried ponds XE2 and XE2S)
- hydrogen sulphide evolution from exposure of acid sulfate soils (ASS) and monosulfidic black ooze(MBO) or dust from ASS.

16.3.3 Pathways

The pathway for dust, odour and foam impacts is provided by wind moving the air offsite. For odour, low wind speed conditions (typically less than 2.5 m/s) are particularly relevant as these present the conditions for poor dispersion of odour. For dust, high wind speeds are the most important. The critical wind speed for pickup of dust from surfaces is 5 m/s. Above 10m/s, pick-up increases rapidly.

The potential for impacts is greatest when onshore winds carry dust and odour towards neighbouring residents east of the salt fields. Onshore winds are more frequent in Summer and in the afternoons (sea breezes). Windroses for the Edinburgh RAAF Base are considered to be the most appropriate representation of wind characteristics that would carry dust towards sensitive neighbouring land uses (Figure 16-1). These show:

- a small frequency of low wind speeds (less than 2 m/s)
- a high frequency of wind speeds exceeding 5 m/s)
- prevailing wind directions are from the south-west and north-east
- winds from the west through to north quadrant are infrequent.

Odour impacts are most noticeable with very light wind conditions and stable atmospheric conditions, which can occur at night. Wind analysis shows that for most of the time, when conditions with the greatest potential for poor dilution and dispersion of odour occur, winds will be blowing towards the sea and away from local residents, with the exception of those at St Kilda and Middle Beach.

Dust impacts may occur when winds are moderate or stronger. Generally, this will occur with winds from the south-west or west.

Once emissions have occurred, only distance and weather conditions ameliorate / disperse concentrations of dust and odour. Dust formation is reduced by:

- formation of a desiccated crust
- deposition of salts as ponds drain and water evaporates from trenches / topographic depressions
- re-vegetation as plants colonise drained ponds.

Foam from inundated ponds only occurs in conditions of high wind.

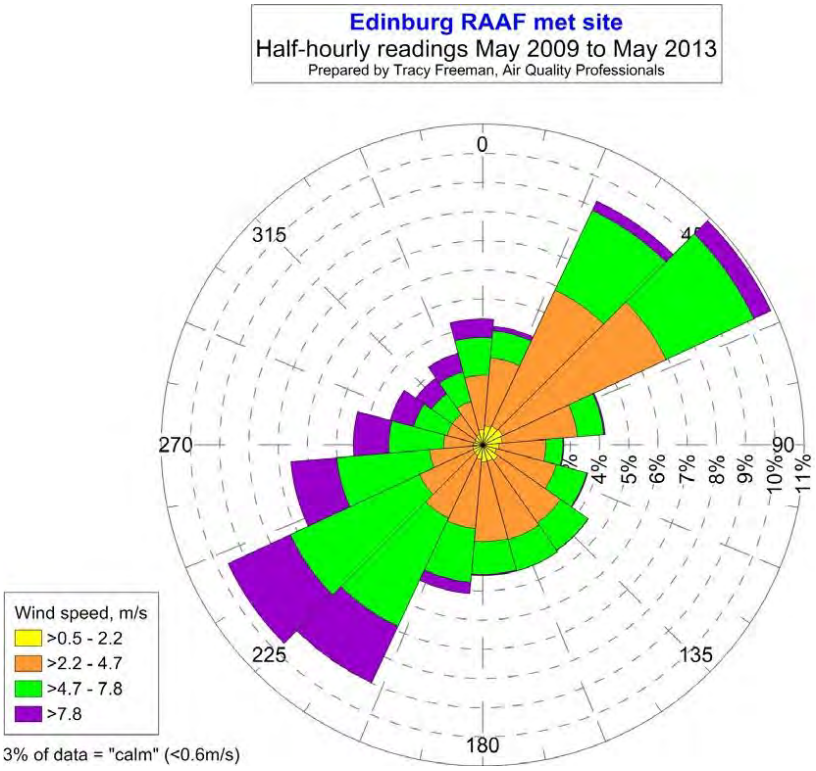


Figure 16-1Windrose for Edinburgh RAAF site

16.3.4 Receptors

As discussed in Part 2 of this PEPR / MOP, a range of residential, pastoral, conservation, horticultural, commercial and other land uses occur adjacent to the salt fields. Those most sensitive to dust and odour impacts include:

- residential suburbs and coastal townships (Globe Derby, Mawson Lakes, St Kilda, Middle Beach, Thompson Beach, Webb Beach and Port Parham). Housing at Globe Derby is as close as 100 m

to the crystallising area of the salt fields and the salinas. Residential development at St Kilda commences 50m from the salinas
- areas of conservation significance, including the Adelaide Dolphin Sanctuary (which extends partly over the salt field), Barker Inlet Aquatic Reserve, St Kilda-Chapman Aquatic Reserve, Port Gawler Conservation Park and Buckland Park Lake
- habitat for flora and fauna on, or adjoining, the salt fields.

The receptor most sensitive to foam is the heritage tramway along St Kilda Road.

16.3.5 Potential Impacts

Dust and odour impacts on receptors only occur when:
- a source of dust or odour exists on the salt field; and
- meteorological conditions are suitable for the transmission of dust or odour to a receptor (noting that conditions most likely to generate dust impacts are different to those that could result in odour impacts).

The need for this combination of factors means that, provided measures are taken to pro-actively manage odour and dust sources, any impacts are expected to be episodic and short-term (i.e. the weather conditions inductive to these impacts would not be likely to continue for an extended period).

Dust

Historically, salt field operations in the northern areas have not exceeded ambient dust loads. Dust impacts have created more concerns in the southern areas where ambient dust loads are lower. This has been caused by historic operations such as pan preparation and stockpiling of calsilt. With the cessation of these activities, these risks have been eliminated. While a stockpile of calsilt remains in Pond XC2E, this has an active dust management program. Dust suppression has historically only been required after an extensive dry period. The use of calsilt for remediation of ASS has the potential to generate dust, however as these soils are saturated and the calsilt is incorporated into these soils, this presents a minimal risk. Consequently, no impacts on receptors are expected from stockpiling or use of calsilt if dust management is maintained.

Due to dilution and dispersion, transmission of dust from ASS into the food chain is unlikely to present any significant risk (SA Health 2009).

The extensive area of the salt field is serviced by formed embankments. Travel in the salt field is limited to an upper speed of 40 km/hr and this serves to reduce dust emissions. The embankments are dressed with a coarse gravel to reduce dust emissions. The majority of the operation is travelled infrequently. Where tracks are travelled regularly they are treated with bitterns as a dust suppressant. Dust from vehicle operations is considered to have minimal impacts on neighbouring receptors.

An additional source of dust is from drying out of ponds. Where fine sand and silt sized particles exist at the soil surface in drained ponds, there is a risk that as these desiccate, they can be prone to wind erosion and dust formation under certain wind conditions. However, such potential sources are not ubiquitous, but occur in patches. The wind and weather conditions required for erosion and dust formation are episodic and not long lived.

Dust from exposed surfaces from the DEWNR trial in XB8A is expected to be negligible. Exposed areas will be subject to a regular exchange of tidal water in sufficient volumes to achieve wetting and drying of the pond surface. Water can be imported from XB8, if necessary, to wet the pond surface.

The trial bulk earthworks in Section 1 will produce minimal dust due to the scale of works and the geotechnical requirements. Fill material will need to be sufficiently moist to ensure acceptable compaction limiting dust generation. Water sprays will be employed where needed.

It is noted that in the St Kilda Section, the presence of gypsum provides a cap that is resistant to dust formation. In the Dry Creek Section, the ongoing decommissioning operations will manage dust risks under the site's existing management procedures. As a result, dust impacts from Sections 1 and 2 are expected to be minimal, and impacts will derive predominantly from Sections 3 and 4. Consequently, it is expected that residents to the north-east of the salt fields may experience short term (in the order of hours) episodic nuisance impacts from dust. This may be noticeable through deposits on surfaces, cars and washing.

The effects of dust deposition can be subjective and are dependent on the sensitivity of the receiving environment. Some people will not be annoyed by dust, others will be annoyed, and some may find it objectionable or offensive. Dust fallout on a road or rural farmland may not be a nuisance even at relatively high deposition rates.

The dust that will be entrained in the wind from the exposed pond surfaces will be comprised of a wide variety of size fractions. The larger deposited dust is material generally greater than 50 µm in diameter. It poses a nuisance potential due to soiling of surfaces and can cause irritation to eyes and nose. Because it is relatively large in size, deposited particulate usually falls out of the air within a short distance of the source (a few hundred metres).

The finer material is defined as suspended particulate. It is commonly referred to as Total Suspended Particulate or TSP. It is generally less than 20 µm and can travel large distances downwind. The portion of TSP that poses the greatest potential health effect is particulate less than 10 µm in diameter (known as PM_{10}) and particulate less than 2.5 µm (known as $PM_{2.5}$). PM_{10} is able to penetrate the upper respiratory tract and consequently has the potential to impact on public health. $PM_{2.5}$ can penetrate even further into the lung and is suspected of being the fraction of PM_{10} that is responsible for health impacts that can lead to an increase in morbidity and mortality in particular circumstances.

The major source of the finer particulates PM_{10} and $PM_{2.5}$ in the atmosphere is combustion processes, particularly for $PM_{2.5}$. The dust from wind erosion at the Dry Creek Salt Fields is likely to be predominantly made up of larger size fractions (greater than 10µm).

Health impacts from exposure to PM_{10} and $PM_{2.5}$ are related to exposure time. The NEPM specifies an exposure time for PM_{10} of 24-hours with five exceedances of the specified concentration permitted annually. Short term exposure to any PM_{10} that may be entrained in dust from the salt field during a wind event (say over a period of an hour or so) is unlikely to exceed the NEPM 24-hour average concentration standard and, if it does exceed that standard due to unusual and persistent high wind speeds, this would be a rare event that would fall within the permitted annual exceedances.

Finally, it is also noted that the meteorological events that may lead to elevated dust erosion and suspended dust concentrations from the salt field would also result in low background concentrations of fine particulate (e.g. from other sources such as power stations or urban vehicle traffic) at receptors, due to the required wind direction and also the wind speeds occurring at the time.

It is concluded that significant adverse effects on health are therefore unlikely as a result of dust emissions from the Dry Creek Salt Fields.

With time, the drained ponds should redevelop vegetation patterns similar to the mix of those observed in similar terrain north of the site. Experience on the salt fields to date suggest this might

take in the order of five years. Consequently, in the medium – long-term, dust formation from this site is expected to be similar to that from similar terrain to the north.

Dust may also impact adjoining areas of conservation significance and habitat for flora and fauna. Impacts could occur through smothering of habitat, impacts on water quality or dust entering the food chain. Given dust events are episodic and short-lived, and the extent of dilution and dispersion that occurs, such dust impacts are expected to be negligible.

Odour

Odour impacts may occur when water pools in trenches and depressions in the ponds for several weeks and becomes stagnant. This is controlled through regular inspections and management of drainage. In suitable meteorological conditions, short term impacts on the amenity of receptors may occur.

Odour impacts may also result from decay of organic matter within the site in anaerobic conditions. Not all organic matter will decay in this way. It is expected the majority will be spread thinly over the ground surface and decay in aerobic conditions. Anaerobic decay would be possible if and where pockets of organic matter accumulate. It is expected that decay (aerobic or anaerobic) would be largely complete within 12 months of ponds drying out.

Ponds with a lower salinity (i.e. closer to sea water) contain aquatic plants and fish. In the northern half of the Port Gawler and northern parts of the Middle Beach Sections, aquatic plants and fish are likely more prevalent than in the ponds further south. Before and during draining of the ponds, fish will be caught by netting in the body of the ponds and at the connections / gates between ponds. Nevertheless, small fish and marine life could be stranded by the draining of the ponds. Aquatic vegetation will also be stranded. The presence of partly decomposed aquatic vegetation (e.g., sea grasses, macroalgal mats etc.), and any remnants of partly decomposed vegetation from pre-salt fields days, could produce odours if draining the ponds changes the decomposition from aerobic towards anaerobic. The aerobic decomposition of 'fresh' aquatic vegetation may also generate some odours, but these are less likely to be pronounced and are unlikely to be distinguishable from normal background coastal odours.

The chemical composition of the odours can be diverse. H_2S and ammonia can be two signature components from anaerobic decomposition, although ammonia is normally only discernible close to the source, as its associated odour disperses quickly in ambient air. These odours should abate after a few weeks at their source. Odour impacts on surrounding residents, however, are expected to be short term and episodic due to the distance from houses and the low frequency of low wind speeds in stable atmospheric conditions that would carry odour towards houses.

Synechococcus is a blue-green algae that is known to occasionally bloom in the more saline ponds, such as XC-5. Blooms tend to occur following sudden reductions in salinity in a pond. The biomass created in the bloom may then die off when the salinity returns to normal levels, creating a large oxygen demand as the biomass decomposes and hence potentially anaerobic and odorous conditions.

Soils generating acid or MBO can also generate hydrogen sulphide (H_2S). If the affected material occupies a small area, the impacted air quality may only be noticeable at short distances from the source. If, however, a large area of soil is involved then impacts may be noticed downwind offsite. The potential for odour impacts from MBO and MBO impregnated soils, varies across the salt field:

- Impacts are not expected in Section 1 due to the present cover over MBO and the nature of the site operations.

- In Section 2 the gypsum cover and gypsum impregnation, and saturation form a permanently high water table, coupled with the acid buffering potential in other soils is expected to prevent any odour impact from the draining of the ponds. However, experience has shown that where rainwater can pond on the surface of the gypsum cap, it can reactivate biological activity from the MBO and this can lead to odour generation before the rainwater infiltrates away and / or evaporates. Appropriate drainage / water management coupled with revegetation to enhance evapotranspiration will minimise the risks. Investigations and planning of such measures are underway.

- In Sections 3 and 4, ponds that remain inundated present a negligible risk. In the ponds that will be drained, the odour potential from MBO and MBO impregnated soils is understood to be low if such soils remain drained and do not experience cycles of saturation and drying to significant depth. Experience (for example in Pond XC2S) has shown that if poor drainage retains rainwater, then odours can be generated as the rainwater evaporates and seeps slowly away. Where this can occur (e.g., in areas receiving shallow seepage, or subject to ponding from rainfall), measures to reduce the risk will be implemented. The measures will include enhancement of drainage (taking advantage of historic landscape drainage pathways wherever possible), encouraging revegetation as soon as soil salinity levels permit, and if cost-effective, soil amendment to reduce odour production. Where drainage enhancement measures have already been implemented they have proved effective. Soil amendment trials are underway.

- Odour from the DEWNR trial in XB8A is expected to be low. Tidal exchange will result in regular wetting and drying of exposed surfaces. This will not produce the odour impacts that can occur when dry soils are subject to heavy rain events with extended pooling of water.

Foam

Foam is considered to have a negligible impact on surrounding receptors. Historically, the only concern raised has come from the Tramway Museum. This has been addressed through the erection of shade cloth. Foam can potentially be a traffic hazard and rust vehicles.

Expected impacts on air quality are summarised in Table 16-3.

Table 16-3: Expected air quality impacts

Event ID	Impact Event	Expected Impact	Significance
A1	Dust from exposed ground surfaces affecting the amenity of adjoining human receptors	Short term episodic impacts	Low
A2	Dust from exposed ground surfaces affecting the health of adjoining human receptors	No measurable impact expected	Negligible
A3	Dust from ASS affecting health of adjoining human or ecological receptors	No measurable impact expected	Negligible
A4	Dust from exposed ground surfaces affecting adjoining areas of conservation significance	No measurable impact expected	Negligible
A5	Dust from calsilt stockpile in Pond XC2E affecting amenity of adjoining human receptors	No measurable impact expected	Negligible
A6	Odour from eutrophication of pooled rainfall water affecting the amenity of adjoining receptors	Short term episodic impacts	Low

Event ID	Impact Event	Expected Impact	Significance
A7	Odours from decay of organic material in anaerobic conditions affecting the amenity of adjoining receptors	Short term episodic impacts	Low
A8	Odour from exposed acid sulfate soils affecting the amenity of adjoining receptors	Short term episodic impacts	Low
A9	Odour from algal blooms affecting the amenity of adjoining receptors	Short term episodic impacts	Low
A10	Foam impacting on adjoining land uses	No measurable impact expected	Negligible
A11	Dust from trial bulk earthworks affecting the amenity of adjoining human receptors	No measureable impact expected	Negligible

16.3.6 Control and Management Strategies

The primary strategies for control and management of dust and odours entail:

- minimisation of the potential for dust entrainment through encouragement of revegetation of drained and dried areas of the site
- minimisation of the potential for odour generation through adaptive improvement of site drainage and of evapotranspiration from revegetation so that, where practicable, areas that are drained remain so i.e. do not pond water for such time as to cause odour problems
- maintenance of tidal exchange of water in XB8A during the DEWNR trial.

The improvement works on a site of this scale are guided by observation and identification of problems as they arise. Detailed topographic survey data is available to inform pro-active drainage improvements.

Indications of problematic areas will be provided by routine monitoring of the site and observations of:

- where revegetation seems slow or impeded
- where prolonged water ponding occurs following significant rainfall events
- wind blown soil movement that could represent a potential source of dust
- odours.

Where problems are identified, contingency measures will include:

- active treatment of areas by ripping, soil treatment and / or replanting to improve revegetation
- management of water levels in ponds
- drainage works to reduce any prolonged water ponding
- re-inundation of drying ponds, if necessary, to reduce dust and odour.

BDC has engaged Air Quality Professionals to assist with development and implementation of air quality monitoring to aid control and management of dust and odours. Planned air quality monitoring in accordance with the environmental outcomes and measurement criteria is set out below.

<u>Approach to air quality monitoring</u>

The scale of the site, the variability of soil and water conditions within the site (both temporally and spatially) and the variability of weather conditions precludes a fixed network of odour and dust

monitoring. Such a network would not be effective and would be inordinately expensive. BDC has therefore adopted a protocol for:

- Intensified monitoring via a tiered approach, that can be implemented if:
  - a significant odour or dust event occurs
  - baseline monitoring indicates that the potential for offsite impacts has increased
  - there is a need to investigate a complaint or a significant dust or odour event
  - there is a need to monitor the effectiveness of risk prevention or mitigation measures.
- Using the monitoring to identify areas that could form sources of significant offsite odours or dusts (if the weather conditions are or become conducive), and then triggering preventive or mitigation measures.

Purposes of air quality monitoring

The purposes of the monitoring program are to:

- quantify background levels of odour and dust
- provide quantifiable information for investigation of causes of complaints
- provide early warning of increasing odour and dust emissions
- track progress with correction of a problematic odour or dust event
- obtain information that can be used in communications and engagement with key stakeholders.

Wind monitoring

Wind monitoring uses data obtained retrospectively from the Bureau of Meteorology for the Edinburgh station, as a proxy for site wind data. Wind data from the Edinburgh site is expected to be sufficient to represent wind conditions across the full length of the salt field, with the accepted limitation that there may be some deviation in direction and speed compared to the Edinburgh site at any particular location within the salt field. Given the approximately consistent and even topography across the length of the salt field, the Edinburgh site data is considered to be appropriate for analysis of odour and dust complaint data, diary entries, dust deposition gauges, and ambient odour measurements.

No real time wind monitoring has been installed at the site for the Holding Pattern. The need for such monitoring will be reviewed as part of the preparation of the closure PEPR / MOP. Staff will continue to use the Beaufort scale for field observations of wind strength (Table 16-4).

Table 16-4: Beaufort Scale

Beaufort scale number	Descriptive term	Speed in km/h	Speed in m/s	Description on land
0	Calm	0	0-0.2	Smoke rises vertically
1	Light Air	1 - 6	0.3-1.5	Smoke drift indicates wind direction, still wind vanes
2	Light Breeze	7-11	1.6-3.3	Wind felt on face, leaves rustle, vanes begin to move
3	Gentle Breeze	12 - 19	3.4-5.4	Leaves and small twigs constantly moving, light flags extended
4	Moderate winds	20 - 29	5.5-7.9	Raises dust and loose paper; small branches are moved.
5	Fresh winds	30 - 39	8.0-10.7	Small trees in leaf begin to sway; crested wavelets form on inland waters
6	Strong winds	40 - 50	10.8-13.8	Large branches in motion; whistling heard in telephone wires; umbrellas used with difficulty.

Beaufort scale number	Descriptive term	Speed in km/h	Speed in m/s	Description on land
7	Near gale	51 - 62	13.9-17.1	Whole trees in motion; inconvenience felt when walking against wind.
8	Gale	63 - 75	17.2-20.7	Twigs break off trees; progress generally impeded.
9	Strong gale	76 - 87	20.8-24.4	Slight structural damage occurs -roofing dislodged; larger branches break off.
10	Storm	88 - 102	24.5-28.4	Seldom experienced inland; trees uprooted; considerable structural damage.
11	Violent storm	103 -117	28.5-32.6	Very rarely experienced - widespread damage
12+	Hurricane	118 or more	32.7 or more	Very rarely experienced - widespread damage

Dust Monitoring

The current program of weekly observation of potential sources (e.g., pond floor conditions, dust entrainment during windy conditions, and development of dunes at the edge of ponds) will be continued, and supplemented with:

- the diary program to record community observations of dust (see below)
- increased monitoring if a dust complaint is received. The purposes of increased monitoring are to:
  - investigate the complaint
  - assess the need and scope for remedial and other dust prevention actions
  - monitor the effectiveness of these actions by quantifying the dust concentrations in air downwind of the identified source area.

Increased monitoring will consist of:

- Tier 1 - establishment of dust deposition gauges:
  - on site, in a location between a source area and from where a complaint has come
  - on site, located in a similar direction and distance from an area that is not a source area (to provide a basis for comparison)
  - comparative data from these gauges (measured over periods of 30 days) will indicate the effectiveness of remedial measures and other dust prevention measures in areas that have been identified to be problematic.

- Tier 2 - in the event that the source area proves to be an enduring source of significant off-site dust impact that is difficult to remediate. If it is decided that it is essential to form an estimate of exposure dose experienced by offsite receptors, then an instrument such as a TES 6200 from Thomson Environmental would be deployed for a defined period of time on site. It would be located at a site between an enduring source area and the location from where the complaint has come. The results, when combined with data from a dust deposition gauge set up nearby and meteorological data from the Bureau of Meteorology, will allow a full analysis of dust occurrence as a function of site activities, wind direction and wind. This in turn will help inform assessment of possible exposure doses experienced offsite.

Odour Monitoring

The current observation program will be continued, and supplemented with:

- A tiered set of triggers for the frequency of observations to be progressively increased if an odour intensity trigger is exceeded, or reduced if odours are declining. The tiers of observation frequencies are:
  - Tier 1: Weekly observations at pre-defined locations
  - Tier 2: Twice weekly observations at pre-defined locations triggered from Tier 1
  - Tier 3: Observations each two days downwind of selected odour sources that triggered the need to move from Tier 2
  - Tier 4: Daily observations at selected odour sources that triggered the need to move from Tier 3.
- Use of a Low Range Odalog for instrumental monitoring of H_2S concentrations. This instrument has a minimum detection limit of 0.1 ppm.

Current observations include the date and location of each observation, odour intensity, and any observations about the source of the odour (including likely reasons for the odour, areal extent, any visible signs of abnormal conditions). The record sheet for these observations will be amended to also include:

- time of the observations
- a map that can be annotated
- instructions for the monitoring, including the tiered scheme requirements
- tables listing the odour intensity and Beaufort (wind speed) scales.

At the higher Tiers (e.g., 3 and 4), additional monitoring will be conducted to investigate the extent of the odour plume downwind of the source. The additional records will include the following:

- approximate definition of the source area(s) of the odours
- source odour intensity, and Odalog H_2S concentration
- odour intensity, and Odalog H_2S concentration at different distances downwind of the approximate location of the strongest odour.

The triggers to increase monitoring are:

- from Tier 1 to Tier 2:
  - reason to expect a deterioration in odours, **and** odour intensity of 1, or certain Odalog reading exceeded
- from Tier 2 to Tier 3:
  - reason to expect offsite impact from odours from a specific source or area; **and**
  - reason to expect a deterioration in odours at the source, **and**
  - an onsite odour intensity of 2, or certain Odalog reading exceeded.
- from Tier 3 to Tier 4:
  - reason to expect deterioration in offsite impact from odours from a specific source or area; and
  - reason to expect a deterioration in odours at the source, and
  - an onsite odour intensity of 3 or more, or certain Odalog reading exceeded.

Reasons to expect a deterioration in odours could include one or more of, e.g.:

- recent heavy rainfall, sufficient to add water to pools in dry pond; or to re-wet / moisten MBO or partially decomposed organic matter for more than a few days
- deterioration in water quality (DO declining towards 1 mg/l or less; and increasing salinity; and reducing pH)
- an increasing area of soil or water becoming discoloured black

- weather conditions becoming unsuitable for dispersion of odours
- a fish kill
- an algal bloom developing
- limited options available to prevent the deterioration in odours from the above causes.

Triggers for reducing the frequency and extent of monitoring by stepping through the tiers, such as:

- from Tier 2 to Tier 1: odour intensity of 1 or less on two consecutive observations, and certain Odalog reading not exceeded
- from Tier 3 to Tier 2: reason to expect an improvement in odours at the source, and source odour intensity of no more than 2, and certain Odalog reading not exceeded
- from Tier 4 to Tier 3: reason to expect an improvement in odours at the source, and source odour intensity of no more than 2, and certain Odalog reading not exceeded

Reasons to expect an improvement in odours could include one or more of, e.g.:

- reduction in area of pooled water, increase in area of dry pond surface
- improvement in water quality (DO increasing above 2 mg/l; and reducing salinity; and increasing pH)
- a reduction of soil or water that is discoloured black
- weather conditions becoming more suitable for dispersion of odours
- removal or burial of organic sources of odour
- deployment of options available to prevent the deterioration in odours.

Setting thresholds for elevating the intensity of monitoring to a higher tier is challenging as odour concentration, such as that specified in EPA guidelines for odour assessment by dispersion modelling, cannot be measured directly in the field. Instead, thresholds based on direct results from monitoring methods need to be developed. For this project, these thresholds will initially be based on recorded observations by site employees and then, if it proves advantageous and practicable for environmental management and compliance purposes, defined in terms of measurements from the Odalog once sufficient information is available. Thresholds will also be reviewed and, if advisable, amended, over time once information from community diaries (see below) and complaints (if received) can be correlated with site observations.

The Odalog will be left in the field (within the site boundary) to carry out automatic 24-hour real time monitoring of H_2S concentrations when it is not being used for the Tier 1-4 monitoring as described above. For this purpose, the Odalog will be left in a location that represents the greatest potential for odour transport between a suspected odour source and a sensitive receptor. This location may vary from week to week. This longer term monitoring will allow access to a snapshot of frequency, duration and magnitude of H_2S air concentrations at known problem locations, especially outside of normal working hours when meteorology would be conducive to poor dispersion. It may take some trialling to determine the most appropriate location(s) to deploy the monitor. The monitor would be mounted in a steel or PVC tube (with sensor exposed at one end) for basic protection from sun and heavy rain, and security.

BDC will also investigate whether data from nasal ranger monitoring, carried out by or on behalf of the Jeffries site, can be shared with BDC, and if there is any opportunity to use the resource in case of need. BDC has in mind that, in event of an extended severe odour impact offsite, nasal ranger monitoring may yield information that can help with community engagement and complaint response.

In addition to prompting increased intensity of observational monitoring, the monitoring data will be used to inform adjustment of the measures being taken on site to prevent, mitigate and manage odour sources

Community (off-site) monitoring

Since 2014 Ridley (and now BDC) has involved a selection of 6 to 10 volunteer members of the community that live downwind of the ponds by asking them to keep an odour and dust diary in which they record any odour and dust they observe, including such factors as:

- date and time, duration of the dust or odour
- rating of odour intensity (using a defined scale)
- description of the odour (using a given list of descriptors)
- description of the character of the dust (using a given list of descriptors)
- wind conditions (strength using Beaufort scale, and direction), and overall weather conditions using a given list.

The volunteers for the odour and dust diary program live close to the salt fields in the following areas:

- west end of Port Gawler Road
- Tozer Road and west of Tozer Road, between Symes and McEvoy Roads
- St Kilda community
- west of Robinson Road / Supple Road between St Kilda Road and Symes Road (noting these properties may also be affected by odour from the sludge ponds at Bolivar).

These areas have been selected because they represent locations that are downwind of the drained ponds and / or areas where ASS or organic decomposition causing odours is suspected to be a potential issue (which is understood to be particularly around ponds XC2, XC2S and in the channel to PA5 from XC2S).

There has been and will continue to be monthly contact with the participants during the warmer months (October to March) to collect completed diary sheets, even if they have entered no records during the month. BDC will collate and report the results as part of its compliance reporting. Summaries of results will also be used in community engagement activities conducted by BDC.

Data Evaluation and Reporting

BDC will include monitoring data in the Monthly Compliance Reports. This data will be accompanied by a commentary on any evident:

- trends or patterns in the data, with emphasis on the identification of those indicating a need to take action to limit or prevent undue dusts or odours and so complaints about these
- relationships between the data and complaints received
- relationships between the data and odour or dust remedial or prevention measures undertaken.

16.3.7 Uncertainties and Limitations

Uncertainties relate to:

- The environmental conditions, other than wind, that are likely to lead to significant dust pick-up from empty pond surfaces given that the soil composition and moisture condition of the ground surfaces in ponds is highly variable both over time and spatially, even in any one pond. The soils that have a significant proportion of silt and fine sand particles, with little clay to bind them would be the most vulnerable.
- The extent to which revegetation will reduce dust impacts and the time required.
- Natural background levels of dust, given the mix of land uses adjacent to the BDC site, and the presence of other sources among them. This makes it difficult to use measures of background levels to set realistic quantitative outcome measurement criteria that would be of practical help

in preventing and mitigating dust impacts, or that would provide a practicable measure against which to assess the scale of any impact attributable to the BDC site.

- The frequency, duration and intensity of odour emissions. While the conditions that are likely to lead to odour emissions are reasonably well-known, BDC is unable to predict the scale of odour impact for houses downwind of ponds, except as hypothetical scenarios.
- The locations outside site boundary where odour impacts are most likely to occur, except in general terms. This makes it difficult to prioritise locations for monitoring.
- The scale, frequency and duration of odour events that would be considered unacceptable by regulators.

Consequently, it is not possible at this stage to set quantitative outcome measurement criteria.

The uncertainties relate to the ability to apply those measures in sufficient time at the right places to prevent impacts, not to the effectiveness of control measures. The monitoring program described above will provide improved data on odour and dust levels.

16.3.8 Risk Assessment

The monitoring program will provide some early warning of potential dust and odour problems. However, to an extent, BDC will have to rely in the short term on an approach that reacts in response to complaints. While it is expected that timely remedial action can be taken to address most complaints, a serious and large scale problem may require re-inundation of a pond. Depending on the size of the pond, this may take several weeks.

The consequence of an amenity impact extending into weeks is conservatively estimated as High. Such an event is considered to be unlikely. An example was the odour impacts from Pond XC2S noted above, caused by eutrophication of pooled rainwater. This event only occurred following a 1 in 100 year rainfall event in February 2014. After approximately a week, the area of concern dried up alleviating the problem. Given the need for the existence of a source of dust or odour to coincide with certain weather conditions, there is no credible risk that a moderate or higher impact event could extend into months.

Given the amount of dust that could be generated, the short term and episodic nature of any incidents and the distance to receptors, the risk of impacts on human or ecological health are considered to be negligible.

Risks that could result in greater than expected impacts, are considered to be acceptable. The monitoring program and further investigations that are proposed will reduce uncertainty over time and are likely to result in this level of risk reducing. Further action to reduce risk is not practicable at this time given the scale of the site. Risk are summarised in Table 16-5.

Table 16-5: Air quality risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
A1	Dust from exposed ground surfaces affecting the amenity of adjoining human receptors	Low	Unlikely	High	Moderate
A2	Dust from exposed ground surfaces affecting the health of adjoining human receptors	Negligible	Unlikely	Low	Negligible

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
A3	Dust from ASS affecting health of adjoining human or ecological receptors	Negligible	Unlikely	Low	Negligible
A4	Dust from exposed ground surfaces affecting adjoining areas of conservation significance	Negligible	Unlikely	Low	Negligible
A5	Dust from calsilt stockpile in Pond XC2E affecting amenity of adjoining human receptors	Negligible	Likely	Moderate	Negligible
A6	Odour from eutrophication of pooled rainfall water affecting the amenity of adjoining receptors	Low	Unlikely	High	Moderate
A7	Odours from decay of organic material in anaerobic conditions affecting the amenity of adjoining receptors	Low	Unlikely	High	Moderate
A8	Odour from exposed acid sulfate soils affecting the amenity of adjoining receptors	Low	Unlikely	High	Moderate
A9	Odour from algal blooms affecting the amenity of adjoining receptors	Low	Unlikely	High	Moderate
A10	Foam impacting on adjoining land uses	Negligible	Unlikely	Low	Negligible
A11	Dust from trial bulk earthworks affecting the amenity of adjoining human receptors	Negligible	Unlikely	Low	Negligible

16.3.9 Proposed Outcome

Surrounding receptors wish to protect their health and amenity. The very low number of odour and dust complaints in the past indicates that short term episodic impacts on amenity are tolerated. More widespread or longer term impacts on public amenity would be considered unacceptable. Consequently, BDC considers the following outcome is acceptable:

No adverse public health and or significant nuisance impacts due to air emissions, dust, odour, or noise.

A significant nuisance impact is considered to be one that generates a complaint that is confirmed as attributable to the salt field and cannot be addressed within the timeframe specified in the measurement criteria.

16.3.10 Measurement Criteria

Outcome measurement criteria are shown in Table 17-1. Given the size of the salt fields and the number of sensitive receptors, it is impractical to establish air quality monitoring stations at all points where sensitive receptors are present. In addition, potential impacts on receptors relate to amenity impacts, not health impacts. Individuals vary in the extent to which they consider they have suffered an amenity impact from dust or noise. For this reason, criteria based on public complaints, rather than air quality parameters, are considered more appropriate at this stage.

BDC will maintain a register of all dust and odour complaints. BDC considers it has met the outcome of 'no adverse public health or significant public nuisance impacts due to air emissions, dust and

odour' when the register demonstrates that for any complaints relating to impacts from dust or noise outside the site boundary:

- the complaint was initially responded to within 48 hours
- the issues underlying the complaint were investigated and the causes identified within 2 weeks, or such other timeframe as agreed by DSD
- the complaint was closed out within 4 weeks or such other time frame as agreed by DSD.

As there is a high reliance on management measures to meet the proposed outcome, leading indicator criteria are also proposed to give an early warning of potential dust or odour problems. For dust, this will involve weekly observations of potential sources to check whether dust is being entrained in windy conditions or dunes developing at the edge of ponds. Odour criteria are based on weekly observations at specified locations in the air quality monitoring plan.

16.4 Flora and Fauna

16.4.1 Assessment Methodology

Appendix 4 contains an assessment of impacts on flora and fauna in the site that are matters of national environmental significance. This draws on information about flora and fauna that may occur on the site obtained from Ridley records, previous ecological studies undertaken for Ridley, the Biological Database of South Australia, the EPBC Act Protected Matters Search Tool and a detailed census of bird species, numbers and uses (pond by pond), in 2013/14, 2014/15 and 2015/2016. Other sources of information about birds at the site included Birdlife Australia shorebird population monitoring studies, Shorebird 2020 count data, the Birdlife Australia Bird Atlas.

16.4.2 Sources of Potential Impacts

Sources of potential impacts on flora and fauna include:

- changes in the depth of water in ponds
- draining of ponds
- decline in the quality of water in wet ponds if inadequately flushed, including increased salinity
- ASS and MBO (addressed in 16.5)
- poor quality of residual water in draining / drained ponds and their topographic depressions, trenches, drains, creeks or water bodies, if these cannot drain freely (via infiltration or runoff) or be refreshed frequently enough
- discharge of saline water to the marine environment (addressed in 16.6)
- production of new areas of dry land
- encroachment of vegetation into areas currently used for roosting
- improved access for predators.
- discharges into the marine environment of water from the site containing fish and marine life with characteristics significantly different from those living in the adjacent marine environment.

16.4.3 Pathways

The primary pathway for impact events is water. Generally, this would occur through direct impacts such as through changed water levels in ponds impacting on the suitability of habitat for some shorebirds, or through changes in salinity. Indirect impacts could occur through changes to water quality in one area of a pond affecting water in other parts of the pond, other ponds or the marine environment. The pathway for impacts on the marine environment is provided by the licensed points of discharge or any unplanned releases.

The creation of drained areas of ground represents another pathway which could, for example, result in spread of weeds and pest animals.

Air is likely to be a minor pathway with negligible impacts expected on flora and fauna from dust, odour and noise.

16.4.4 Receptors

The significant receptors are:

- feeding and roosting habitat for migratory shorebirds, particularly in Ponds XE1-3 and the intertidal area west of the salt fields
- vegetation that may represent the Subtropical and Temperate Coastal Saltmarsh ecological community
- areas of conservation significance adjoining the western boundary of the salt fields, including mangrove forests, tidal mudflats and salt marshes
- listed threatened / protected species including the vulnerable Bead Samphire (*Tecticornia flabelliformis*), Barren Cane-grass (*Eragrostis infecunda* - Rare), Southern Saltbush (*Atriplex australasica* - Rare) and vulnerable Australian Fairy Tern (*Sternula nereis nereis).*
- remnant vegetation on the salt fields
- marine life (flora and fauna) in water and sediment in tidal and intertidal parts of Gulf St Vincent, adjacent the site.

16.4.5 Potential Impacts

Shorebirds and waterbirds are considered by BLA to be the fauna group most sensitive to changes in environmental conditions in the salt fields. Consequently, the impact assessment focuses on these groups. Impacts on flora and other fauna groups are expected to be negligible give they are generally well represented throughout the region and the habitat that will be impacted by the activities in this PEPR will be very limited.

<u>Changes to water levels in ponds</u>

Migratory shorebirds use shallow water and beach / intertidal zones, and rely on a suitable mix of water depths, availability of benthic organisms, fish and bottom dwelling species for food. For this, the water needs to be of the right quality, and water depths need to vary regularly. Species have different requirements and, consequently, are impacted differently. A drop in water levels would expose more areas with available macroinvertebrate food for small shorebirds, but reduce the volume of water containing available brine shrimp and other food in the water column, key prey for Banded Stilts.

Changes in water levels can also provide easier access for predators, and allow encroachment of vegetation into ponds currently used for roosting.

The water depths in the ponds have been stable and typically 0.5 to 1m (but shallower at the edges of ponds and deeper where natural drainage courses lie beneath the water). Migratory shorebirds require water depths of less than 0.3m and with a soil substrate that provides food. This occurs in the Middle Beach and the northern parts of the Port Gawler Sections, where water salinity is not too high, and where the topography means that the required water depth is accompanied by suitable 'beaches'. The Holding Pattern maintains inundated ponds in a state similar to past operational management. Surveys to date indicate there has not been an obvious impact on bird numbers, which are consistent with levels in recent decades. Consequently, impacts are expected to be negligible.

The DEWNR trial in XB8A seeks to create additional areas of mudflat and shallow water for shorebird feeding and roosting through controlled tidal wetting and drying. This is expected to result in an increase in shorebird use of the pond. Current water levels in the pond are too high for many bird species. Consequently, the impact is expected to be beneficial.

A survey for the listed vulnerable Bead Samphire (*Tecticornia flabelliformis*) identified 10 patches with a combined area of 12.7ha. Where the species was found to be present within the salt field boundaries, it was confined to the coastal side of the westerly bunds in Section 3 and the coastal side of the northerly ponds in Section 4 and not in the operational areas of the salt field. As such, the species will not be impacted by the holding pattern.

Changes to water quality in ponds

The residual salinity in the soils in the floors of the drained ponds will take time to diminish. Consequently, this will decrease the suitability of the habitat for some species. The ponds take some time to drain providing ample time for birds to move to alternative habitat. Impacts are expected to be negligible.

The Holding Pattern seeks to maintain adequate flows and flushing to ensure water quality in the ponds that remain inundated does not deteriorate. Consequently, impacts on birds are expected to be negligible.

Draining of ponds

Draining of ponds will reduce the foraging area in the ponds available to migratory shorebirds. This reduction represents a very small percentage of the total foraging area that is available and accessible to these birds. The quality of the foraging areas outside the ponds is likely to be substantially better than that inside the ponds due to tidal exchange. BL&A undertook an assessment of the impacts of the Holding Pattern on matters of national environmental significance and concluded it was unlikely to have a significant impact (Appendix 4). Therefore, the impact on bird populations is considered to be low.

Feral animals will be attracted by the bird life and other fauna that colonise the drained ponds. As the ponds are emptied of water, the risk to the birds from feral animals increases because there is more dry land for these animals to access. However, this will be a gradual process providing ample opportunity for birds to move to more suitable habitats. The risk of weeds is low in the short term because of the salinity of water in the shallow soil profile, which will take some time to be leached out. BDC runs an ongoing control program and impacts from pest plants and animals is expected to be low.

Discharge to the marine environment

BDC has an authorisation under the Environment Protection Act to discharge saline water at a location downstream of the SA Water Bolivar Waste Water Treatment Plant Outfall Weir. The discharge must not have a salinity greater than 45 parts per thousand. Continuous in-line monitoring of salinity is required and BDC must cease discharge if the salinity criteria is exceeded. The salinity criteria has been set by the EPA to prevent harm to the marine environment. Consequently, no impact is expected on habitat for species of conservation significance from planned discharges.

As a result of the continuous discharge, flow rates of water through the salt field are sustained at higher levels for longer periods of time than would otherwise have been the case. The result is that salinities in the salt field have reduced, benefiting its bird habitats. The salinities in PA5 have been:

- Summer peak:
  - 2014: 260 ppt approx.
  - 2015: 240 ppt approx.
  - 2016: 195 ppt approx.
- Winter trough:
  - 2014: 185 ppt approx.
  - 2015: 135 ppt approx.
  - 2016: < 110 ppt approx.

This has been achieved with only a few, intermittent and short lived, excursions of salinity at Site 1a / Site 3 above the 45 ppt criterion.

Bitterns, a waste product from salt production, were disposed to sea, although small quantities are used for dust control. Some salt from the St Kilda Section (from stockpiles or from crystalliser beds) will be re-dissolved and also discharged along with the bitterns. Discharge of bitterns can cause a short term increase in salinity of tidal waters in the vicinity of the discharge point. The sodium absorption ratio (SAR) is the ratio between Na and Ca/Mg in waters. Too much Na will disrupt the osmotic balance, reducing the availability of Ca/Mg to cells within organisms. All organisms have evolved to tolerate the SAR of water they inhabit. Flora and fauna in marine environments prefer an effective SAR around 60. The SAR of bitterns varies from 50-70, falling with increased specific gravity.

Bitterns were discharged in accordance with criteria in an EPA Licence. These are set to ensure there is no environmental harm to the marine environment. Historic aerial photography and published research (Burton 1982, Coleman 1998, Leinfelder 2000) have confirmed the lack of visible impacts on either the flora or the fauna of the marine environment. This suggests that the discharge has been managed to a point where the impact is apparently insignificant.

Trial discharge of sodium chloride brines (as distinct from bitterns), whether to Port River via the Brine Main, to the North Arm and Dry Creek from Section 1, or to Pumping Creek from XB8A, will be closely controlled and monitored as described in Appendices 6, 7 and 10. Due to the controls and monitoring, no adverse impacts on flora and fauna are expected.

The duration and frequency of trial discharge into the Gawler River is managed in response to monitoring of salinities at the compliance point and in XE6. The background salinity at the compliance point is variable and reflects the combined effects of:

- tidal ebbs and flows, noting that the compliance location is near the head of the tidal section of the river
- the discharge over the last 40 years (approx) of estimated 50ppt to 70 ppt water from seepage drains beside pond XE6
- seepage into the Gawler River from Ponds XE6 and XE7 of water that reflects the salinity in these ponds (50 to 70 ppt)
- seasonal changes in temperatures and evaporation on the water in the Gawler River
- discharges of low salinity water from Buckland Lake – noting that these are intermittent in Winter and absent in Summer.

The biota and habitats in this section of the Gawler River are likely to have adapted to tidal, diurnal and seasonal fluctuations in salinity and no impacts on marine ecology are expected.

The DEWNR trial in XB8A will result in a new discharge point into the marine environment. This may result in short duration episodic impacts on marine water quality, such as increases in salinity, nutrients, turbidity and contaminants. Continuous monitoring of water quality will occur at the tidal gate. Full remote control and telemetered systems on the tidal gate will ensure any risks can be immediately managed (i.e. alert and automatic gate closure if triggers reached). Cumulative impacts will also be monitored through data collection and analysis. Given these measure, impacts on the marine environment are expected to be low.

CEE Consultants were commissioned by BDC to assess fish health and diversity (Appendix 5). They concluded:

- The fish population in the salinas are derived from wild fish in Barker Inlet and continue to receive eggs and larvae from wild populations in the gulf and tidal mangrove creeks via seawater pumps.
- Fish biodiversity in the salinas is representative of species found locally.
- Fish in the salinas were generally healthy and in good nutritional condition.
- Parasites observed in the salina fish populations would pose little threat if released to the general population outside the salinas.

Consequently, discharges from the salinas to the marine environment are expected to be negligible, in terms of:

- genetic changes to the external marine life in the adjacent parts of the Gulf caused by differences in the genetic make-up of the marine life in the ponds
- export of diseases of marine life in the ponds that are different from those in the marine life in the adjacent parts of the Gulf.

Expected impacts on flora and fauna are summarised in Table 16-6.

Table 16-6: Expected flora and fauna impact

Event ID	Impact Event	Expected Impact	Significance
F1	Changes to water levels in wet ponds impacting flora and fauna	Minimal change to current water levels	Negligible
F2, F3, F4	Draining of ponds encouraging spread of pest plants and animals	No significant spread of pest plants or animals	Negligible
F5	Changes to water quality in ponds impacting flora and fauna	Minimal change to current water quality. Decrease in salinity in southern ponds.	Negligible
F6	Draining of ponds resulting in loss of habitat	Minor loss of lower quality habitat	Low
F7, F8	Discharge to the marine environment impacting on habitat	No measurable impact	Negligible - Low

16.4.6 Control and Management Strategies

The designated 'wet ponds' in Section 3 will have water pumped through them from Chapman Creek to Pumping Creek. The pumping and discharge rates will be adjusted so as to preserve water quality in the 'wet ponds' and also to manage the water level. These parameters will be monitored, as will bird numbers. After the dry ponds have been drained the water level in the 'wet ponds' will be fluctuated about 1.5m AHD. This is about 0.5m lower than the level when the salt fields were operational. With this lower water level, it is envisaged some beaches and areas of shallow water (<0.15m, <0.3m) that

can provide shorebird habitat will emerge along the eastern and northern ends of the 'wet ponds'. The fluctuations will assist establishment / maintenance of food sources for birds within the ponds

In Section 4, the draining of the ponds will be accompanied by pumping water from Middle Beach through XE1- 3, XE5, XE6 and XE6A. This will maintain water quality in these ponds as the water level drops. As the water level drops in these ponds, the areas of shallow water (<0.15m, <0.3m) that provide shorebird habitat will move but not disappear until late in the draining process.

The designated 'wet ponds' in the Port Gawler Section do not appear to have provided the right mix of water salinity beaches, water depth with the right soil substrate, as they seem to have been less attractive to migratory shorebirds. The maintenance of the status quo here (i.e. good flushing and sustaining of present water depths) therefore poses little risk to existing shorebird habitat or numbers. However, there would appear to be an opportunity to manage salinity and water level to form new lengths / areas of shallow water with suitable substrate and beach that are similar in magnitude and quality to those that will be lost from the dry ponds. This is being considered further in the proposed investigations.

BDC has monitored bird numbers by species, water quality and the approximate areas of water of different depths (<0.15m, <0.3m, >0.3m) in the ponds since the 2013 / 14 bird season. The resulting data will be compared with the statistics of comparable historical data to confirm that draining of ponds has not significantly impacted the migratory birds. The contingency arrangements are:

- to maintain the ability to operate all pumps and the existing systems of connections / gates / syphons between ponds so as to put water back into any individual pond or to sustain it there
- draining ponds from "bottom to top" in each of Sections 3 and 4, to sustain for as long as possible the ability to restore water into a lower pond from the next higher pond using gravity flow.

To date, bird surveys have shown there have been no significant changes in the numbers of listed migratory birds or any other waterbirds at the salt field attributable to the holding pattern since it was implemented (Appendix 4).

The impacts of the DEWNR trial in XB8A will be monitored as described above and in more detail in Appendix 10. Water levels will be modified if adverse impacts do result.

Where the topographic depressions and trenches revealed by the draining of the ponds look to hold water, they will be drained by:

- pumping using portable pumps; or
- installing drain pipes through bunds to lower ponds; or
- (where ASS conditions allow) excavation of swales.

BDC controls noxious weeds on the site and works with neighbours to control environmental weeds, as reflected in Standard Operating Procedures.

BDC will also be developing a terrestrial flora and fauna conservation management plan for implementation during and beyond the closure process. This will address the risk of feral animals and weeds, with the aim of reducing the assessed risk level to Low.

16.4.7 Uncertainties and Limitations

Information on migratory birds is based on counts taken over many years with data available back to 1978. While numbers do fluctuate from year to year, the use of salinas by birds is reasonably well understood. However, it is not clear how changes to pond water levels will affect prey availability. A macroinvertebrate data collection program and winter bird survey have been undertaken to quantify

the use of the salt field outside the migratory season, including the use at this time by non-migratory juvenile shorebirds.

The main uncertainty relates to cumulative impacts on shorebirds and waterbirds from changes to water levels and draining of ponds. Appropriate management of a range of water levels in ponds that remain inundated could potentially offset any loss of habitat from draining of ponds. While cumulative impacts may have some level of uncertainty, the water depths and salinity ranges preferred by the different shorebirds and water birds in this salt field has been confirmed through:

- investigations at Cheetham Wetlands near Melbourne (BL&A 2014a), and
- more specifically by interpreting the following data for this site
  - areas of different water depths in each inundated pond
  - salinities of the water in each inundated pond
- counts of bird numbers and bird activities (foraging or roosting) in each pond.

As a result, relationships have been identified between bird usage and pond morphology, salinity and water levels; and work is ongoing to investigate the implications of these relationships for the carrying capacities of the ponds under different water conditions (of areas of different water depth and also of water salinity). This will inform assessment of the merits of options for mitigating the loss of migratory and resident bird habitat from different closure scenarios to be considered.

An objective of the DEWNR trial in XB8A is to improve habitat for migratory birds. There is some uncertainty as to the extent to which XB8A will provide shorebird habitat and the potential adverse impact of the changes on migratory birds. Monitoring during the trial will reduce this level of uncertainty.

16.4.8 Risk Assessment

Changes to water levels in ponds and draining of ponds

As noted above, the cumulative impacts of changes in water levels in ponds has some degree of uncertainty. Management of water levels must also address other environmental risks, such as those from ASS and MBO. Given this, the potential for closure to result in a reduction in the carrying capacity of the site for some bird species cannot be ruled out. However, experience with the Holding Pattern since 2013/2014 suggests that:

- fluctuations in water levels have been limited in magnitude and duration: The water levels have generally complied with the PEPR requirements; and
- such fluctuations in water levels that have unavoidably occurred in some ponds have not resulted in significant impacts to overall numbers of each species of bird that use the site for foraging or roosting – even if there has been short term impact on number using the ponds where the larger than desired fluctuations have occurred.

Changes to water quality in ponds

The experience with the Holding Pattern since 2013/2014 indicates that water quality (as measured by salinity, DO, pH, temperature) has remained generally consistent with PEPR requirements. There have however been episodes in a few ponds where salinity has risen above desired levels in the warmest months of the bird season. The consequence for those ponds was a short term reduction in bird numbers. This did not however result in significant impacts to overall numbers of each species of bird that use the site for foraging or roosting.

Draining of ponds

Draining ponds reduces the area of attractive water depth / salinity available for shorebirds and water birds. The evidence from the bird monitoring between 2013 and 2016 is that the draining of ponds XF1, XF2, XE4, XC1, XC2, XC2S for the Holding Pattern (essential to manage salinity in the remaining inundated ponds) has not resulted in significant impacts to bird numbers – in that the numbers using the site appear to have been well below the reduced carrying capacity of the site.

No further draining of ponds is proposed as part of the holding pattern.

Discharge to the marine environment

A failure of an embankment could also result in unplanned release of saline water to the marine environment. Planned and unplanned releases could result in impacts on flora and fauna.

Within the salt fields, habitat suitability for different species depends in part on salinity. Species can generally handle some fluctuation in salinity. For this reason, given any unplanned release is likely to be limited and be rapidly dispersed in the marine environment, impacts on flora and fauna are likely to be low. The risk that impacts on flora and fauna could be higher than expected are summarised in Table 16-7.

Table 16-7: Flora and fauna risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
F1	Changes to water levels in wet ponds impacting flora and fauna	Negligible	Likely	Moderate	Moderate
F2, F3, F4	Draining of ponds encouraging spread of pest plants and animals	Negligible	Likely	Low	Low
F5	Changes to water quality in ponds impacting flora and fauna	Negligible	Unlikely	Moderate	Low
F6	Draining of ponds resulting in loss of habitat	Low	Likely	Moderate	Moderate
F7, F8	Discharge to the marine environment impacting on habitat	Negligible	Unlikely	Low	Negligible

Further reduction in risk could only be achieved through continuing to pump sea water through the entire system. This would produce 500,000 tonnes to 900,000 tonnes of salt which, because there is no market, would need to be re-dissolved and disposed of. This would require considerable energy, water and money along with ongoing environmental risk management. It is doubtful that the salinity criteria for discharge to the marine environment in the EPA licence could be met.

16.4.9 Proposed Outcome

As clearance of vegetation on the salt fields is regulated under the Native Vegetation Act, the requirements of this Act must be met. In addition, the importance of the salt fields for waterbirds and shorebirds is recognised by BDC and stakeholders and is an environmental value that should be maintained. Consequently, BDC proposes the following outcomes:

- No loss of abundance or diversity of native vegetation on the Salt Field through clearance arising from the Holding Pattern, unless prior approval under the relevant legislation is obtained

- No adverse impacts to avifauna using the site beyond internationally recognised impact thresholds, or outside historic ranges of variability in species and bird numbers.

16.4.10 Proposed Measurement Criteria and Monitoring Plan

The proposed measurement criteria and monitoring plan for flora and fauna outcomes are in Table 17-1. BDC will maintain records to demonstrate all clearance of native vegetation has been undertaken with appropriate permissions. In addition, BDC will implement a Holding Pattern bird monitoring program, with a scope and methodology acceptable to DEWNR and DEE, to demonstrate no adverse impact beyond internationally recognised impact thresholds, or outside historic ranges of variability in species and bird numbers. BDC has also completed an initial self-assessment of risks to matters of national environmental significance and submitted this to DEE (BL&A 2014b). DEE has not disagreed with this assessment.

Leading indicator criteria are not considered necessary for flora and fauna.

16.5 Soil Quality

16.5.1 Sources of Potential impacts

The presence of ASS / PASS and MBO provides the greatest risk to the environment from soil quality on the salt field. These occur throughout the salt field although are protected by natural soil cover and the crystalliser beds in Section 1.

Other sources of impact include:

- potential contamination of soils from leaks and spills of chemicals or fuel from the residual operations in Section 1
- potential contamination of soils from leaks and spills of chemicals or fuel from the care and maintenance activities operations and site investigations in Sections 2-4
- release of asbestos fibres into the air from asbestos containing material, if it is disturbed
- exposure to salt and/or gypsum impacted soils.

16.5.2 Pathways

Acidity can enter shallow groundwater and the surface water within the site. Groundwater can seep into drainage channels within the site to impact water in these channels. Existing fill and operations in Section 1 provide a barrier to acidity, as does gypsum in Section 2.

One pathway for leaks and spills of chemicals or fuels is through the soil. This is unlikely to affect existing use of land but could compromise future uses. An additional pathway is the dissolving and leaching of contaminants into groundwater or surface runoff. This could enter water bodies on and off site.

Impacts from exposure to gypsum or salt can occur through direct exposure; soils impregnated with gypsum or salt; and solutions of gypsum or salt in groundwater.

Wind is an additional pathway for odour impacts on adjoining residents from ASS (due to production of hydrogen sulphide gas). This is discussed in Section 16.3. Wind, soil and water are potential pathways for impacts from asbestos fibres on human health.

16.5.3 Receptors

Receptors on the salt fields includes flora and fauna that may be impacted by changes in soil quality, and / or the resultant impacts on water quality. Humans working at or visiting the salt fields could also be a receptor. Structures and building can also be impacted by ASS.

Off-site receptors include:

- areas of conservation significance (Adelaide Dolphin Sanctuary, Barker Inlet Aquatic Reserve, St Kilda- Chapman Aquatic Reserve, Port Gawler Conservation Park, Buckland Lake Park)
- adjoining habitat for flora and fauna, in particular, species of conservation significance
- adjoining agricultural / horticultural activities
- adjoining structures and buildings.

16.5.4 Potential Impacts

As noted in EPA Guideline 638/07, ASS can have the following impacts:

- Sulfuric acid generation can result in the corrosion of concrete, steel and some aluminium alloys used in buildings, drainage systems and roads.
- The use of acid sulfate soil material as site fill material or in embankments can affect plant growth and block pipe drainage systems due to the formation of iron oxides.
- Both acidity and increased liberation of soluble metals may result in direct plant toxicity and decreased uptake availability of some nutrients, as well as a potential reduction in plant productivity.
- Acidic waters entering estuarine, coastal or riverine environments can result in mortality of fish and crustaceans and can affect aquatic plants through direct acid exposure, smothering of aquatic plants by iron precipitates and toxicity by aluminium and heavy metals.
- Odour impacts as discussed in Section 16.3.

ASS can also prevent the formation of healthy terrestrial flora and fauna habitats as a result of:

- acid scalding of surface soils where impacted by acidic groundwater or surface water
- jarosite crystallisation / alteration to geochemistry of soils
- acidity and metals leaching into surface water (in topographic depressions, trenches, drains, creeks) and shallow groundwater.

When mixed with water, the iron monosulfide in MBO can react within minutes to completely consume dissolved oxygen (Bush, Fyfe and Sullivan 2004). As with ASS, oxidation of sulfide in MBO will create sulfuric acid with the impacts described above.

Acidity and / or metal contamination in groundwater or surface water also has the potential to reduce the ecological health and utility of tidal water environments, or of soils and sediments in the intertidal zone reaching the external environment.

The potential for impacts from ASS and MBO varies across the salt fields but in general is considered low because of the high buffering capacity of soils along exposure pathways from soils that have acid generating potential. Overall:

- Impacts are not expected in Section 1 due to the present cover over ASS and the nature of the site operations.
- In Section 2, the gypsum cover and gypsum impregnation, and saturation from a permanently high water table, coupled with the acid buffering potential in other soils is expected to prevent any impact from soils that do have acid generating potential, or that exhibit acid generation

from the draining. Appropriate drainage / water management will also reinforce that protection.

- In Sections 3 and 4, ponds that remain inundated present a low to negligible risk. In the ponds that will be drained, the acid buffering potential in other soils is expected to prevent any impact from soils that do have acid generating potential, or that exhibit acid generation from the draining. Appropriate drainage / water management will also reinforce that protection.

To date, draining of ponds has not resulted in ASS risks requiring active management other than in the south-western corner of XF1. Sampling at location DXF1.10 (see Figure 16-2) has confirmed in the second layer (depth 10 to 25 cm) the presence of jarosite, and sulfuric material (pH < 4) by measuring in the field a pH of 3.3, and by laboratory testing. In conditions of no to very light winds a sulphuric odour is detectable in the vicinity of DXF1.10. This was expected from the previous investigations and monitoring. It has nonetheless taken about 12 months from the draining of XF1 for this to occur at this location.

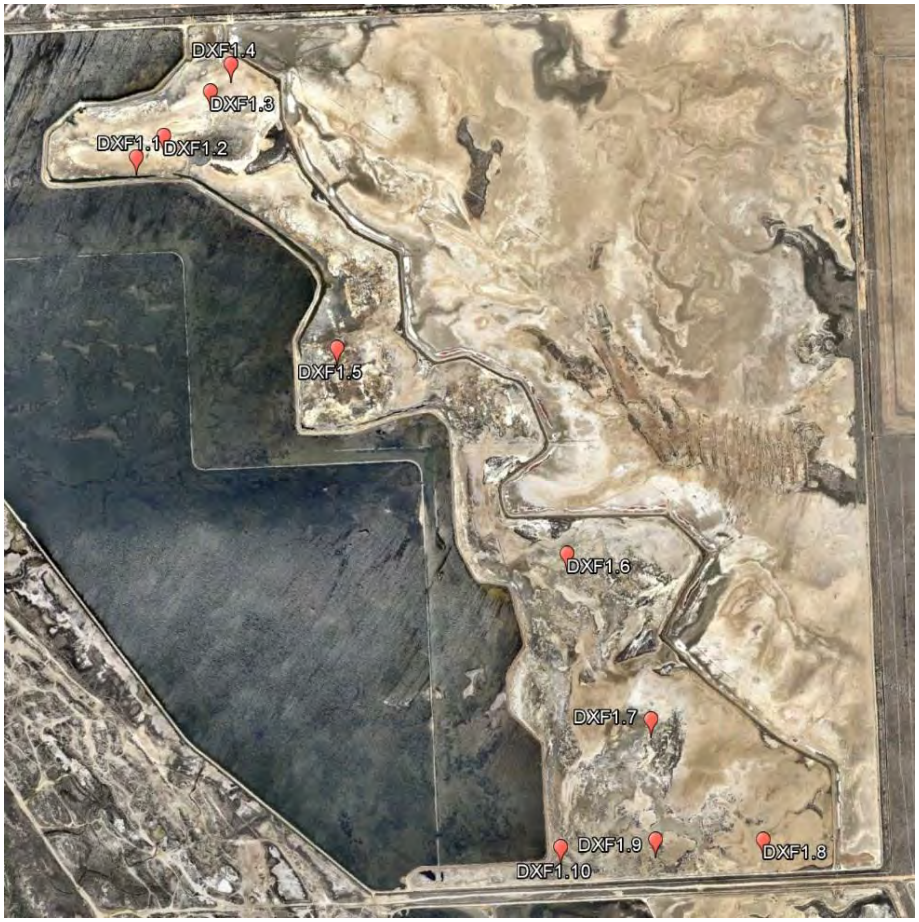


Figure 16-2: Acid sulfate soil monitoring sites in XF1

The shallow soil profile at this location DXF1.10 is specific to this part of XF1. The top layer (0.1m thick or so) is a mix of MBO and sediment that has accumulated during the operational life of XF1. The next layer (the layer of interest) is the topsoil layer from before the construction of XF1 – but geochemically altered as a result of being inundated in anoxic conditions. That topsoil would have comprised a mix of wind blown sands and silts and of sediment from run off and stream flow through the landscape.

The overlying material and the underlying material to this layer are alkaline and likely to remain so. The overlying material has and will crack to let in water and oxygen to the layer of interest. So as time goes by, each summer more hypersulfidic material (pH > 4) in this layer would transform to sulfuric material (pH < 4). The pH of the drainage water from this part of XF1 remains alkaline. The underlying clay forms a barrier to infiltration to ground water and so, after big rainfall events or wet periods, water will saturate the soils above the clay and the drainage system will conduct seepage and runoff water into the external seepage drain.

Exposure of ground surfaces during the DEWNR trial in XB8A is unlikely to result in ASS impacts. These areas will be subject to tidal flushing which will provide buffering of acidity. Buffering will also occur from the carbonate content of clays, sands and calcarenite layers / lenses.

Provided water remains in the former creeks, risk from ASS in these areas are generally low as the driving head for groundwater would be diminished, and groundwater would tend to seep towards the sea and have opportunities for buffering of any acidity and metallic contamination. In some areas, there are concerns that draining could 're-set' the ability of certain soils to generate acid, that capacity having been long gone at the time the salt fields were created. Draining of ponds will not occur until ASS/PASS and MBO investigations have been undertaken and risk management plans developed and endorsed by relevant government agencies where warranted. Consequently, impacts from ASS/PASS and MBO are expected to be negligible.

Spills of oils and fuels inevitably occur in any operation of this type, however the quantities involved would be small. The immediate impacts would be confined within bunded ponds. Additionally, spill containment measures are practiced and clean-up undertaken if needed. The expected impact from spills is expected to be negligible. Surface and groundwater are vectors for offsite impacts but are discussed in 16.6.

The salt impacted soils from historic works within the site will have negligible impact on human uses in Sections 1 and 2 within the site during the works in this PEPR/MOP. In the Dry Creek Section, the current works include ongoing operations to clears salt and to decommission the operational activities. In the St Kilda Section, the presence of gypsum precludes the recovery of ecological values. Investigations are under way to identify how this can best be managed. It presents minimal risk to current ecological values. Impacts on bunds and water control systems are within the ability of current maintenance procedures to deal with. In Sections 3 and 4, there has been limited deposition of salt or gypsum, and it is expected that over 2 years or so (i.e. by end 2015 for ponds already drained) salinity levels in the surficial soils of already drained ponds should have declined sufficiently to encourage widespread natural revegetation by salt tolerant native plants. If any asbestos containing material is identified on site as a hazard, access will be controlled and removal undertaken by licenced operators to ensure no impact occur to human health.

Soil quality impacts are summarised Table 16-8.

Table 16-8: Potential soil quality impacts

Event ID	Impact Event	Expected Impact	Significance
SQ1	Acidity generated from ASS / MBO impacts on existing vegetation	No decline in vegetation expected due to soil buffering and confinement of impacts on site	Negligible
SQ2	Acidity generated from ASS / MBO impacts on revegetation of drained ponds	Potential for specific areas to require soil amelioration	Low

Event ID	Impact Event	Expected Impact	Significance
SQ3	Acidity generated from ASS / MBO impacts on on-site or off-site infrastructure	No measurable impact expected due to soil buffering and limited areas of acidification	Negligible
SQ4	Acidity generated from ASS / MBO impacts on future land uses	No impact expected in areas that remain inundated. Potential for small areas to require active management in drained or exposed areas.	Low
SQ5	Discharge of acidic water generated from ASS / MBO impacts on the marine environment	No expected impact due to buffering of soil and seawater	Negligible
SQ6	Contamination of soil from leaks or spills impacts on current or future land uses	Any spills or leaks expected to be contained and/or of a magnitude that will allow easy clean-up	Negligible
SQ7	Exposure to salt / gypsum impacted soils impacts on earthworks or built structures on site	Minimal impact	Negligible
SQ8	Exposure to salt / gypsum impacted soils impacts on ecological values on or off site	Minimal impact on current ecological values	Negligible
SQ9	Asbestos fibres in soil impact on human health	No exposure to hazardous areas	Negligible

16.5.5 Control and Management Strategies

An adaptive risk assessment / management approach is being adopted to manage ASS / MBO drawing on the outcomes of ASS studies. The management and monitoring strategy proposed above are designed to accommodate the present uncertainties.

The strategies for managing ASS / MBO during the Holding Pattern include:

- In Section 1, preserving the current soil cover over ASS and MBO
- In Section 2, preserving the gypsum cap, and encouraging revegetation, while doing the investigations to design works for preserving the high water table in a better managed range, and enhancing surface water drainage.
- In Section 3 and Section 4, preserving inundation all but the eastern higher elevation ponds, while doing the investigations to design works for base case closure (such as the XB8A trial). Also using the opportunity provided by draining the higher elevation eastern ponds to trial approaches for enhancing surface water drainage, and encouraging revegetation, and undertaking soil treatment where needed and effective.

In the small area of concern in XF1, impacts from ASS will be managed through maintenance of drainage and construction of limestone filters on the pond side of the bund and also in the seepage drain downstream of where the drainage enters. Depending on the results of monitoring, soil amelioration using carbonate sands and Calsilt may also be used.

Monitoring during the DEWNR trial in XB8A will identify any potential issues with ASS before impacts become significant. If necessary, water from XB8 can be used to re-inundate pond surfaces.

Under the conditions of the EPA Licence, BDC must implement a Pond Water Level Control Plan to address prevention of mobilisation and exposure of ASS / MBO. This includes:

- levels of water to be maintained in each of the inundated ponds
- the measures that will be taken to ensure the water levels are maintained at the proposed levels in each inundated pond
- the method of monitoring to ensure the water levels are maintained at the proposed levels in each inundated pond.

The existing measures to prevent, contain and treat spills of all types that could affect soil include:

- a spill kit is available for use in the event of vehicle accident in remote parts of the site
- fuel tanks at the workshop are contained within bunds
- a 40km/hr. speed limit is mandatory across the mine site in order to reduce the likelihood of accidents
- chemicals purchased for the dissolving tests are delivered in break-resistant containers, pre-diluted to the strength required for the analyses, to reduce the need for additional handling
- chemical spill kits are used that provide treatment for specific spilt chemicals
- work instructions have been implemented for:
  - #SOP-SC-C004 SPILLS CONTINGENCY
  - #SOP-SC-E001 EMERGENCY RESPONSE PROCEDURE
  - #143 BRINE MAIN REPAIR INSTRUCTIONS
  - #80 WORKSHOP SPILL INSTRUCTIONS
  - #81 HAZARD REGISTER INSTRUCTION
  - #150 CHEMICAL HYGIENE INSTRUCTION.

These existing measures apply to the whole salt field and all operations conducted by BDC and its contractors on the salt field. They therefore cover all works conducted under this PEPR/MOP. The following measures will be applied to any asbestos containing material (ACM):

- compile an ACM register for each Section of the site to identify the location, and nature of ACM
- design works to avoid / prevent disturbance of ACM to the extent practicable
- develop and implement an ACM management procedure for the event that ACM requires disturbance. This management procedure to include a) investigation to provide information for the design of safe work procedures b) design of safe works procedures to remove and dispose of ACM c) supervision of works and monitoring of air quality by a qualified hygienist, d) conduct of the works by suitably licensed contractors d) licensed disposal of the ACM.
- when work is completed to the satisfaction of the Hygienist, this Hygienist to 'sign off' works as being conducted in accordance with the safe work procedures and that the residual risk of ACM at the 'work site' is low to negligible.

16.5.6 Uncertainties and Limitations

Studies undertaken by the University of Adelaide (Appendix 3) have greatly improved knowledge of ASS and MBO across the salt field, in particular, in Sections 2 and 4. Further surveys, sampling and data acquisition are proposed for Section 3. Risks in relation to ASS and MBO in Section 1 are considered to be low and this has not been the focus of investigations.

These investigations will inform decisions as to whether specific management actions are required and, if so, the most appropriate actions and/or land uses to ensure an acceptable level of risk.

16.5.7 Risk Assessment

Notwithstanding the scale of ASS / PASS on the salt fields, the management of these types of soils is well established and shown to be effective. While ASS / PASS and MBO could result in long-

term ecological impacts if inappropriately managed, the approach described above ensures this is unlikely to occur.

Exposure to salt / gypsum impacted soils represents a low risk with any impacts localised and small scale. Procedures for managing spills and leaks and ACM are also well established and are successful in reducing the level of risk. Ineffective management of ACM could have serious health impacts and is rated as a high consequence for that reason. The likelihood of such an event is, however, considered to be rare give the controls in place.

Table 16-9 summarises the risk of greater than expected impacts relating to soil quality. Given the scale of the salt fields, more intensive management and treatment of ASS is considered to be impractical and the risks are considered to be as low as reasonably practicable.

Table 16-9: Soil quality risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
SQ1	Acidity generated from ASS / MBO impacts on existing vegetation	Negligible	Unlikely	Low	Negligible
SQ2	Acidity generated from ASS / MBO impacts on revegetation of drained ponds	Low	Unlikely	High	Moderate
SQ3	Acidity generated from ASS / MBO impacts on on-site or off-site infrastructure	Negligible	Unlikely	Moderate	Low
SQ4	Acidity generated from ASS / MBO impacts on future land uses	Low	Rare	High	Low
SQ5	Discharge of acidic water generated from ASS / MBO impacts on the marine environment	Negligible	Unlikely	Low	Negligible
SQ6	Contamination of soil from leaks or spills impacts on current or future land uses	Negligible	Unlikely	Moderate	Low
SQ7	Exposure to salt / gypsum impacted soils impacts on earthworks or built structures on site	Negligible	Rare	Low	Negligible
SQ8	Exposure to salt / gypsum impacted soils impacts on ecological values on or off site	Negligible	Unlikely	Low	Negligible
SQ9	Asbestos fibres in soil impact on human health	Negligible	Rare	High	Low

16.5.8 Proposed Outcomes

The proposed outcomes in 16.4.9 sufficiently address potential impacts on ecological values. Spills and leaks can potentially compromise future land uses as can poor management of ASS/PSS. Mobilisation of acid from ASS/PASS can potentially affect adjacent land uses, including management of ecological values. Consequently, the following outcomes are proposed:

- No compromise to potential future land use
- No adverse impacts to adjacent land use.

16.5.9 Measurement Criteria

Measurement criteria are proposed in Table 17-1. As the primary management measure for ASS is maintenance of appropriate water levels in ponds, the proposed measurement criteria focus on ensuring the levels agreed in the Holding Pattern are maintained. The criteria also ensure bunds are appropriately maintained to reduce the risk from ASS and also any spills or leaks.

16.6 Surface Water

16.6.1 Sources of Potential Impacts

Sources of potential impact include:

- stormwater entering the salt field from offsite degrading water quality on site
- stormwater runoff from the site into the drainage channels and waterways at the site impacting water quality (addressed under Soil Quality in 16.5)
- deterioration of water quality in the ponds, if left un-drained or not flushed, causing odours, midges, mosquitoes etc.
- deterioration of quality of residual water in draining / drained ponds and their topographic depressions, trenches, drains, creeks or water bodies causing odours, midges, mosquitoes etc.
- discharges into the marine environment of water from the site containing:
  - salt at concentrations higher than background sea water
  - if present, other chemicals, at concentrations higher than background sea water.

16.6.2 Pathways

The pathway for most of the impact events above is water. The pathway for odours and biting insects is the air environment. Odour is addressed in Section 16.3.

The pathway for impacts on the marine environment is provided by the licensed points of discharge or any unplanned releases.

16.6.3 Receptors

Receptors include:

- environmental uses of waters in drains, creeks and water bodies on site
- residents surrounding the salt fields
- workers on site
- environmental uses of water in Gawler River and Pumping Creek and the parts of Gulf St Vincent adjacent to the site
- marine life (flora and fauna) in water and sediment in tidal and intertidal parts of Gulf St Vincent, adjacent the site
- areas of conservation significance adjoining the site.

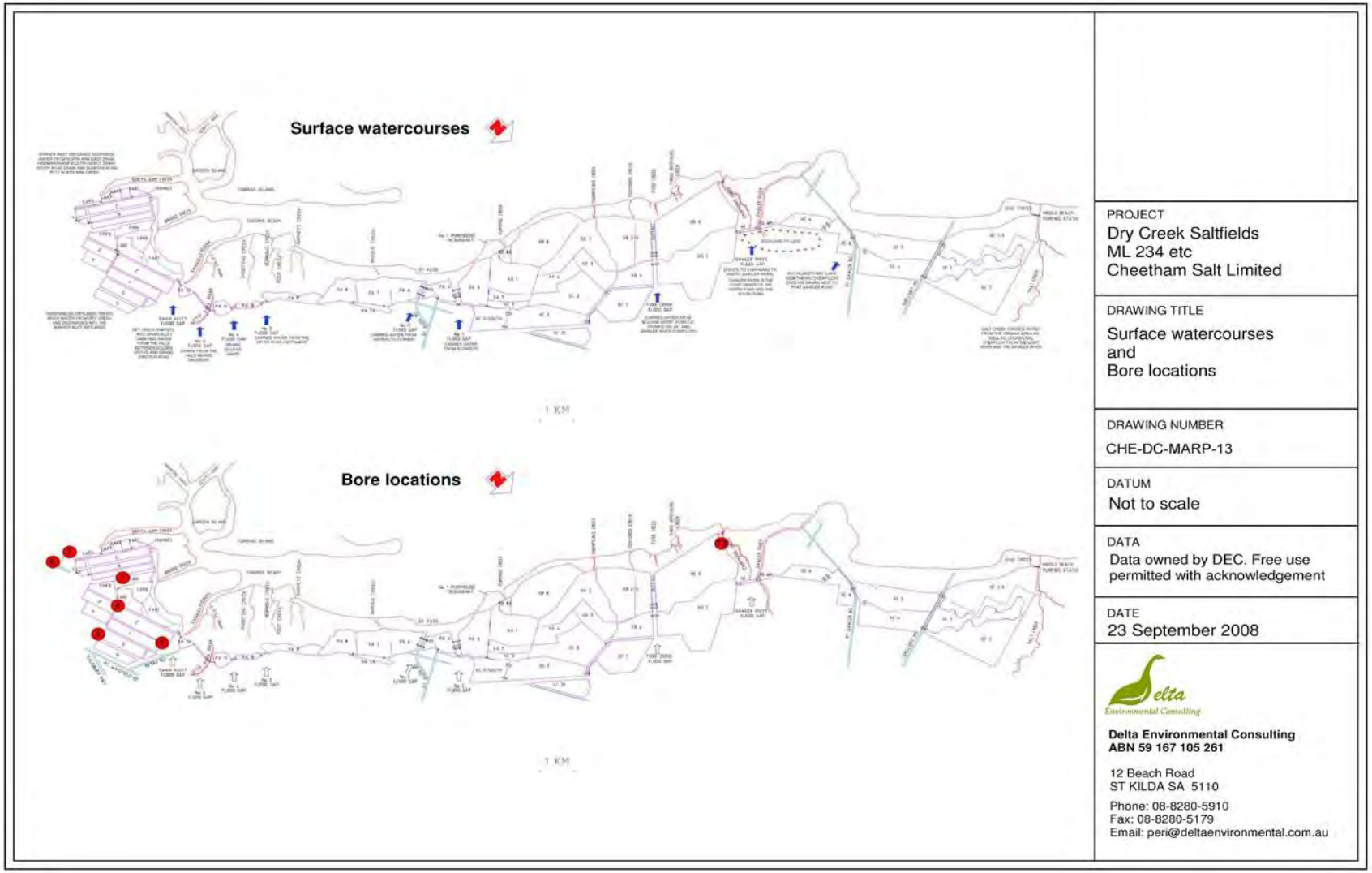


Figure 16-3: Surface water and bore locations

16.6.4 Potential Impacts

The salt fields are bunded with an external perimeter seepage drain and isolated from externally sourced runoff. Consequently, offsite stormwater is not expected to impact water quality in the salt field. One exception is overflow from a Salisbury City wetland outside the south-east boundary of Section 1. The E Row drain and flap is used to conduct overflow from the wetland through Section 1 to Dry Creek. This function will be preserved during residual operations and will not be impacted by the bulk earthworks trial.

The other exception is the managed trial of introduction of stormwater to XC3, discussed in 15.3.1. The quality this stormwater is not expected to compromise water quality in XC3 or other ponds – the main impact, as planned, will be to reduce salinity. This will be monitored during the trial.

The water in the ponds is subject to evaporation and seepage losses. If no new water is pumped in to the ponds, this evaporation and seepage loss will reduce the depth of water and ultimately leave discrete pools / pockets of water in the natural and man-made depressions in the topography within the ponds. The man-made depressions include trenches excavated to provide soil for bunds. Salinity will increase due to evaporation - the rate of evaporation (mass of water per day) relates to surface area and thus does not change much as the water level drops, whereas the concentration of salt is a function of the mass of salt divided by the available volume). So as the water volume reduces, the rate of evaporation loss becomes proportionately more important, and the rate of increase in salinity can accelerate.

Stagnation could occur when residual water in the ponds as a whole or left behind in depressions is not free draining, tidally flushed or able to dry out relatively easily and quickly by seepage and / or evaporation. Some of the ponds and some of the depressions contain aquatic life (plants, algae and fish) and fine grained sediments containing organic detritus. With the right temperature conditions, the water quality could deteriorate (low oxygen, increase in salinity, availability of nutrients and organic carbon) and lead to algal blooms in the water. In turn, this could provide fertile breeding ground for midges and mosquitoes. So, while the direct impact from the deteriorating water quality could be confined (i.e. kept within the individual ponds) or kept localised (i.e. kept within the discrete pools / pockets of water), the impacts from midges and mosquitoes could be more widespread, albeit seasonal or episodic. As the Holding Pattern will maintain flows through inundated ponds, these impacts are not expected to occur. Water quality in XB8A during the DEWNR trial will be monitored but it is expected this can be maintained through tidal flushing.

Similarly, the draining of the ponds will reduce the depth of water and ultimately leave discrete pools / pockets of water in the natural and man-made depressions in the topography within the ponds. Impact events could occur as above. This will be monitored during draining. However, given the scale of the draining exercise and the number of topographic depressions in the site, short term episodic impacts may occur.

If not appropriately managed, discharges of bitterns and hypersaline water to the marine environment could result in:

- permanent change (in the mixing zone of the discharge) of salinity or concentrations of other chemicals
- short term significant changes (in the mixing zone of the discharge) of salinity or concentrations of other chemicals. The ecological impacts of these discharges are discussed in 16.4. As impacts on marine flora and fauna are expected to be negligible, no impacts are expected on recreational use of the marine environment or other uses.

Silt retention dams or other forms of retention are not required for runoff. The majority of the site is unsealed, vegetated, tidal or ponded. Ponded areas will retain all runoff and tidal areas do not generate runoff. Unsealed and vegetated areas infiltrate a large quantity of rain as the soils are frequently sandy. Runoff that develops in the stack bays and roads of the crystallising area travels slowly down the drains to discharge into Dry Creek and North Arm Creek. This runoff is similar in composition to estuarine water, and has a low turbidity compared to the stormwater-affected receiving waters. Stormwater developed in the southernmost portions of the site settles in a stormwater pit near the front entry prior to discharge.

The bulk earthworks trial in Section 1 is not of a scale that would have any significant impact on surface water on the site.

Appropriate management of acid sulphate soils as discussed in Chapter 16.5 will ensure impacts of acid leaching to surface water will be negligible.

Surface water impacts are summarised in Table 16-10.

Table 16-10: Expected surface water impacts

Event ID	Impact Event	Expected Impact	Significance
SW1, SW5	Deterioration of quality of residual water in draining / drained ponds and their topographic depressions, trenches, drains, creeks or water bodies causing odours, midges, mosquitoes etc.	Minor short term episodic impacts may occur	Low
SW2, SW3	Degrading of water quality on site from stormwater entering the salt fields from offsite or run-off impacting waterways within the site.	Unplanned stormwater flows not expected to enter salinas	Negligible
SW4	Deterioration of water quality in the ponds, if left un-drained or not flushed, causing odours, midges, mosquitoes etc.	Holding Pattern is expected to maintain water quality	Negligible
SW6	Algal blooms in the water due to increased salinity, low oxygen, and availability of nutrients and organic carbon.	Holding Pattern is expected to maintain water quality	Negligible
SW7, SW8	Discharges of water from the site impacting the marine environment.	No adverse impact outside mixing zone	Negligible
SW9	Leaching of acid and metals into surface water impacting on ecosystems.	No adverse impact expected	Negligible

16.6.5 Control and Management Strategies

Surface water quality is managed through a program of pumping and discharge to ensure water levels are maintained at appropriate levels and salinity stays within desired criteria. Further trials are proposed to increase BDC's capability to manage salinity.

Bitterns are disposed to sea, although small quantities are used for dust control. Existing operational measures to reduce any impacts include:

- Dry Creek holds its bitterns longer than most salt fields to extract more NaCl, which reduces the sodium absorption ratio
- holding the bitterns longer also reduces the overall volume discharged
- discharge occurs in 'pulse' rather than 'press' cycles of between 16 and 70 discharges per annum over a period from December to July each year, allowing tidal flushing and complete dilution to occur prior to the subsequent discharges

- all discharge locations are designed to hyperoxygenate the bitterns at discharge
- discharge occurs where there is sufficient tidal flushing to ensure rapid dilution
- work instructions and a monitoring program have been implemented that address the requirements of the Environmental Authorisation.

Brine from Section 1 will be discharged into the North Arm Creek or Dry Creek on a trial basis. The trial procedure provides for:

- real time monitoring of the salinity at the mouth of each creek
- control of the:
  - salinity of each batch of diluted discharge into each creek
  - periods in between discharges
  - timing (to be on outgoing tides only) of discharges
  - duration of each discharge.

Should the salinity of a batch of diluted brine cause an exceedance of compliance criteria, then this batch can be either transferred into another part of Section 1 to make way for a new, more diluted batch, or further diluted itself.

Saline water may be discharged into coastal waters from Pond PA5 via the SA Water Bolivar Waste Water Treatment Plant Outfall. Table 16-11 extracted from the EPA Licence sets out the compliance monitoring points and compliance criteria for this discharge.

Table 16-11: Extract from EPA licence – compliance criteria and monitoring points

Location Identification	Location	Latitude/Longitude	Nature of Discharge	PARAMETER	COMPLIANCE CRITERIA
A1	Site 3 - Downstream of the SA Water Bolivar WWTP Outfall weir	Latitude -34.6991 Longitude 138.4757	Bolivar Channel Outfall Saline Water Discharge	Salinity	45 parts per thousand measured on a 6 hour rolling average
A2	Site 1a - Downstream of the SA Water Bolivar WWTP Outfall weir	Latitude -34.7006 Longitude 138.4749			

Under the conditions of the EPA Licence:

- Continuous in-line monitoring of salinity is required, with submission of monthly reports to the satisfaction of the EPA; and BDC must cease discharge if the salinity criteria is exceeded.
- BDC must develop and implement a Discharge Criteria Management Plan which includes:
  - methodology to maintain compliance with the 45 parts per thousand salinity criteria at Location A
  - proposed measures to address any exceedances of salinity criteria
  - steps BDC will take to resume discharge following any exceedances.

BDC ensures compliance with discharge criteria by undertaking the following monitoring (as shown in Figure 16-4)

- the salinity at the compliance points
- the salinity at the Bridge – a measure that is about 6 to 9 hours ahead of what will occur at the compliance points. This is compared with the operational warning trigger of 55 ppt and operational pump off trigger of 60 ppt for the salinity at the Bridge

- the estimated salinity at the Bridge in about 4 hours time - calculated from the current PA5 discharge flow rate and salinity, and the current outfall flow rate and estimated salinity
- The estimated PA5 discharge flow rate that would cause the Bridge salinity to reach 45 ppt in about 4 hours time. This is compared with the actual discharge rate.

BDC regularly reviews trends in the various signals and decides whether to:

- do nothing
- reduce the discharge flow rate (by increasing return flow to PA5 and (if needed) by inserting an orifice plate in the discharge plate)
- turn the pump off as a precaution, following which there are further reviews of trends in the various signals to decide whether to:
  - leave the pump off for a while
  - turn the pump on with a reduced discharge flow rate
  - turn the pump on with no change in discharge flow rate.

BDC also has a specific telephone and email alarm (warning) trigger based on the one hour moving average exceeding 55 ppt at the Bridge or 45 ppt at one or other of the compliance locations. This is to prompt reviews by BDC operations people of the trends in the various signals.

If the 6 hour moving average at the Bridge exceeds 55 ppt or if it exceeds 45 ppt at one or other of the compliance locations, the pump is automatically switched off and a telephone and email alarm (pump off) is sent out to BDC operations people.

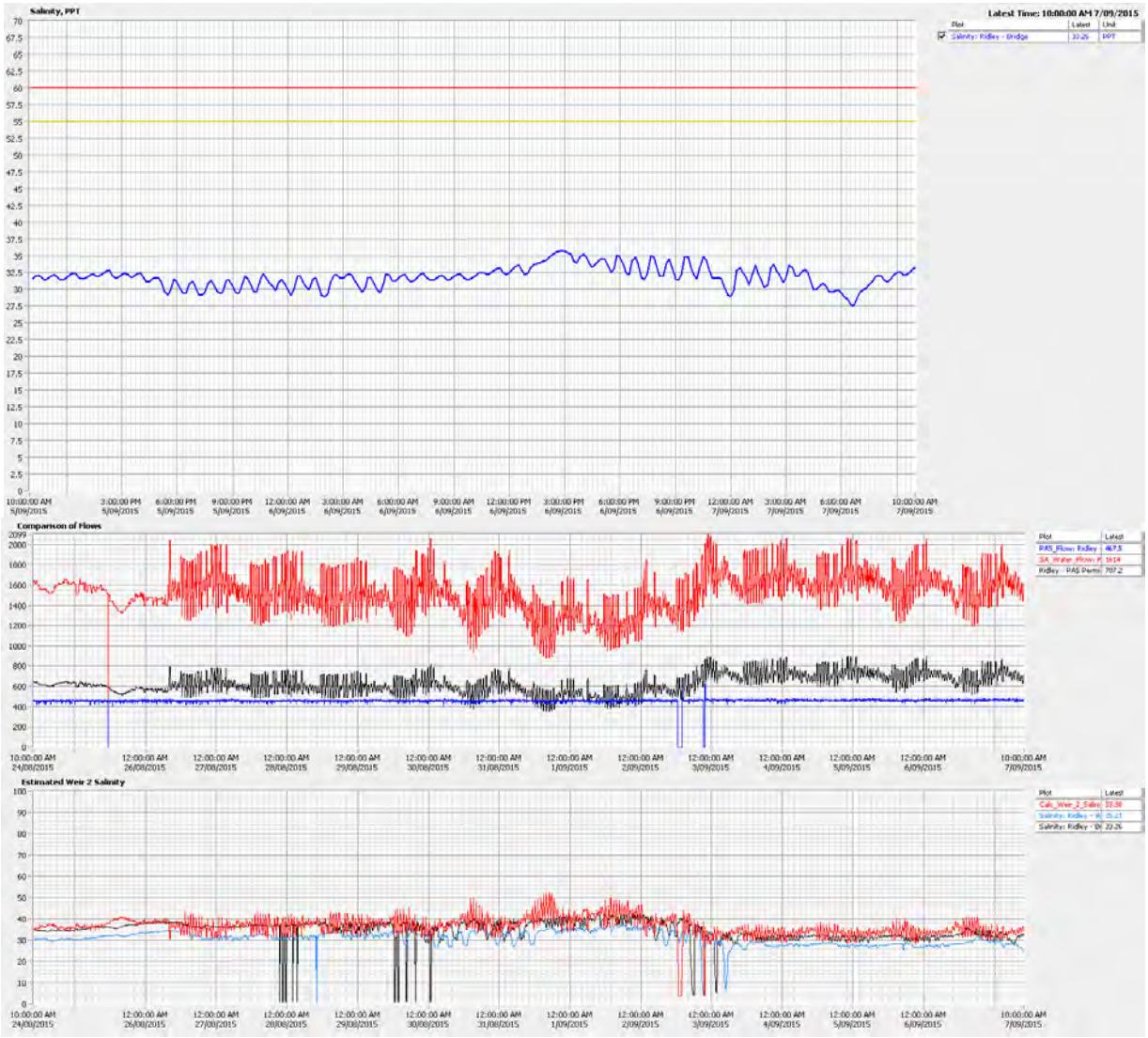
Discharge to the marine environment from the DEWNR trial in XB8A will be subject to continuous, telemetered instrumented monitoring of the discharge at the tidal gate of:

- salinity
- pH
- DO
- turbidity
- temperature

In the event that compliance criteria are reached, the mortised tidal gate will shut down and discharge will cease until further discharge is authorised by the EPA.

Pest insects are managed by:

- operation of inundated ponds with water quality resembling historical levels, which have historically managed pests at the site
- active monitoring of ponds to identify emergent issues which may prompt a management intervention (e.g. changes in water quality or targeted spraying)
- managing pools of water across the site, particularly in drying ponds, where monitoring shows this is necessary to prevent pest risk.



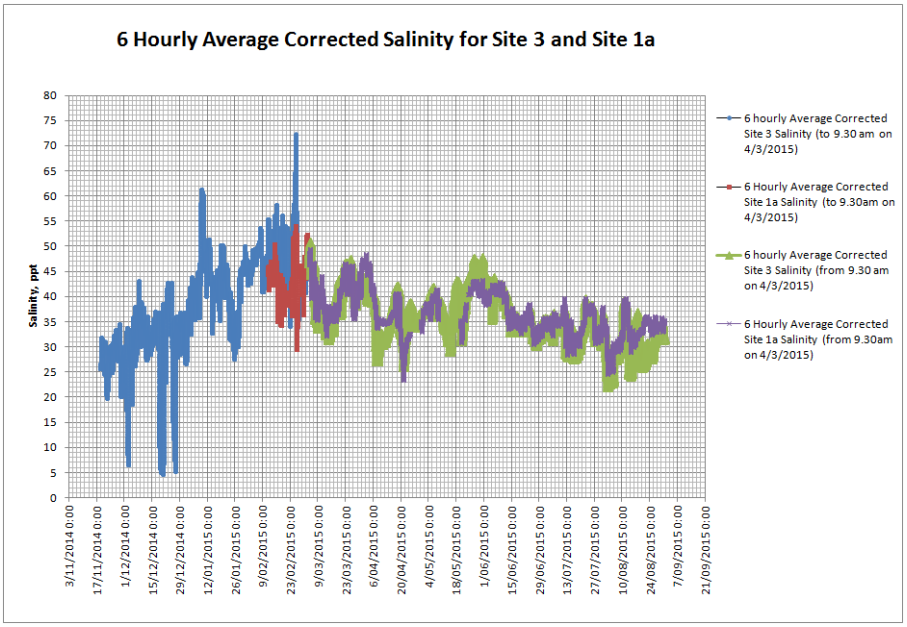


Figure 16-4: Monitoring at the Bridge (top) of discharge rates and expected salinities, and of salinity at the compliance point

16.6.6 Uncertainties and Limitations

The Holding Pattern builds on 70 years of experience in managing the salt field. Consequently, there is a high degree of confidence in being able to manage water flows across the salt field. However, during operation, the objective was to allow salinity to increase as water flowed towards Section 1. The Holding Pattern now seeks to control salinity given salt production has ceased. To date, the Holding Pattern has been successful in managing this but it has not been tested in the full range of climatic conditions. If salinity cannot be managed in the salinas, there is a risk that discharge criteria to the marine environment could not be met.

BDC has accurate information on the bathymetry of ponds from recent surveys and this helps to reduce uncertainties relating to the draining of ponds.

16.6.7 Risk Assessment

Pest insects have been successfully managed across the salt fields for many years to ensure there has been minimal impact on neighbouring residents. These measures will continue with particular attention paid to draining ponds.

The main risk relates to management of salinities in ponds to ensure discharge criteria are met, and to sustain bird habitat in the site. A significant and prolonged exceedance of the discharge criteria could have short-medium term impacts on the marine environment; while a prolonged period of excessive salinities within one or more ponds that are used by birds could have significant short term adverse impacts on the role of the site in sustaining migratory birds. Such an event would be related to seasonal conditions so would not occur on an ongoing basis. In practice, such an exceedance could not occur – because of the operational controls. Leading indicators that are designed to keep the salinity at the compliance point below 45 ppt are reinforced by a trigger that shuts the pump discharging to the SA Water outlet down automatically when the 6 hour average salinity at the compliance point exceeds exceeds 45 ppt.

Table 16-12 summarises the risks of greater surface water impacts than expected. Note that outcomes are required where regulatory criteria exist.

Table 16-12: Surface water risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
SW1, SW5	Deterioration of quality of residual water in draining / drained ponds and their topographic depressions, trenches, drains, creeks or water bodies causing odours, midges, mosquitoes etc.	Low	Likely	Moderate	Moderate
SW2, SW3	Degrading of water quality on site from stormwater entering the salt fields from offsite or run-off impacting waterways within the site.	Negligible	Rare	Low	Negligible
SW4	Deterioration of water quality in the ponds, if left un-drained or not flushed, causing odours, midges, mosquitoes etc.	Negligible	Unlikely	Low	Negligible
SW6	Algal blooms in the water due to increased salinity, low oxygen, and availability of nutrients and organic carbon.	Negligible	Unlikely	Low	Negligible

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
SW7, SW8	Discharges of water from the site impacting the marine environment.	Negligible	Unlikely	Moderate	Low
SW9	Leaching of acid and metals into surface water impacting on ecosystems.	Negligible	Unlikely	High	Moderate

16.6.8 Proposed outcomes

Adjoining residents will expect an environmental outcome that minimises nuisance impacts they experience. These nuisance impacts include dust and odour (addressed in 16.3) and pest insect species (e.g. midge, mosquitoes). Consequently, the following outcome is proposed:

- no adverse public health and or significant nuisance impacts due to pest insect species.

The other impact event requiring an outcome concerns discharges of water from the site into the marine environment. As the adjoining marine area provides for ecological processes, conservation and recreational uses, a high level of protection is warranted. Consequently, the following outcomes are proposed:

- no adverse impacts to adjacent land use
- no adverse impacts on the environmental values of marine waters due to water discharge.

16.6.9 Measurement Criteria

Outcomes and proposed measurement criteria are presented in Table 17-1. As management of water levels in ponds is the primary means to achieve the proposed environmental outcomes, measurement criteria focus on the appropriate levels. For discharge to the marine environment, the measurement criteria are set by the EPA licence. In addition to pond water levels, measurement criteria for pest insects will include maintenance of a complaints register and resolution of those complaints by BDC.

As compliance with the discharge criteria relies heavily on ongoing management of water levels in ponds, leading indicator criteria are proposed. As discussed above, leading indicator criteria will derive from monitoring:

- salinity at the Bridge
- estimated salinity at the Bridge in about 4 hours time
- estimated PA5 discharge flow rate that would cause the Bridge salinity to reach 45 ppt in about 4 hours time.

Leading indicator criteria for other discharges will be developed through the respective trials.

16.7 Groundwater

16.7.1 Sources of Potential Impacts

Sources of potential impact include:

- use of groundwater impacting other users
- contamination, salinity, acid sulfate conditions impairing quality of infiltration to groundwater at the site
- changes to groundwater impacting groundwater dependent ecosystems
- changes to groundwater quality and pressure impacting surface water and/or the marine environment

- seepage and Runoff from the construction area, and from Haul Roads:
- seepage and runoff from the placed materials will be collected within the E Row Crystalliser or within existing drains within Section 1.

16.7.2 Pathways

The pathway for the impact events above is water. Seepage and leaching of water to groundwater also occurs.

16.7.3 Receptors

Receptors include:

- other users of groundwater in the T1 and T2 aquifers
- environmental uses of water in the Gulf St Vincent, adjacent to the salt fields
- environmental uses of water within the site
- groundwater dependent ecosystems.

16.7.4 Potential impacts

Seepage drains around the salina ponds are used on the landward side of the ponds to ensure the head of water in the ponds does not cause "mounding" of the groundwater in the surrounding areas, as the salt field is underlain by several shallow, hypersaline aquifers in the St Kilda Formation. The brines gathered in these drains, composed both of salina seepage and discharge from the subsurface hypersaline water table from the higher lands to the east, are recycled back into the salina ponds.

Groundwater seepage will be reduced (as compared with normal operations) as the floors of crystallisers are revealed, salt removed and water levels kept low in Section 1. In Sections 2 to 4, draining of ponds will also reduce seepage. Inundated ponds will retain similar levels to those during operation so the head of pressure should not significantly change. Acid sulfate soils and contamination are discussed in Section 16.5. Appropriate management of ASS will ensure seepage will not adversely impact groundwater in the area.

The shallow groundwater may seep into drainage channels and affect surface water quality. Impacts on the marine environment could also occur through seepage or indirectly through the surface water impacts, and marine discharge of this water. For example, seepage has occurred into the Gawler River from Ponds XE6 and XE7 of water that reflects the salinity in these ponds (50 to 70 ppt). As this has continued for decades, the marine ecology adapted to this environment, although any impacts would be highly localised as dilution quickly occurs. The Holding Pattern does not increase salinity or water levels in ponds. In some cases, both would be reduced. Consequently, any new seepage impacts are expected to be negligible.

The trial for filling of F and G Row pits in Section 1 with salt residues is expected to show very low dissolution rates for the salt residues contained in these pits. Settlement rates and salt flux rates in groundwater should also be very low and not have material impacts on the external environment. In the trial plan, the ultimate risk management measure is to remove the placed salt in the pits, in the event that data from the trials indicates a material impact.

Seepage from the trial bulk earthworks in Section 1 will be limited given the low permeability in the crystallising pans. The small scale of these works will also ensure there will be no measurable impact.

At approximately 60 m below ground level, the T1 aquifer is the shallowest of the Tertiary aquifers. Given this depth and the presence of confining layers, seepage is not expected to affect this or any of the other Tertiary aquifers.

In summary, seepage from ponds and drains will only impact hypersaline aquifers and be at a similar or reduced rate to that which has occurred since the salt field was operational. This will not affect other groundwater users and is expected to have a negligible impact on groundwater dependent ecosystems.

There is currently no evidence to suggest that the taking of underground water from the Tertiary aquifers in the Northern Adelaide Plains Prescribed Wells Area has caused any detrimental impact to surface water resources in the region. There are also no known ecosystems dependent on the deep Tertiary aquifers on the Northern Adelaide Plains Prescribed Wells Area (NABCWMB 2000). These impacts are not considered further.

Bores 1, 3, 4 and 5 have a combined allocation of 1,177,248 kL per year. Aquifers T1 and T2 have a combined allocation in the Northern Adelaide Plains Prescribed Wells Area of 26,500 ML. Therefore the Dry Creek Salt Field usage accounted for approximately 5% of the total allocation of this resource.

Pressure levels in the main T1 and T2 aquifers declined after 2006 due to increased pumping, driven by below average rainfall. However higher rainfall during the growing season since 2009 has led to reduced pumping by other users and allowed the pressure levels to recover to pre-drought levels (Adelaide and Mt Lofty Ranges NRM Board 2013). The activities in this PEPR/MOP do not increase groundwater usage and, consequently, impacts on other users are expected to be low.

Two bores (6 and 7) are located within the Dry Creek Prescribed Wells Area and are allocation-free. These bores were also used for the dissolving operation. The usage from these bores is up to 650,000 kL. As these bores are the only bores in the Dry Creek Prescribed Wells Area they do not impact on other users.

A summary of expected impacts is in Table 16-13.

Table 16-13: Expected groundwater impacts

Event ID	Impact Event	Expected Impact	Significance
G1	Use of groundwater impacting other users	Usage of groundwater will not increase and is not expected to affect other users.	Low
G2	Contamination, salinity, acid sulfate conditions impairing the quality of infiltration to groundwater at the site	No adverse impact expected.	Negligible
G3	Changes to groundwater quality impacting surface water and / or the marine environment	No additional impact.	Negligible
G4	Groundwater seepage impacting groundwater dependent ecosystems	No additional impact.	Negligible

16.7.5 Control and Management Strategies

Measures are in place to ensure water extraction does not exceed sustainable levels. These include:

- monitoring of borewater usage
- use of recycled stormwater from the City of Salisbury's Greenfields Wetlands under the *City of Salisbury / Cheetham Salt Storm Water Supply Agreement*
- implementation of formal work instructions for resource management, bore management and wetlands water.

16.7.6 Uncertainties and Limitations

Given the well-established monitoring program for groundwater use, uncertainties are considered to be low.

16.7.7 Risk Assessment

As the shallow aquifers below the salt field are hypersaline, the risk of adverse groundwater quality impacts from seepage are considered to be low. The low level of uncertainty around groundwater usage and impacts on the resource means the risk to other users is also low. The Holding Pattern does not introduce any new activities that would increase the risk of groundwater seepage to surface water or the marine environment. The risk of greater impacts than expected are shown below in Table 16-14.

Table 16-14: Groundwater risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
G1	Use of groundwater impacting other users	Low	Unlikely	Moderate	Low
G2	Contamination, salinity, acid sulfate conditions impairing the quality of infiltration to groundwater at the site	Negligible	Unlikely	Moderate	low
G3	Changes to groundwater quality impacting surface water and / or the marine environment	Negligible	Unlikely	Low	Negligible
G4	Groundwater seepage impacting groundwater dependent ecosystems	Negligible	Unlikely	Low	Negligible

16.7.8 Proposed Outcome

Licensing of water bores is in place to ensure other groundwater users are not adversely impacts. Consequently, the proposed outcome is:

- no adverse impacts on other groundwater users.

16.7.9 Measurement Criteria

Measurement criteria in Table 17-1 reflect the water licence conditions.

16.8 Noise

16.8.1 Sources of Potential Impacts

Sources of noise include:

- machinery used in residual operations in Section 1, including for the trial fill site
- vehicle movement around salt fields
- haulage of material for the trial fill in Section 1
- operating pumps to move water between pumps in the salt fields
- machinery used in investigations and trials in Sections 2 – 4
- civil works to install tidal gate infrastructure and isolate pond XB8A from the holding pattern flow path.

16.8.2 Pathways

The pathway for transmission of noise is through the air.

16.8.3 Receptors

The main receptors are adjoining residents. Fauna on or near the salt field could also be receptors.

16.8.4 Potential impacts

The residual operations and trials in Section 1 represent a reduced level of activity in this area with no significant new equipment being used. Consequently, noise from these operations will not exceed historical levels of noise. As noted above, historical noise has rarely exceeded ambient levels due to the adjoining highway traffic. Housing at Mawson Lakes, however, is approximately 200 m away from the boundary of the crystallising area and occasional noise issues have been reported in the past by residential neighbours.

Operations for the trial fill in Section 1 will occur in the site's normal working hours. The plant and equipment to be used to construct the pilot trial will comply with relevant noise emission limits. The haul roads to be used and the location of the pilot trial are remote from the site boundaries.

Vehicle movement on site is occasional and not at a level which could cause nuisance. Noise from electrically driven brine pumps at St Kilda can be heard from the nearest housing under certain weather conditions, as can noise from the electrical sea-pumps of the Middle Beach pump station.

Noise from investigations and trials will be short term. As a new noise source, there is the potential for complaints from neighbouring residents.

Roosting and foraging birds can be sensitive to discrete, unpredictable disturbances such as sudden loud noises. This can cause them to waste energy stored for migration (DEWHA 2009). Noise disturbance from activities on the site will be limited, short-term and away from important roosting and foraging sites.

Table 16-15: Expected noise impacts

Event ID	Impact Event	Expected Impact	Significance
N1	Noise from machinery used in residual operations affecting adjoining residents	Within regulatory limits and generally within background levels	Negligible
N2	Vehicle noise on site affecting adjoining residents	Within regulatory limits and generally within background levels	Negligible
N3	Noise from operating pumps affecting adjoining residents	Within regulatory limits and generally within background levels	Negligible
N4	Noise from machinery used in investigations and trials affecting adjoining residents	Potential short term impacts but within regulatory limits	Low
N5	Noise from machinery used in investigations and trials affecting fauna	Minimal disturbance	Negligible

16.8.5 Control and Management Strategies

All equipment, including that used by contractors, is required to comply with relevant noise control policies and guidelines issued by the EPA. Night operation of construction equipment in

investigations and trials is not proposed. BDC's operating pumps are maintained in good condition, and a complaints register for noise is maintained along with action taken.

16.8.6 Uncertainties and Limitations

Noise exposure from existing operations is well understood. The only uncertainties stem from the investigations and trials as the scope of all trials and equipment to be used has not been finalised.

16.8.7 Risk Assessment

As the levels of uncertainty around existing noise levels are low, there is a negligible risk that greater noise impacts may result. The control and management strategies should ensure a risk of increased noise levels from investigations and trials is low.

Table 16-16: Noise risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
N1	Noise from machinery used in residual operations affecting adjoining residents	Negligible	Likely	Negligible	Negligible
N2	Vehicle noise on site affecting adjoining residents	Negligible	Unlikely	Negligible	Negligible
N3	Noise from operating pumps affecting adjoining residents	Negligible	Unlikely	Negligible	Negligible
N4	Noise from machinery used in investigations and trials affecting adjoining residents	Low	Likely	Low	Low
N5	Noise from machinery used in investigations and trials affecting fauna	Negligible	Unlikely	Low	Negligible

16.8.8 Proposed outcome

Residents adjoining the salt fields expect their amenity will be maintained. Consequently, the following outcome is proposed:

- no adverse public health or significant nuisance impacts due to noise.

16.8.9 Proposed measurement criteria

Outcomes and proposed measurement criteria are presented in Table 17-1. As noise issues are only sporadic, the measurement criteria rely on maintenance of a complaints register and demonstration of appropriate action to respond to complaints.

16.9 Heritage

16.9.1 Sources of Potential Impacts

Heritage items could potentially be impacted by:

- direct disturbance through earthworks
- off-road vehicle and machinery movement
- fire
- changes in water levels.

16.9.2 Pathways

The main pathway for impacts is through direct disturbance. Water can be a pathway for indirect impacts. Soil provides a barrier where sites, such as artefact scatters, are buried.

16.9.3 Receptors

Receptors are items or areas of heritage significance as described in Part 2 of this PEPR / MOP.

16.9.4 Potential Impacts

Activities on the salt fields are undertaken away from known sites of heritage significance. Consequently, there is a negligible risk of direct disturbance of heritage sites. Due to the pondage and limited are of dry vegetated land, fire risk on the salt fields is low. Heritage sites are generally located in submerged, or tidal areas meaning the risk from fire is also negligible.

Salt field operations only affect water levels in the ponds. There are no heritage items located in the ponds and, consequently, any changes to water levels in ponds will not affect heritage.

The heritage values of the salt field will be considered in the closure planning process. While the Holding Pattern results in draining of some ponds, the more significant ponds adjoining the coast are unaffected. In addition, the drained ponds retain all infrastructure (bunds, pumps) meaning that changes made are reversible, should heritage values subsequently identified warrant this. Consequently, it is not considered that the Holding Pattern compromises any heritage values of the salt field. Heritage impacts are summarised in Table 16-17.

Table 16-17: Heritage impacts

Event ID	Impact Event	Expected Impact	Significance
H1	Disturbance of heritage sites by earthworks, vehicles or machinery	No disturbance proposed	Negligible
H2	Damage to heritage sites from fire	Fire risk will remain low	Negligible
H3	Changes in water levels affecting heritage sites	Not expected to affect heritage sites or compromise any heritage value of the salt field	Low

16.9.5 Control and Management Strategies

The location and protection of the Aboriginal artefact scatter is detailed in the company's SOP-SC- A013 Heritage Management Instruction. Other known sites are outside any areas where disturbance occurs.

16.9.6 Uncertainties and Limitations

A comprehensive heritage survey of the salt field has not been undertaken. It is possible other heritage sites exist. The heritage value of the salt field has also not been assessed.

16.9.7 Risk Assessment

Risks result from unauthorised activities or disturbance to heritage sites that are not currently known. Both are considered to be low. The operational areas of the salt field have been extensively utilised and any further heritage sites would most likely have been identified. The non-operational areas of the salt

field will not be impacted by Holding Pattern activities. The risks to heritage values are shown in Table 16-18.

Table 16-18: Heritage risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
H1	Disturbance of heritage sites by earthworks, vehicles or machinery	Negligible	Unlikely	Moderate	Low
H2	Damage to heritage sites from fire	Negligible	Rare	Moderate	Negligible
H3	Changes in water levels affecting heritage sites	Low	Unlikely	Moderate	Low

16.9.8 Proposed Outcome

No outcomes are required.

16.9.9 Measurement Criteria

Not required.

16.10 Other Potential Impacts

16.10.1 Traffic

Traffic access to the residual operations in Section 1 is from the Salisbury Highway. This is a major arterial road and salt field traffic accounts for a small percentage of overall traffic. Access to other areas of the salt fields is occasional and vehicle numbers are low. Consequently, the salt fields operations will have a negligible impact on traffic movement in the area around the salt fields.

16.10.2 Public Safety

The salt fields area are fenced and the public excluded. The operating site is secured with heavy duty gates and padlocking at all road entry points and agricultural fencing along property boundaries that are accessible. Signage is provided along accessible fence lines at regular intervals. The management of access at the salt field is detailed in the company's SOP-SC-A004 Security instruction.

While illegal access does occur, there are no significant risks on site other than vehicular traffic (e.g. there are no pit voids or other hazards normally associated with a mining operation). A vehicle speed limit of 40 km/h is enforced across the site. Consequently, no public safety impacts are expected and risks are considered to be negligible.

16.10.3 Visual Amenity

Dry Creek Salt Fields has considerable scenic and aesthetic value. The open ponds of the salinas and crystallisers are regularly the subject of photographers hoping to obtain images of sunsets and reflections. Specialist photographers such as bird photographers and coastal wetland photographers regularly visit the salt fields for nature photography. Over the period of its operation the salt fields have hosted the filming of several feature productions and numerous television commercials, magazine advertising shoots and art photograph. The salt fields most commonly used for these purposes are those close to the coast. These are not impacted by the operations in this PEPR / MOP.

The majority of the salt fields comprises low lying ponds backed with mangroves. These do not require screening, as they are consistent with the natural environment in which they occur. The crystallising area with its stacks of salt has a more mixed visual impact, depending on the point of view of the observer and this area has some screening/amenity plantings where the pans are immediately adjacent to roadways.

Draining of ponds will result in a change in the landscape – such changes will only be visible to a small number of observers. Drainage of ponds is reversible during the Holding Pattern. Any changes in inundated ponds will have minimal impact on visual amenity. The impacts of the Holding Pattern on visual amenity are considered to be low. No additional risks have been identified.

16.10.4 Conservation Areas

The mineral tenements of the salt fields are adjacent to, or overlain by, several conservation areas. The Port Gawler Conservation Park shares a boundary with ML608 and ML404. DEWNR also administer land at Buckland Park Lake adjacent to PM100, ML608 and ML 5210. The Adelaide Dolphin Sanctuary boundary overlays parts of the mineral tenements between North Arm Creek and Gawler River. This enables DEH staff to utilise the seawalls to access the Sanctuary. Similarly, the two Aquatic reserves (Barker Inlet Aquatic Reserve, and St Kilda-Chapman Creek Aquatic Reserve) and the two Wetlands of National Importance (Barker Inlet and St Kilda wetlands and Port Gawler and Buckland Park Lake wetlands) overlay portions of the mineral tenements.

Impacts to areas of conservation are discussed above:

- dust from exposed ground surfaces affecting adjoin areas of conservation significance – addressed in 16.3
- discharge to the marine environment impacting on habitat – addressed in 16.4
- exposure to salt / gypsum impacted soils impacts on ecological values off site – addressed in 16.5
- acidity generated from ASS / PASS impacts off land uses on site – addressed in 16.5
- discharges of water from the site impacting the marine environment – addressed in 16.4, 16.6 and 16.7.

No additional impacts or risks have been identified.

16.10.5 Waste Management

The salt field administration offices operate on a septic tank system. Office and general waste is dealt with using a licensed waste contractor.

Office wastes include recyclable materials such as paper and toner cartridges, and lunch room waste. The maintenance workshop generates oily waste, tyres and scrap metal. Infrastructure upgrades may generate asbestos, timber and building waste.

Measures to manage wastes of all types include:

- appropriate bins for recycling materials, non-toxic solids and oily wastes are provided
- scrap wood and metal is reused or sold on to recyclers
- chemical wastes are collected by licensed contractors
- tyres are disposed to a licensed dealer
- asbestos is removed and disposed by licensed operatives
- stack bay muds are returned to the final areas ponds
- work instructions, #SOP-SC-A012 WASTE MANAGEMENT and #SOP-SC-A002 MONTHLY REPORTS have been implemented that specify the appropriate disposition of specific wastes, retention of waste transfer dockets and monthly reporting of waste volumes.

Given these measures, risks to the environment from management of wastes are considered to be negligible.

17 Environmental Outcomes and Measurement Criteria – Holding Pattern and Residual Operations

Environmental outcomes and proposed measurement criteria are shown in Table 17-1 for each of the environmental aspects above. An outcome has been proposed for all potential and actual impact events unless the potential receptor has no environmental value or could not reasonably be expected to be affected by the impact event.

All outcomes require measurement criteria to determine whether the outcome is being met. Leading indicator criteria are required where there is a high reliance on management measures to achieve the outcome.

17.1 Operator Compliance Monitoring Plan – Holding Pattern and Residual Operations

The compliance monitoring plan is described in Table 17-1. This specifies:

- the parameters which will be monitored
- how they will be monitored
- the location of monitoring
- the frequency of monitoring

Table 17-1 also specifies the compliance reporting that will be provided to DSD (and other government agencies where noted). There are two main types of reporting:

- Incident reporting, which includes:
  - reporting of non-compliance with a PEPR outcome under Reg 87 of the Mining Regulations, where the occurrence of a reportable incident must be reported to DSD within one day of BDC becoming aware of the incident
  - for other incidents (such as receipt of an odour complaint) in Table 17-1, within the period specified in the table.
- Routine compliance reporting under Reg 86 of the Mining Regulations, with the reporting period being six months. This will address the matters in Table 17-1 and in Ministerial Determination 009, including reporting on:
  - any changes to the Holding Pattern or residual operations since the previous report
  - the outcome of any studies or investigations
  - any new potential environmental risks
  - revegetation and other rehabilitation activities
  - compliance with outcomes and leading indicator criteria
  - rectification of any non-compliance
  - outcome of any management system audits undertaken.

BDC is also required to submit an Annual Return to the EPA under s. 48(2)(a) of the Environment Protection Act, and a monthly report on the results of the continuous in-line monitoring of the PA5 discharge and analysis of the discharges.

Within each 6 month period, BDC will continue to report for the purposes of operational management, informing discussion of strategic issues and advising progress, to government regulators and members of STAG. The mode, scope and frequency of this reporting will be determined with STAG, DSD, and EPA.

BDC is also providing progress reports on the status of closure planning, including investigations and trials, to STAG at each meeting, currently held every three weeks. This is expected to continue through the closure planning period. This non-regulatory reporting will be summarised in the six monthly compliance reports.

Table 17-1: Environmental outcomes and measurement criteria – Residual Operations (Section1); Holding Pattern (Sections 2 to 4) and Investigations / Trials for Closure Works Design

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
No adverse public health and or significant nuisance impacts due to air emissions, dust, pest insect species, odour, or noise (A significant nuisance impact is considered to be one that generates a complaint that is confirmed as attributable to the salt field and cannot be addressed within the timeframes specified in the measurement criteria.)	**Dust** Register demonstrates that in respect of complaints relating to impacts from dust outside site boundary: ▪ complaint initially responded to within 48 hours; ▪ issues underlying complaint investigated and causes identified within 2 weeks or other time frame agreed by DSD; ▪ complaint closed out within 4 weeks or other time frame agreed by DSD **Pest Insects** Register demonstrates that in respect of complaints relating to impacts outside site boundary from pests: ▪ complaint initially responded to within 48 hours; ▪ issues underlying complaint investigated and causes identified within 2 weeks or other time frame agreed by DSD;	**Dust** Register of complaints received and response actions taken **Pest Insects** Register of pest control advice from Dept of Health responded to within reasonable timeframe. **Odour** Register of complaints received and response actions taken **Noise** Register of complaints received and response actions taken	Site-wide	**Dust** Entries in register are triggered by complaints **Pest Insects** Entries in register are triggered by complaints **Odour** Entries in register are triggered by complaints **Noise** Entries in register are triggered by complaints	**Dust** Weekly observations of potential sources identify dust is being entrained in windy conditions or dunes are developing at the edge of ponds **Pest insects** Not required **Odour** Weekly observations at locations shown in air quality monitoring plan identify an odour intensity of 1 (mild) or more and a reason to expect a deterioration in odours. Reasons to expect a deterioration in odours could include the following: ▪ recent heavy rainfall, sufficient to add water to pools in dry pond; or to re-wet / moisten MBO or partially	**Incident reporting** ▪ any dust, pest insect, odour or noise complaints reported to DSD within 48 hours of receipt ▪ progress reporting on resolution of complaint provided as directed by DSD ▪ report closing out complaint provided to DSD within 4 weeks, or timeframe otherwise agreed. **Six monthly reporting** ▪ complaints received for period and status ▪ any exceedances of leading indicator criteria and action taken ▪ compilation of odour monitoring results.

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
	▪ complaint closed out within 4 weeks or other time frame agreed by DSD **Odour** Register demonstrates that in respect of any complaints relating to impacts outside site boundary from pests: ▪ complaint initially responded to within 48 hours; ▪ issues underlying complaint investigated and causes identified within 2 weeks or other time frame agreed by DSD; ▪ complaint closed out within 4 weeks or such other time frame agreed by DSD **Noise** Register demonstrates that in respect of any complaints relating to impacts from noise outside the site boundary: ▪ complaint initially responded to within 48 hours; ▪ issues underlying complaint investigated and causes identified within 2 weeks or other time frame agreed by DSD;				decomposed organic matter for more than a few days. ▪ deterioration in water quality (DO declining towards 1 mg/l or less; and increasing salinity; and reducing pH) ▪ an increasing area of soil or water becoming discoloured black ▪ weather conditions becoming unsuitable for dispersion of odours ▪ a fish kill ▪ an algal bloom developing. **Noise** Not required	

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	**What will be measured and how**	**Location**	**Frequency**		
	▪ complaint closed out within 4 weeks or other time frame agreed by DSD					
No adverse impacts to adjacent land use	**Inundated ponds[1]** Records from weekly monitoring of pond water levels demonstrate pumped entrainment and discharge have: ▪ maintained water levels in ponds within target range set out in Table 17-2, or other levels agreed with EPA in writing. **Other ponds[2]** Records demonstrate: ▪ ASS / MBO investigations undertaken and results provided to EPA / DSD ▪ risk monitoring and management plan prepared as agreed with DSD / EPA ▪ actions in risk monitoring and management plan implemented in accordance with timeframes specified in plan ▪ outcome measurement criteria specified in plan met	**Inundated ponds** ▪ water levels using established procedures ▪ pumped water entrainment rates per ha ▪ pumped water discharge rates per ha **Other ponds** ▪ progress in undertaking investigations and preparing risk monitoring and management plan (where required) ▪ monitoring parameters specified in each endorsed plan. **Bund banks** Register of: ▪ dates, location and scopes of maintenance / repairs to bund banks ▪ twice yearly inspections of condition of all bund banks to inundated ponds **Seepage Drains** Register of:	**Inundated ponds** ▪ water levels measured at established locations in ponds used during historic operations. Are typically close to where water flows out of each pond - see Table 17-2 ▪ pumped water entrainment rates per/ha of inundated ponds at Middle Beach and Chapman Creek ▪ pumped water discharge rates from PA5 per ha of inundated ponds **Other Ponds** ▪ monitoring and measurement	**Inundated ponds** ▪ Water levels, pumped entrainment rates and pumped discharge rates recorded weekly, reported fortnightly and reviewed monthly with DSD and EPA **Other Ponds** ▪ Frequency of monitoring and measurement defined in endorsed risk monitoring and management plan ▪ Frequency of reporting and review of monitoring and measurement with DSD and EPA to be as defined in the risk monitoring and management plan **Bund banks**	Leading indicator criteria will be specified in risk monitoring and management plans, where needed.	**Incident reporting** ▪ any non-compliances with pond levels specified in the outcome measurement criteria reported to DSD within 48 hours of recording. ▪ progress reporting on remedial action taken as directed by DSD. **Six monthly reporting** ▪ compilation of weekly pond level monitoring results ▪ status of ASS/MBO investigations ▪ status of implementation of any risk monitoring and management plans

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
	Bund banks Records demonstrate that: ▪ inspections every six months of bunds banks for inundated ponds demonstrate are stable and maintained at a height that will ensure no unplanned overflow from ponds; or ▪ if any maintenance / repairs issues are identified from 6 monthly inspections, they are closed off within 1 calendar month unless otherwise agreed with DSD and EPA **Seepage Drains** Records demonstrate that: ▪ quarterly inspections of seepage drains demonstrate they are stable; or ▪ if any maintenance / repairs issues identified from quarterly inspections of seepage drains are closed off within 1 calendar month unless otherwise agreed with DSD and EPA	▪ dates, location and scopes of maintenance / repairs to seepage drains ▪ quarterly inspections of functioning of all seepage drains	locations defined in endorsed risk monitoring and management plan **Bund banks** ▪ where maintenance / repairs are required ▪ all bund banks to inundated ponds **Seepage Drains** ▪ all seepage drains	▪ Inspections of all bund banks to inundated ponds – twice yearly ▪ Register reviewed twice yearly with DSD and EPA **Seepage Drains** ▪ Inspections of functioning of all seepage drains – quarterly ▪ Register reviewed quarterly with DSD and EPA		▪ any additional reporting requirements specified in endorsed risk monitoring and management plans ▪ bund inspection results and status of any maintenance / repair issues identified ▪ seepage drain inspection results and status of any maintenance / repair issues identified.

<table>
<tr><th rowspan="2">Environmental Outcome</th><th colspan="4">Outcome Measurement Criteria</th><th rowspan="2">Leading Indicator Criteria</th><th rowspan="2">Compliance Reporting</th></tr>
<tr><th>Measurement Criteria</th><th>What will be measured and how</th><th>Location</th><th>Frequency</th></tr>
<tr>
<td>No adverse impacts on other groundwater users</td>
<td>Water bores
Records of meter readings demonstrate the volume of water extracted per annum does not exceed the following allocations:
<table>
<tr><th>Bore number</th><th>Aquifer</th><th>Allocation</th></tr>
<tr><td>6628_19184</td><td>T1</td><td rowspan="4">1,177,255 kL</td></tr>
<tr><td>6628_10427</td><td>T1</td></tr>
<tr><td>6628_04356</td><td>T1</td></tr>
<tr><td>6628_13020</td><td>T1</td></tr>
<tr><td>6628_13170</td><td>T1</td><td rowspan="2">850,255 kL</td></tr>
<tr><td>6628_18042</td><td>T1</td></tr>
<tr><td>6528_2005</td><td>T3</td><td>1,200,000 kL</td></tr>
</table>
</td>
<td>Water bores
Metered volume of water</td>
<td>Bore Number:
▪ 6628_19184
▪ 6628_10427
▪ 6628_04356</td>
<td>Water bores
▪ Annual records of the volumes of water extracted</td>
<td>Other ponds[2]
Water from drained ponds has a pH of 7 or more as measured at the discharge point for each pond.</td>
<td>Annual reporting
▪ Actual volumes of water extracted per annum compared to allocations.
▪ Records of any exceedance of leading indicator criteria and action taken.</td>
</tr>
<tr>
<td>No loss of abundance or diversity of native vegetation on or off Sections 2 to 4 of salt field through clearance arising from Holding Pattern, unless prior approval under relevant legislation is obtained</td>
<td>Records demonstrate that all clearance of native vegetation has been undertaken with appropriate permissions.
It is noted that clearance can also include loss from:
▪ physical works,
▪ dust/contaminant de position,
▪ fire, or
▪ other damage.</td>
<td>Register of approvals sought and granted for loss of abundance or diversity of native vegetation arising from Holding Pattern or other activities in Sections 2 to 4, and due to:
▪ clearance,
▪ dust / contaminant deposition,
▪ fire, or other damage
Loss of abundance or diversity of native vegetation arising from Holding Pattern or other</td>
<td>As defined in approvals granted</td>
<td>As defined in approvals granted</td>
<td>Not required</td>
<td>Incident reporting
▪ Any unauthorized vegetation clearance reported to DSD within 48 hours of incident
▪ Progress reporting on remedial action taken as directed by DSD.
Six monthly reporting
▪ Summary of vegetation</td>
</tr>
</table>

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
		activities in Sections 2 to 4, and due to: ▪ clearance, ▪ dust / contaminant deposition, ▪ fire, or ▪ other damage				clearance approvals sought in previous 6 months ▪ List of approvals granted and action taken by BDC ▪ Map showing any areas cleared.
No adverse impacts on the environmental values of marine waters due to water discharge	**PA5 and Gawler River Discharges** Records demonstrate that salinity from: ▪ PA5 discharges, measured as a moving 6hr average at the "PA5 Discharge compliance point" taken no less frequently than each 10 minutes is within the 45ppt TDS threshold. ▪ XE6 discharges, measured at the "Gawler River Discharge compliance point" taken no less frequently than each 10 minutes is within criterion for this compliance point - being the greater of: ▪ The maximum diurnal TDS measured in the past 30 days at the compliance point in the	**PA5 and Gawler River Discharges** Salinity from discharges: ▪ Salinity measured by calibrated conductivity sensor Records of notification and of exceedance reports **XB8A Trial Discharges** Continuous, telemetered instrumented monitoring of the discharge at the tidal gate of: ▪ Salinity ▪ pH ▪ DO ▪ Turbidity ▪ Temperature Records of notification and of exceedance reports	**PA5 and Gawler River Discharges** The PA5 Discharge compliance point using monitoring sites 1a and 3, was, until January 2017 Lat: -34.6989 Long: 138.4759. From January 2017, following installation of Buoy 3a to replace damaged and inoperable monitoring sites 1a and 3, the compliance point is: Lat: -34.700097 Long: 138.475268. The Gawler River Discharge Compliance	**PA5 and Gawler River Discharges** Salinity from discharges: ▪ No less frequently than each 10 minutes Monthly reports of daily monitoring submitted to EPA, with graphs of data Monthly review of weekly monitoring results with EPA Exceedance reports to be provided within 3 days with root cause assessment and proposed or taken corrective action. **XB8A Trial Discharges**	**PA5 and Gawler River Discharges** Monitoring of: ▪ salinity at the compliance points ▪ salinity at the Bridge ▪ salinity at Weir ▪ estimated PA5 discharge flow rate that would cause the salinity to reach 45 ppt in about 4 hours time, or the Weir 2 salinity to reach 45 ppt in about 10 hours time. This is compared with the actual discharge rate **XB8A Trial Discharges**	**All Discharges** **Incident reporting:** ▪ Any non-exceedances of the outcome measurement criteria notified to DSD, EPA and PIRSA within 24 hours ▪ Progress reporting on remedial action taken as directed by DSD, EPA or PIRSA. **Monthly reporting** ▪ Results of the continuous in-line monitoring and analysis of the discharges

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
	absence of discharge from XE6; or ▪ The measured contemporaneous maximum diurnal TDS in Chapman Creek (at the pumping station). In the event of an exceedance at a discharge compliance point, records will demonstrate that: ▪ there has been notification to DSD, PIRSA and EPA within 24 hrs ▪ exceedance was followed by a period of nil discharge from PA5 or XE6, as appropriate, unless and until further discharge is endorsed by EPA Exceedance reports were provided within 3 days with root cause assessment and proposed or taken corrective action. **XB8A Trial Discharges** ▪ Salinity greater than 45 trigger at compliance point down Pumping Creek over greater than 6 hour rolling average (while discharging from tidal gate). ▪ <50% saturation dissolved oxygen saturation in	**XB8A Trial: Other Monitoring** The scope, quality and completeness of reports of the following monitoring as specified in Appendix 10 ▪ Tidal event-based water sampling and testing (all parameters for the proposed trial, as listed in Appendix 10: turbidity, total suspended solids, electrical conductivity, pH, dissolved oxygen, redox potential, alkalinity, total, dissolved and colloidal metals (Al, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, V, Zn) and metalloid (As), and sulfate-S.) ▪ Sediment/soil quality sampling and testing ▪ Biological monitoring ▪ Benthic invertebrate monitoring ▪ Birds monitoring ▪ Vegetation monitoring **Brine Discharge from Section 1 into North Arm Creek or Dry Creek** ▪ Salinity from discharges measured by calibrated conductivity sensor	point was until December 2016, at: Lat: -34.6729 Long: 138.4652 Following theft of the salinity sensor and 60 m of cable in September 2016, a new sensor was installed in December 2016 at a more secure compliance location at Lat: -34.672169°, Long: 138.466514° **XB8A Trial Discharges** The compliance point is at: Lat: - 34.728131 Long: 138.516584 **XB8A Trial: Other Monitoring** As specified in Appendix 10 **Brine Discharge from Section 1 into North Arm Creek or Dry Creek**	Monitoring will be undertaken only for the duration of the DEWNR trial unless otherwise requested by DSD and / or EPA. For the DEWNR trial: • Instrumented monitoring no less frequently than each 10 minutes • Monthly reports of daily monitoring submitted to EPA, with graphs of data • Monthly review of weekly monitoring results with EPA • Exceedance reports to be provided within 3 days with root cause assessment and proposed or taken corrective action. **XB8A Trial: Other Monitoring** Monitoring will be undertaken only for the duration of the DEWNR trial unless otherwise	▪ Salinity greater than 45 ppt at compliance point down Pumping Creek ▪ <50% saturation dissolved oxygen saturation in outflowing pond water averaged over diurnal tidal cycle. ▪ pH < 6.5 in water exiting pond; AND/OR Major (>50 %) pond area) surface sediment (0-30 cm) acidification (pH<4) ▪ Pond outflow temperature ± 10 % outside local reference data (tidal creek inflows and adjacent intertidal mudflat water) averaged over diurnal tidal cycle **XB8A Trial: Other Monitoring**	**Six monthly reporting** ▪ Any exceedances of leading indicator criteria and action taken ▪ Graphs showing measured parameters vs time recorded at compliance points, and compared with measurement criteria

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	**What will be measured and how**	**Location**	**Frequency**		
	outflowing pond water averaged over diurnal tidal cycle. ▪ pH < 6.5 in water exiting pond; AND/OR Major (>50 %) pond area) surface sediment (0-30 cm) acidification (pH<4) ▪ Pond outflow turbidity >150 % of local reference data (tidal creek inflows and adjacent intertidal mudflat/creek water) averaged over diurnal tidal cycle ▪ Pond outflow temperature ± 10 % outside local reference data (tidal creek inflows and adjacent intertidal mudflat water) averaged over diurnal tidal cycle **XB8A Trial: Other Monitoring** Reports show that the following monitoring has been conducted as specified in Appendix 10 ▪ Tidal event-based water sampling and testing ▪ Sediment/soil quality sampling and testing ▪ Biological monitoring	▪ Records of notification and of exceedance reports	The North Arm Creek Discharge compliance point is at: Lat: -34.826173, Long: 138.565533 Dry Creek Discharge compliance point is at: Lat: -34.826173° Long: 138.565533	requested by DSD and / or EPA. For the DEWNR trial: • As specified in Appendix 10 **Brine Discharge from Section 1 into North Arm Creek or Dry Creek** Instrumented monitoring no less frequently than each 10 minutes Monthly reports of daily monitoring submitted to EPA, with graphs of data Monthly review of weekly monitoring results with EPA Exceedance reports to be provided within 3 days with root cause assessment and proposed or taken corrective action.	Reports will be produced when requested by DSD **Brine Discharge from Section 1 into North Arm Creek or Dry Creek** Leading indicator criteria will be developed from the results of the trial	

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	**What will be measured and how**	**Location**	**Frequency**		
	▪ Benthic invertebrate monitoring ▪ Birds monitoring ▪ Vegetation monitoring **<u>Brine Discharge from Section 1 into North Arm Creek or Dry Creek</u>** Discharges, measured as a moving 6hr average at the "North Arm Creek Discharge compliance point ” or the “Dry Creek Discharge compliance point" taken no less frequently than each 10 minutes is within the 45ppt TDS threshold.					
No adverse impacts to avifauna using the site beyond internationally recognised impact thresholds, or outside historic ranges of variability in Species and bird numbers	Records demonstrate that impacts on listed migratory birds from activities in this PEPR / MOP are below significant impact threshold as determined by EPBC Act significant impact guidelines for Matters of National Environmental Significance **Inundated ponds** Records from weekly monitoring of pond water levels demonstrate pumped entrainment and discharge have maintained water levels in ponds within target range set out in Table 17-2, or other	EPBC Act Self- Assessment completed for Sections 3 and 4 and submitted to DEE. Review by DEE indicates no disagreement with findings **Inundated ponds** Water levels using established procedures	Holding Pattern Bird Monitoring and EPBC Self Assessment for all ponds in Sections 3 and 4 **Inundated ponds** Water levels measured at established locations in ponds locations used during historic operations. Are typically close to where water flows out of each pond - see Table 17-2	Monthly Holding Pattern Bird Monitoring, unless otherwise agreed with DEWNR and DEE ▪ Self-assessment reviewed annually to take account of bird monitoring results ▪ For inundated ponds, water levels, pumped entrainment rates and pumped discharge rates recorded weekly, reported	Leading indicator criteria will be developed following completion of studies on the relationship between bird usage and pond morphology, salinity and water levels	▪ DSD provided with any updated self-assessment or copy of EPBC referral within 7 days of completion. ▪ Any feedback from DEE provided to DSD within 7 days **Six monthly reporting** ▪ Bird monitoring results ▪ Status of studies on migratory

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
	levels agreed with EPA in writing.			fortnightly and reviewed monthly with DSD and EPA		birds as set out in Table 15-3.
No compromise to potential future land use	Compliance with measurement criteria (as above) for the following outcomes: ▪ No adverse impacts to adjacent land use ▪ No adverse impacts to avifauna using the site beyond internationally recognised impact thresholds, or outside historic ranges of variability in species and bird numbers	As specified above for those outcomes	As specified above for those outcomes	As specified above for those outcomes	As specified above for those outcomes	**Incident reporting** As specified above for those outcomes **Six monthly reporting** As specified above for those outcomes

[1] Inundated ponds are defined as: Ponds XE1-3, XE5, XE6, XE7, XD1, XC3, XB3, XB4-5, XB6, XB8, XB8A, XA1, XA2, XA3, XA4, XA7, PA3, PA4, PA5

[2] Other ponds are defined as XF1, XF2, XE4, XC1, XC2, XC2S, PA6, PA7, PA7A, PA8, PA9, PA10, PA11, PA12

Table 17-2: Historical operational water levels (from measured data)

Section	Pond	Maximum Water Level (m AHD) 2003 - 2013	Average water level (m AHD) 2003 - 2013	Minimum Water Level (m AHD) 2003 - 2013	Fluctuation in Water Level (Max – Min) (m)	Min to Max Levels = Compliance Range for Purposes of Error! Reference source not found.
Section 4	XE1-3	3.10	2.65	2.52	0.58	Yes
	XF1	3.24	3.11	2.87	0.37	No – This is a drained / dry pond
	XF2	4.08	3.96	3.77	0.31	No – This is a drained / dry pond
	XE4	3.07	2.97	2.41	0.66	No – This is a drained / dry pond
	XE5	2.68	2.59	2.06	0.62	Yes
	XE6	2.34	2.18	2.00	0.34	Yes
Section 3	XE7	Water level controlled by XD1				No
	XD1	2.90	2.82	2.59	0.31	Yes. Minimum level of 2.30 m
	XB6	2.78	2.48	2.28	0.50	Yes. Minimum level of 2.10 m
	XC1	3.35	3.23	3.10	0.25	No – This is a drained / dry pond
	XC2	3.34	3.24	3.14	0.20	No – This is a drained / dry pond
	XC2S	3.30	3.16	3.06	0.24	No – This is a drained / dry pond
	XC3	2.56	2.49	2.05	0.51	Yes. Minimum level of 1.95 m
	XB3	2.38	2.26	2.03	0.35	Yes
	XB4-5	2.21	2.10	1.97	0.24	Yes
	XA3	2.14	2.08	1.98	0.16	Yes. Minimum level of 2.00 m
	XA4	Water level controlled by XA2 or XA1				No
	XA2	2.16	2.09	2.00	0.16	Yes
	XB8	Water level controlled by XB8A				No
	XB8A	2.16	2.07	1.97	0.19	Yes
	XA7	Water level controlled by XA1 or PA3				No
	XA1	2.12	2.04	1.95	0.17	Yes. Min. level of 1.90 m
Section 2	PA3	2.11	2.03	1.90	0.21	Yes
	PA4	Water level controlled by PA5				No
	PA5	2.12	2.01	1.65	0.47	Yes
	PA6	Water level controlled by PA9				No – This is a drained / dry pond that may be used for contingency

Section	Pond	Maximum Water Level (m AHD) 2003 - 2013	Average water level (m AHD) 2003 - 2013	Minimum Water Level (m AHD) 2003 - 2013	Fluctuation in Water Level (Max – Min) (m)	Min to Max Levels = Compliance Range for Purposes of Error! Reference source not found.
						brine containment and evaporation
	PA7	Water level controlled by PA9				No – This is a drained / dry pond that may be used for contingency brine containment and evaporation
	PA7A	2.45	2.37	2.00	0.45	No – This is a drained / dry pond
	PA8	Water level controlled by PA9				No – This is a drained / dry pond that may be used for contingency brine containment and evaporation
	PA9	2.20	1.98	1.86	0.34	No – This is a drained / dry pond that may be used for contingency brine containment and evaporation
	PA10	Water level controlled by PA12				No – This is a drained / dry pond
	PA11	Water level controlled by PA12				No – This is a drained / dry pond
	PA12	1.99	1.57	1.30	0.69	No – This is a drained / dry pond

DRY CREEK SALT FIELDS PEPR REVISION 3 – PART 4

18 Overview of the Closure Strategy

This part of the PEPR / MOP describes the proposed closure activities on the salt field i.e. the operations that will be carried out to prepare the site for the agreed post mining land uses. Mine completion is defined by DSD as the goal of mine closure. A completed mine has been rehabilitated to an extent that the mineral lease / licence can be surrendered and ongoing responsibility accepted by the next land user.

As closure operations will occur in a staged manner within each section, some parts of sections will still be subject to the holding pattern or residual operations, while others will be undergoing closure activities. In this revision of the PEPR, closure operations will only occur in Section 1. Eventually, all operations within the salt field will come under this Part. The base case closure strategy is discussed below as background context.

This Part describes the environmental impacts of closure operations and outcomes to be achieved. It also sets out the outcomes and criteria that will be used to define mine completion.

18.1 Closure Strategy for Section 1

The future land use for Section 1 of the Salt Field (the part south of Dry Creek), is a mixed used urban development, but with parts of the land excised for the Norther Connector. Buckland Dry Creek Pty Ltd (BDC) and Renewal SA are collaborating, as adjoining land owners of Section 1, on a review and revision of a Master Plan for this development. It is envisaged that the mixed use urban development will include measures for stormwater management and protecting the urban environment from the effects of sea level rise and land subsidence. This is discussed further below.

18.2 Base Case Closure Strategy for Sections 2 – 4

18.2.1 Need for Base Case Closure Strategy

An integrated PEPR / MOP is required to describe potential land use options for a mine site at mine completion.

For Sections 2 to 4 of the Salt Field, options for land uses are under consideration, and being informed by further discussions and investigations. Such options will be also informed by engagement with the community. The South Australian Government is the owner for the Crown land part of the salt fields and, consequently, is also a key stakeholder. BDC is also a key stakeholder because it is the owner of the Freehold land part of the salt fields and also the holder of mining tenements (private mines and mine lease) that together cover both the Crown and Freehold land parts of the salt fields.

Therefore, a base case closure strategy has been developed for Sections 2 to 4 to:

- provide a framework for investigations and design for the purposes of the PEPR / MOP (and also the referral under the EPBC Act)
- achieve process certainty and a clear definition of closure
- define the outcomes sought in each closure domain at mine completion.

This strategy has been conceived so that:

- It does not exclude any of the range of future land uses for Sections 2 to 4 that BDC considers, on the basis of its knowledge of the site's characteristics and its consultations thus far with third

parties, could be found to be feasible in different parts of each Section of the site. For Sections 2 to 4, this includes (but is not limited to):

- stormwater management
- nutrient removal from treated sewage effluent
- protection of the urban environment at St Kilda and also east of the salt fields from effects of sea level rise / land subsidence
- contribution to the Adelaide International Bird Sanctuary
- horticulture / agriculture
- aquaculture
- salt production
- urban development
- landfill for raising ground levels.
- solar power generation
- quarrying to provide soil to assist filling Section 1 or parts of Sections 2 to 4 for their rehabilitation and future land uses
- vegetation management for carbon sequestration

- In the absence of the emergence within a reasonable timeframe of specific and potentially feasible future land uses in Sections 2 to 4, the base case closure strategy will be implemented to achieve mine completion.
- It can be adapted to accommodate specific and potentially feasible future land uses in Section 2 to 4 that emerge within a reasonable timeframe.
- Where feasible, the investigations for the revisions of the integrated PEPR / MOP, that will be needed for mine closure and completion, can be done collaboratively with investigations needed by proponents for future land uses.

18.2.2 Key Issues

Key issues for the base case closure strategy and the design of plans to implement that strategy include:

- the management of water for the sustainable protection and conservation of an appropriate scale of migratory bird habitat
- the prevention and management of risks from acid sulfate soils (ASS) and mono-sulfidic black ooze (MBO) within the ponds – especially risks to the external sensitive coastal environment
- the need to achieve economically, environmentally, and socially sustainable future land uses.
- the need to re-align some of the boundaries between Crown and Freehold portions of the salt field to assist separate future land use and management responsibilities, where this is necessary / desirable.

Due to the complexities and nature of the altered environment and geomorphology of the site, and its adjacent natural coastal areas:

- long term post-mine completion environmental management of the different parts of the site will be unavoidable.
- balanced judgements incorporating a range of perspectives will be required to derive the precise definition of the scope and compliance requirements for mine completion needed to engender confidence and certainty for all key stakeholders.
- achieving mine completion cannot be risk-free, but risks can and must be managed in an adaptable and prudently regulated manner.
- mine completion may not mark the end of rehabilitation processes. The intent is that the site's environmental responses to closure actions is established and on a stable footing at mine

completion. However, these environmental responses may continue and evolve into the long term.

- mine completion can provide a prudent way-station along a pathway to future land uses. This means that, for the environment at the site, mine completion is not an end in itself, but a stage in a multi-staged transition to the future uses.

18.2.3 Principles for Design of Closure Plans

The South Australian Government has established a Strategy / Technical Advisory Group (STAG) to provide technical and strategic input to the closure process. This group has agreed the following principles for the design of closure of this site:

- Closure of each part of the site is to involve regulated works that have clear objectives, defined scopes, and measureable completion criteria, and that are capable of completion in a definable period of time.
- Mine completion requires closure works that achieve reasonable compliance (respecting the site specifics) with relevant State and Commonwealth legislation.
- Mine completion for a part of the salt field, when followed by surrender of its mine lease or private mine status, would mark the end of the site's status as a mine and its regulation under the Mining Act; and the start of its regulation and management under other planning and environmental legislation.
- Where a specific future land use **can be defined** for a part of the site, and can be assessed to be feasible and achievable within reasonable time frames and with reasonable certainty, closure works can be designed to progress the relevant part of the site towards that specific option.
- Where a specific future land use **cannot be defined** for a part of the site, or is assessed not to be feasible or achievable within reasonable time frames and with reasonable certainty, the Base Case Closure Strategy is to be implemented for that part of the site; and in such a way that its condition at mine completion is not to unduly constrain its plausible future land uses.

Appendix 13 contains the Base Case Closure Strategy endorsed by the STAG.

18.2.4 Closure Goals and Overarching Environmental Values and Outcomes Sought

Closure works planning and design will aim to achieve the following general environmental, social and economic outcomes.

Environmental

- Rehabilitation of the land, groundwater, surface water and ecosystems within the site will, in part, necessarily involve some interactive, mutually dependent natural geochemical, physical and biological processes which take time to occur and reach completion. At the point of mine completion, rehabilitation needs to have ensured these processes are underway, and are progressing in directions that lead to environmental sustainability and sensibly minimal residual environmental risks.
- The protection of air, land, groundwater and surface water quality outside the site so that the health, safety, and amenity of people and ecosystems that use or depend on these are protected, both during the work to achieve completion and after completion.
- Practicable, risk-based environment monitoring and management plans with clear goals, environmental control measures, inspection and monitoring measures, performance indicators and criteria, reporting and resourcing requirements, to provide ongoing environmental risk management of the land, groundwater, surface water and ecosystems within the site following mine completion.

- Compliance with relevant, applicable, regulatory requirements, as identified in consultations with regulatory government agencies, including DSD, EPA, PIRSA and the Commonwealth Department of the Environment and Energy.
- Application of the precautionary principle, defined as follows:
  - *Environment Protection Act 1993* (SA): to apply a precautionary approach to the assessment of risk of environmental harm and ensure that all aspects of environmental quality affected by pollution and waste (including ecosystem sustainability and valued environmental attributes) are considered in decisions relating to the environment.
  - *Environment Protection and Biodiversity Conservation Act 1999* (Cth): lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage.

Social

- Pro-active consultation to enable stakeholders who are interested in, may be affected by or have influence on, the achievement of rehabilitation and completion outcomes to be well informed about the environmental constraints and opportunities for future uses of the salt field land after closure.
- Protection of the important cultural and geological heritage values of the land at the site.

Economic

- The maintenance of the integrity and functionality of engineered structures at the site which protect land outside the site from adverse economic consequences of inundation from tides and storm surges in the Gulf St Vincent and Barker Inlet.

Table 18-1 summarises the key overarching environmental values and strategic goals sought from rehabilitation and closure. Outcomes and criteria for achieving these goals, relevant to each stage in the rehabilitation and closure process, will be documented in subsequent revisions to this PEPR / MOP.

Table 18-1: Strategic goals for mine completion and principles for outcomes and measurement criteria

(Note: The information in this table is aspirational and intended to guide the investigation and design of closure works to achieve mine completion. Revisions to this integrated PEPR / MOP will contain descriptions of specific operations for the closure works in different parts of the site informed by such investigations and design. Those descriptions will be accompanied by specific environmental outcomes and measurement criteria that are broadly in line with the strategic goals and principles expressed in this table).

Key environmental values	Strategic goals to protect key environmental values	Principles for establishing outcomes and measurement criteria specific to closure works for mine completion
Terrestrial flora and fauna communities and species	▪ No adverse impacts from the condition of the site at mine completion on native flora and fauna communities and species on or off the salt field. ▪ Compliance with EPBC Act requirements for mitigation and offset of impacts from the controlled	Criteria will need to enable demonstration that: ▪ all clearance of native vegetation for mine completion has been undertaken with appropriate permissions. It is noted that clearance can also include loss from: ▪ physical works ▪ dust / contaminant deposition ▪ fire ▪ other damage.

Key environmental values	Strategic goals to protect key environmental values	Principles for establishing outcomes and measurement criteria specific to closure works for mine completion
	action that will form part of the works to achieve mine completion. ▪ Re-colonisation of native vegetation habitats in drained parts of the site is demonstrably underway, with management measures in place to address any threatening processes (e.g. drainage problems, feral animals and weeds) and to ensure re-colonisation will continue in the long term.	▪ no adverse offsite impacts from closure on native flora and fauna have occurred or are likely to occur ▪ compliance with EPBC Act conditions including demonstrating offset requirements have been met ▪ performance measures for vegetation re-colonisation, as specified in an environmental management plan, are being or have been met.
Surface water	▪ The land surface within drained ponds at the site is free draining, such that ponding of water from rainfall, outside natural or man-made drainage courses within the site, is temporary and able to disappear within a reasonably short time, from a combination of infiltration, surface runoff, evaporation and evapotranspiration, without human intervention. ▪ No adverse impacts on the marine environment from the discharge of surface water into the external environment from the site at defined discharge points approved under EPA Licences and Fisheries Management Act exemptions. ▪ Within ponds on the site that hold or transmit water, the water levels and water quality are maintained to ensure there is no adverse impact on habitat for EPBC Act listed birds, or native vegetation. ▪ Surface water levels in natural or man-made water courses are maintained, where practicable, at or above their pre-salt fields levels.	Criteria will need to enable demonstration that: ▪ In drained ponds: ▪ ponding of water does not occur for a duration that results in unacceptable odour impacts on receptors ▪ salinity of any discharge to the marine environment is at a level that does not result in environmental harm ▪ water quality and depths within natural or artificial water courses within the site are maintained to protect habitat for EPBC Act listed birds, or native vegetation ▪ surface water levels are controlled by the combination of groundwater levels and water levels in the adjacent Gulf St Vincent ▪ surface water levels in natural or artificial water courses are maintained at or above their pre-salt fields level, unless otherwise agreed. ▪ In inundated ponds: ▪ water quality and depths are maintained to protect habitat for EPBC Act listed birds, or native vegetation
Air Quality	▪ No adverse impacts on local communities from odours or dusts emanating from the salt fields.	Criteria will need to enable demonstration that: ▪ any organic material remaining in drained ponds is unlikely to result in unacceptable odour impacts as a consequence of either ponding of water, or loss of saturation ▪ ASS are appropriately managed to ensure unacceptable odour impacts do not occur ▪ algal blooms are not of a magnitude that would result in unacceptable odour impacts ▪ performance measures for recolonisation of drained ponds with vegetation are being or have been met, except where alternative land uses have been agreed ▪ other potential dust sources are managed to ensure agreed outcomes for dust impacts on receptors are met.

Key environmental values	Strategic goals to protect key environmental values	Principles for establishing outcomes and measurement criteria specific to closure works for mine completion
Contamination / wastes, salinity, acid sulfate	▪ Any contamination or waste is remediated so that it complies with EPA policies and guidelines. ▪ Constraints (if any) on post-closure land uses at the site from residual salt in soils or monosulfidic black ooze caused by salt field operations are understood. ▪ No adverse impacts from acid sulfate soils and monosulfidic black ooze at the site on the external environment.	Criteria will need to enable demonstration that: ▪ remediation of contamination or waste has successfully occurred in any areas that were identified as requiring specific remediation measures ▪ impacts from ASS and MBO at the site comply with the other environmental outcomes in this table.
Infrastructure management to protect public safety and the environment	▪ Existing bunds are maintained at their existing crest heights and with their integrity and functionality intact. ▪ All redundant gates, syphons, connections or other hydraulic flow control structures between ponds have been removed or blocked off / closed in a durable manner that protects public safety and the environment. ▪ All redundant water pumps have been removed from site. Supporting structures, pipelines, flow control valves and power supplies associated with these pumps have also been removed or appropriately decommissioned in manner that protects public safety and the environment. ▪ All remaining operating pumps, and associated supporting structures, pipelines flow control valves and power supplies are in operable, well-maintained condition, with an effective care and maintenance plan in place. ▪ All site fences and gates remain intact, with sufficient warning signs advising the public that entry to the site without permission from the land owner is forbidden and that entry carries safety risks. ▪ All seepage drains remain functional.	Criteria will need to enable demonstration that: ▪ the site has been left in a stable and non-polluting condition ▪ all infrastructure has been removed other than that which has been agreed will remain ▪ all remaining operating pumps, and their associated supporting structures, pipelines flow control valves and power supplies, are in operable, well-maintained condition ▪ all bund banks and seepage drains are functional and stable.
Community	▪ Mine completion has broad acceptance by the community.	▪ The Closure PEPR / MOP will need to demonstrate that consultation and engagement with the community has occurred and resulted in their broad acceptance of the proposed works for mine completion
Cultural and geological heritage	▪ No adverse impacts on the cultural heritage values of the site.	Criteria will need to enable demonstration that: ▪ cultural heritage values of the site before and at closure have been documented

Key environmental values	Strategic goals to protect key environmental values	Principles for establishing outcomes and measurement criteria specific to closure works for mine completion
	▪ Landforms of drained ponds are substantially unaffected by closure works.	▪ landform within drained ponds is within agreed parameters that substantially retain the landforms existing prior to closure of the salt fields.

19 Proposed Operations Covered by this PEPR / MOP

This chapter describes the closure operations that are included in this revision of the PEPR / MOP.

19.1 Proposed Closure Operations in Section 1

Section 1 of the Dry Creek Salt Field has been identified in Adelaide's 30 Year Plan for Greater Adelaide as a future urban growth area. The eastern half of this land, abutting the western side of Port Wakefield Road and south of Globe Derby Park, is owned by BGC. Land to the west, abutting Barker Inlet and St Kilda Aquatic Reserve, is owned by Renewal SA.

The operations covered in this PEPR / MOP are restricted to the land owned by BGC (PM248). This is shown in Figure 19-1.

Figure 19-1: Location of PM248

Ridley, with Delfin and involvement from Renewal SA and Salisbury Council, previously created a draft master plan for the development of Section 1 for residential and mixed use purposes (Figure 19-2). This is under review and a Master Planning study is about to be implemented. That study will produce a 'high level' and 'strategic' plan to guide the subsequent detailed planning and design of the urban development and the gaining of Development Approvals under the Development Act. The detailed planning and design will, among other matters, refine concepts for the final developed topography.

However, it is clear already that PM248 – the Private Mine part of Section 1 – will require filling to raise ground levels and prepare this area for future development. It is therefore intended that the closure operations for PM248 comprise the raising of the ground levels and the production of land that is suitable for redevelopment in the manner that is envisaged by the agreed revised Master Plan and subsequent Development Approvals.

Figure 19-2: Possible Future Land Uses – the Ridley / Delfin Concept

19.2 Strategy for Bulk Earthworks and its Regulation

The bulk earthworks in PM248 are needed for the following purposes:

- To rehabilitate this land to enable mine completion and closure.
- To prepare this land for subsequent urban (mixed uses and residential) development:
  - by raising the minimum ground levels above levels stipulated by the relevant planning authority to accommodate for factors such as high tides and storm surges, sea level rise, and floods from stormwater flows

- by creating topography for the urban development that can accommodate stormwater runoff and drainage adequately, allowing for the effects of climate change
- by elevating and separating the ground, on and in which the landscaping, infrastructure and foundations for the urban development will be built, from the existing salty ground of the floors of the final area ponds, crystallisers, stacking bays, and drains that formed the operational features of PM248. This elevation and separation is to prevent salt rising and adversely affecting the landscaping, infrastructure and foundations for the urban development.

19.2.1 Management and Regulation of Bulk Earthworks

The bulk earthworks will be conducted in stages, with each stage creating a platform for an area of subsequent urban development.

Figure 19-3 illustrates the process for managing and regulating the bulk earthworks.

Prior to each stage, a Bulk Earthworks Plan with the following information will be submitted to DSD as a Notification of Minor Change:

- a survey plan of existing ground levels
- a plan of intended ground levels after the bulk earthworks
- drawings showing the engineering design and specifications for the bulk earthworks i.e. materials of construction (and their sources and engineering and environmental properties), layer thicknesses and volumes, compaction requirements, quality control requirements, and construction environmental management requirements
- endorsement by a suitable qualified Geotechnical Inspection Testing Authority (GITA) that the Bulk Earthworks Plan is consistent with AS 3798-2007 and, if implemented diligently, will produce a land form that that would be geotechnically suitable for the intended land use (to be considered as “Residential” unless documented otherwise in an approved Master Plan or other suitable document).
- endorsement by an EPA Accredited Auditor that the endorsed Bulk Earthworks Plan, and associated Construction Quality Assurance Plan and Construction Environmental Monitoring and Management Plan, if properly implemented should a) generate sufficient information for an audit of the outcomes to be completed, and b) that there is a reasonable prospect that the outcomes will be environmentally suitable for the intended land use (to be considered as ‘Residential’ unless documented otherwise in an approved Master Plan or other suitable document).
- endorsement by a suitably qualified and experienced hydrological engineer that the Bulk Earthworks Plan, if implemented diligently, is likely to produce a landform that will accommodate the tidal and stream levels and flows, flood levels and flows and stormwater flows associated with the intended land use (to be considered as ‘Residential’ unless documented otherwise in an approved Master Plan or other suitable document).
- endorsement by the relevant planning authority that the Bulk Earthworks Plan, if implemented diligently, is likely to produce a land form that is consistent with future land uses (to be considered as “Residential” unless documented otherwise in an approved Master Plan or other suitable document).
- a construction environmental management plan for the bulk earthworks that articulates how the earthworks will be done, monitored, managed and controlled so that the end result as well as the filling processes comply with the endorsed design and specifications.

Work would not commence until the Notification of Minor Change is approved by DSD.

Figure 19-3: Process to manage and regulate bulk earthworks

After each stage of broadscale bulk earthworks, a completion report will be prepared which contains:

- as-built drawings and other records that demonstrate that the endorsed design and specifications have been complied with.
- endorsements, from review of these documents, supported by such independent checks as have been needed, by:
    a. the qualified party that will be responsible for the engineering / geotechnical supervision of the bulk earthworks. This endorsement will state that the constructed bulk earthworks have complied with the design and specification and is in effect 'fit for engineering purpose' in the context of the planned urban development and anticipated or actuals requirements of the relevant planning authority; the planning authority
    b. an EPA accredited Auditor. This endorsement will state that the constructed bulk earthworks are in effect 'fit for environmental purpose' in the context of the planned urban development and the requirements of the Environment Protection Act (and other Acts with relevant environmental requirements)
    c. a suitably qualified and experienced hydrological engineer confirming that the As Constructed landform will accommodate the tidal and stream levels and flows, flood levels and flows and stormwater flows associated with the intended land use, and; the quality of water within and discharged from the As Constructed landform will not have adverse impacts on the use of land or water within or outside the site.
- an endorsement by the responsible Planning Authority, based on its review of the above. This endorsement will state that the relevant conditions of Development Approval have been satisfied by the constructed bulk earthworks.

DSD approval of the completion report would trigger an application for the area of land containing the filled stage to be excised from the Private Mine tenement and thus from the jurisdiction of the Mining Act.

19.2.2 Design of Proposed Bulk Earthworks

The final structure and dimensions of the bulk earthworks in each Stage will be designed and specified taking account of:

- the results of the Pilot Trial (see Appendix 15). The conduct of this Pilot Trial has been approved by DSD (see Part 1 of this PEPR / MOP)
- the results of the review of the Master Plan, and in particular, what these results mean[1] for, e.g:
    a. minimum and maximum finished ground surface levels to accommodate planning requirements (e.g. for sea level rise, flood prevention, stormwater management etc.)
    b. maximum finished ground surface levels
    c. minimum and maximum finished ground slopes
- ground surface levels in areas to be filled after undesirable, surplus crystallised salt and salt muds have been removed to provide a 'stripped' ground surface ready for filling
- other constraints and opportunities – such as maximum permissible fill thicknesses over existing gas pipelines; clearance requirements under high voltage power lines etc
- the need to enable the drainage / capillary layer to discharge its water into open swales or waterways within the site
- the need to accommodate a minimum thickness of 1m of cover fill over the drainage / capillary layer. This 1m thickness is intended to assure physical separation between the drainage /

[1] It is noted that the review of the Master Plan may identify specific requirements for bulk earthworks that need to be satisfied in order that the development on the finished surface of the bulk earthworks may obtain and then comply with the necessary further planning and environmental approvals, permits or endorsements.

capillary layer and civil works, earthworks, and infrastructure works for the subsequent land development. That is the bottom 0.5m of the cover fill is intended never to be disturbed by such works – without adequate prior planning and control to ensure that the integrity of the drainage / capillary layer is never compromised.

19.3 Closure Operations Elsewhere in Section 1

Once the revised masterplan has been produced, the scope and nature of closure operations elsewhere in Section 1 can be considered. As these operations become defined, they will be embodied in further revisions to this PEPR / MOP.

20 Environmental Assessment and Outcomes

This chapter discusses the environmental impacts of the proposed closure operations, drawing on the impact and risk assessment in Appendix 16.

20.1 Air Quality Impacts

20.1.1 Sources

Sources of dust include:

- transport of fill material to the intended locations in PM248. This includes construction rubble, natural soils and Calsilt
- unloading of fill material
- shaping and compaction of fill
- pick up of dust from the surface of filled areas
- travel on dirt roads in the salt fields

There are no sources of odour associated with bulk earthworks operations in PM248. Odour from exposure of acid sulfate soils will not occur as the cover over these soils will be retained. The design of bulk earthworks will not allow water to pool for an extended period and become stagnant.

20.1.2 Pathways

The pathway for dust impacts is provided by wind moving the air offsite. The critical wind speed for pickup of dust from surfaces is 5 m/s. Above 10m/s, pick-up increases rapidly. Generally, this will occur with winds from the south-west or west.

Once emissions have occurred, only distance and weather conditions ameliorate / disperse concentrations of dust.

20.1.3 Receptors

As discussed in Chapter 12, a range of residential, pastoral, conservation, horticultural, commercial and other land uses occur adjacent to the salt fields. Those most sensitive to dust impacts from PM248 include:

- residential suburbs and coastal townships (Globe Derby, Mawson Lakes). Housing at Globe Derby is as close as 100 m to the crystallising area of the salt fields and the salinas
- areas of conservation significance, including the Adelaide Dolphin Sanctuary (which extends partly over the salt field) and Barker Inlet Aquatic Reserve
- habitat for flora and fauna on or adjoining the salt fields.

20.1.4 Potential Impacts

Any fill material that is likely to generate dust during transport to the fill site will be moist or covered. In particular, Calsilt will be sufficiently saturated to control dust during transport and unloading. Consequently, dust impacts are expected to be negligible.

The main potential source of dust is from earthmoving operations in shaping and compacting fill. For geotechnical reasons, any fine material capable of producing dust will need to be sufficiently moist to allow adequate compaction. Acceptable soil moisture parameters will be specified in the detailed engineering design and endorsed by a suitable qualified Geotechnical Inspection Testing Authority. In

addition, should weather conditions and the moisture condition of the calsilt, soil or rubble indicate a non-negligible risk of dust, waster sprays will be deployed as a dust preventive measure.

Once bulk earthworks have been completed, there may be a period of time before development occurs in accordance with an approved Master Plan. Consequently, the soil surface will need to be left in a stable condition, either through establishment of vegetation, mulching or the use of some other appropriate treatment. This will be further considered in the pilot bulk earthworks trial and detailed in the Minor Change Notification for each stage.

If dust is entrained from exposed surfaces or during earthworks, it will be comprised of a wide variety of size fractions. The larger deposited dust is material generally greater than 50 µm in diameter. It poses a nuisance potential due to soiling of surfaces and can cause irritation to eyes and nose. Because it is relatively large in size, deposited particulate usually falls out of the air within a short distance of the source (a few hundred metres).

The finer material is defined as suspended particulate. It is commonly referred to as Total Suspended Particulate or TSP. It is generally less than 20 µm and can travel large distances downwind. The portion of TSP that poses the greatest potential health effect is particulate less than 10 µm in diameter (known as PM_{10}) and particulate less than 2.5 µm (known as $PM_{2.5}$). PM_{10} is able to penetrate the upper respiratory tract and consequently has the potential to impact on public health. $PM_{2.5}$ can penetrate even further into the lung and is suspected of being the fraction of PM_{10} that is responsible for health impacts that can lead to an increase in morbidity and mortality in particular circumstances.

The major source of the finer particulates PM_{10} and $PM_{2.5}$ in the atmosphere is combustion processes, particularly for $PM_{2.5}$. The dust from wind erosion at PM248 is likely to be predominantly made up of larger size fractions (greater than 10µm).

Health impacts from exposure to PM_{10} and $PM_{2.5}$ are related to exposure time. The NEPM specifies an exposure time for PM_{10} of 24-hours with five exceedances of the specified concentration permitted annually. Short term exposure to any PM_{10} that may be entrained in dust from the salt field during a wind event (say over a period of an hour or so) is unlikely to exceed the NEPM 24-hour average concentration standard and, if it does exceed that standard due to unusual and persistent high wind speeds, this would be a rare event that would fall within the permitted annual exceedances.

Finally, it is also noted that the meteorological events that may lead to elevated dust erosion and suspended dust concentrations from the salt field would also result in low background concentrations of fine particulate (e.g. from other sources such as power stations or urban vehicle traffic) at receptors, due to the required wind direction and also the wind speeds occurring at the time.

It is concluded that significant adverse effects on health are therefore unlikely as a result of dust emissions from PM248.

The extensive area of the salt field is serviced by formed embankments. Travel in the salt field is limited to an upper speed of 40km/hr and this serves to reduce dust emissions. The embankments are dressed with a coarse gravel to reduce dust emissions. If tracks need to be used regularly for transport of fill, they will be treated with bitterns as a dust suppressant. Dust from vehicle operations is considered to have minimal impacts on neighbouring receptors.

Dust may also impact adjoining areas of conservation significance and habitat for flora and fauna. Impacts could occur through smothering of habitat, impacts on water quality or dust entering the food chain. Given dust events are episodic and short-lived, and the extent of dilution and dispersion that occurs, such dust impacts are expected to be negligible.

Expected impacts on air quality are summarised in Table 20-1.

Table 20-1: Expected air quality impacts

Event ID	Impact Event	Expected Impact	Significance
A1	Dust from transport and unloading of fill affecting the amenity of adjoining human receptors	No measurable impact expected	Negligible
A2	Dust from transport and unloading of fill affecting the health of adjoining human receptors	No measurable impact expected	Negligible
A3	Dust from earthworks affecting the amenity of adjoining human receptors	No measurable impact expected	Negligible
A4	Dust from earthworks affecting the health of adjoining human receptors	No measurable impact expected	Negligible
A5	Dust from exposed ground surfaces affecting the amenity of adjoining human receptors	Short term episodic impacts	Low
A6	Dust from exposed ground surfaces affecting the health of adjoining human receptors	No measurable impact expected	Negligible
A7	Dust from exposed ground surfaces affecting adjoining areas of conservation significance	No measurable impact expected	Negligible

20.1.5 Control and Management Strategies

The primary strategies for control and management of dust during bulk earthworks entail:

- ensuring fill material is maintained at a sufficient moisture content to minimise dust
- revegetation, mulching or other treatment of the surface of filled areas to minimise dust pick up
- monitoring of dust at source and the mine boundary.

Dust monitoring will continue as described for the holding pattern and residual operations. In addition, monitoring will occur at the mine boundary when there is visible entrainment of dust at source.

20.1.6 Uncertainties and Limitations

Uncertainties relate to:

- The design of bulk earthworks, noting this will be informed by the pilot filling trial. However, as noted above, Calsit and other fill material will need sufficient moisture content to allow compaction. Consequently, geotechnical requirements will mean there is little likelihood of fine, dry material being handled.
- The surface cover of filled areas and, therefore, the propensity to produce dust. This will be specified in the bulk earthworks plan and Minor Change Notification. Consequently, there will be a high level of certainty regarding any surface treatment by the time fill operations commence.
- Natural background levels of dust, given the mix of land uses adjacent to the BDC site, and the presence of other sources among them. This makes it difficult to use measures of background levels to set realistic quantitative outcome measurement criteria that would be of practical help in preventing and mitigating dust impacts, or that would provide a practicable measure against which to assess the scale of any impact attributable to works on PM248. Consequently, monitoring of whether visible dust leaves the mine boundary, supplemented by the complaints register, is considered the most effective means to measure achievement of environmental outcomes. As with the holding pattern and residual operations, monitoring will

be escalated if necessary in response to any complaints or if dust is observed leaving the mine boundary.

20.1.7 Risk Assessment

Excessive dust production during bulk earthworks will be immediately noticeable allowing action to be undertaken (such as using water sprays). Consequently, any dust incidents, if they did occur, would be in the order of hours (more likely minutes) in duration and restricted to a small number of receptors.

The risks that could result in greater than expected impacts, are considered to be acceptable. Further action to reduce risk is not considered necessary or practicable.

Table 20-2: Air quality risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
A1	Dust from transport and unloading of fill affecting the amenity of adjoining human receptors	Negligible	Unlikely	Low	Negligible
A2	Dust from transport and unloading of fill affecting the health of adjoining human receptors	Negligible	Unlikely	Low	Negligible
A3	Dust from earthworks affecting the amenity of adjoining human receptors	Negligible	Unlikely	Low	Negligible
A4	Dust from earthworks affecting the health of adjoining human receptors	Negligible	Unlikely	Low	Negligible
A5	Dust from exposed ground surfaces affecting the amenity of adjoining human receptors	Low	Unlikely	Moderate	Low
A6	Dust from exposed ground surfaces affecting the health of adjoining human receptors	Negligible	Unlikely	High	Moderate
A7	Dust from exposed ground surfaces affecting adjoining areas of conservation significance	Negligible	Unlikely	High	Moderate

20.1.8 Proposed Outcomes

Surrounding receptors wish to protect their health and amenity. The very low number of dust complaints in the past indicates that short term episodic impacts on amenity are tolerated. More widespread or longer term impacts on public amenity would be considered unacceptable. Consequently, BDC considers the following outcome is acceptable for closure operations:

- No adverse public health and or significant nuisance impacts due to air emissions, dust, pest insect species, odour, or noise

(A significant nuisance impact is considered to be one that generates a complaint that is confirmed as attributable to the closure operations and cannot be addressed within the timeframes specified in the measurement criteria.)

At mine completion, land surfaces need to be left in a condition that is stable and resistant to wind erosion. Consequently, the following mine completion outcome is proposed:

- No adverse impacts on adjoining land uses from dust or soil erosion and sediment transport.

20.1.9 Measurement Criteria

As bulk earthworks are not expected to produce significant dust and any incidents are only likely to produce a short term nuisance impact, ongoing monitoring of dust deposition is not likely to provide useful information. Visual monitoring will be a more reliable way to identify any dust incidents. A complaints register will continue to operate so that any complaints can be investigated and action taken where necessary. Consequently, the following measurement criteria are proposed:

- no visible dust generated by closure activities in Section 1 leaves the site, or
- register demonstrates that in respect of complaints relating to impacts outside site boundary from dust:
  - complaint initially responded to within 48 hours
  - issues underlying complaint investigated and causes identified within 2 weeks or other time frame agreed by DSD
- complaint closed out within 4 weeks or other time frame agreed by DSD.

Leading indicator criteria will be specified in the endorsed Construction Environment Monitoring and Management Plans for each Stage of Bulk Earthworks.

Minimum completion criteria for soil cover and any other relevant parameters will be defined in the endorsed Construction Environmental Monitoring and Management Plan for each stage of bulk earthworks.

20.2 Flora and Fauna

20.2.1 Sources of Potential Impacts

As the area in PM248 has been cleared of vegetation, there are no sources of direct impacts to flora and fauna.

Sources of potential indirect impacts on flora and fauna include:

- Dust deposition from bulk earthworks (addressed in 20.1)
- Changes to hydrological flows due to bulk earthworks (addressed in 20.4)

The bulk earthworks will not result in any new discharge points from Section 1.

20.2.2 Pathways

As there are no receptors directly affected by bulk earthworks, the pathways are through windblown dust or through changed water flows.

20.2.3 Receptors

The significant receptors are:

- areas of conservation significance adjoining the western boundary of the salt fields, including mangrove forests, tidal mudflats and salt marshes
- marine life (flora and fauna) in water and sediment in tidal and intertidal parts of Gulf St Vincent, adjacent the site.

20.2.4 Potential Impacts

Dust impacts are discussed in 20.1 and hydrological changes are discussed in 20.4. Consequently, there are no further impacts to discuss in this Chapter or need for additional outcomes.

20.3 Soil Quality

20.3.1 Sources of Potential Impacts

Sources of impact include:

- PASS soils
- Potential contamination of soils from leaks and spills of chemicals or fuel from the bulk earthworks operations
- Exposure to salt impacted soils.

20.3.2 Pathways

The crystallisers have an engineered floor built over the natural ground comprising compacted fill and, over this, a compacted clay / calgrit layer. Salt operations have resulted in some disturbance to this layer through wheel ruts and scraping of salt but to a depth of no more than around 10 cm. Scraping of further salt will have a similar level of disturbance. This means that PASS soils within the natural ground will not be disturbed and there is no pathway for impacts from PASS / ASS to occur.

The pathway for leaks and spills of chemicals or fuels is through the soil. This is unlikely to affect existing use of land but could compromise future uses.

Exposure to salt could impact on future land use as high salinity can degrade infrastructure and inhibit establishment of vegetation.

20.3.3 Receptors

There are no current environmental values within the area to be filled in Section 1. The receptors of concern are those associated with future land uses.

Off-site receptors include:

- areas of conservation significance (Adelaide Dolphin Sanctuary, Barker Inlet Aquatic Reserve)
- adjoining habitat for flora and fauna, in particular, species of conservation significance
- adjoining agricultural / horticultural activities
- adjoining structures and buildings.

20.3.4 Potential Impacts

Spills of oils and fuels can occur in any operation of this type, however the quantities involved would most likely be small. The immediate impacts would be confined within the current salt pans. Additionally, spill containment measures are practiced and clean-up undertaken if needed. The expected impact from spills is expected to be negligible. Surface and groundwater are vectors for offsite impacts but are discussed in 20.4 and 20.5.

The salt impacted soils from historic works represent a hazard for future development. As discussed in 19.2.2, the proposed design for the bulk earthworks includes a capillary layer to prevent movement of salt into the cover fill. The final design for the bulk earthworks will endorsed by an EPA accredited environmental auditor and a suitable qualified Geotechnical Inspection Testing Authority. Given these design measures, the expected impact from salt impacted soils is expected to be negligible.

Soil quality impacts are summarised in Table 20-3.

Table 20-3: Potential soil quality impacts

Event ID	Impact Event	Expected Impact	Significance
SQ1	Contamination of soil from leaks or spills impacts on current or future land uses	Any spills or leaks expected to be contained and/or of a magnitude that will allow easy clean-up	Negligible
SQ2	Exposure to salt impacted soils compromises future land use	No impact expected	Negligible

20.3.5 Control and Management Strategies

Existing measures to prevent, contain and treat spills of all types will continue:

- a spill kit is available for use in the event of vehicle accidents
- fuel tanks at the workshop are contained within bunds
- a 40km/hr. speed limit is mandatory across the mine site in order to reduce the likelihood of accidents.

As noted above, fill will be designed to prevent upward migration of salt. The Bulk Earthworks Plan will be reviewed by a suitably qualified Geotechnical Inspection Testing Authority as described above.

20.3.6 Uncertainties and Limitations

As fill design has not been finalised, it's effectiveness is unknown. However, the use of a capillary break is widely practiced and the pilot fill trial will inform the detailed design. Consequently, it is expected that the effectiveness of the proposed fill design will have been demonstrated by the time operations commence.

20.3.7 Risk Assessment

The bulk earthworks will not require use of chemicals so fuel and oil spills will be the primary risk. It can reasonably be expected that any spill can be cleaned up and the area remediated, if necessary, within a year. Consequently, the risk is considered to be low.

There is a risk that the design for bulk earthworks may not be effective in preventing upward movement of salt. Design failure could result in the need for moderate repair measures. However, such a consequence is considered to be unlikely.

Table 20-4 summarises the risk of greater than expected impacts relating to soil quality.

Table 20-4: Soil quality risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
SQ1	Contamination of soil from leaks or spills impacts on current or future land uses	Negligible	Unlikely	Low	Negligible
SQ2	Exposure to salt impacted soils compromises future land use	Negligible	Rare	Moderate	Low

20.3.8 Proposed Outcomes

Spills and leaks can potentially compromise future land uses and have offsite impacts. Salt impacted soils could affect future land use. Consequently, the following closure outcomes are proposed:

- No compromise to potential future land use
- No adverse impacts to use of adjacent land or water.

At mine completion, no sources of spills of leaks remain so the remaining risk is that of upward migration of salts. The proposed mine completion outcome is:

- The bulk earthworks have created a landform that is suitable for the intended land use.

20.3.9 Measurement Criteria

Measurement criteria are proposed in Table 21-1. The criteria focus on ensuring endorsement of Bulk Earthworks Plan by appropriately qualified geotechnical, contamination and hydrological experts.

Closure criteria are in Table 21-2 and seek similar review by experts based on the constructed landform and quality assurance/quality control during construction.

20.4 Surface Water

20.4.1 Sources of Potential Impacts

Sources of potential impact include:

- Stormwater entering PM248 from offsite degrading water quality on site
- Changes to surface water flows due to bulk earthworks resulting in impacts on adjoining land uses.

The bulk earthworks do not require discharge of brine to the marine environment (noting that this is occurring as part of the residual operations).

20.4.2 Pathways

The pathway for the impact events above is water.

20.4.3 Receptors

Receptors include:

- residents surrounding PM248
- marine life (flora and fauna) in water and sediment in tidal and intertidal parts of Gulf St Vincent near PM248
- areas of conservation significance near PM248.

There are no environmental receptors for surface water on site.

20.4.4 Potential Impacts

The salt fields are bunded with an external perimeter seepage drain and largely isolated from externally sourced runoff. The one exception is overflow from a Salisbury City wetland outside the south-east boundary of Section 1. The E Row drain and flap is used to conduct overflow from the wetland through Section 1 to Dry Creek. This function will be preserved and will have no impact on filling works. Consequently, offsite stormwater is not expected to impact water quality on PM248.

The bulk earthworks will change surface water flows within the site and potentially result in offsite impacts. These could include changes to stream flows, flood management and stormwater management outside the site. However, any discharge from Section 1, including PM248, can only occur through a deliberate managed discharge. This is because it lies behind a sea wall and is an isolated surface water system. Unless action is taken to discharge water, the default position is that all surface water remains within Section 1.

Nevertheless, as previously discussed, the Bulk Earthworks Plan for each stage of filling will be reviewed by a qualified hydrologist to ensure any planned offsite impacts are acceptable. As surface water on Section 1 of the salt fields has been a successfully managed system for many years, adverse offsite impacts are not expected.

Surface water impacts are summarised in Table 20-5.

Table 20-5: Expected surface water impacts

Event ID	Impact Event	Expected Impact	Significance
SW1	Stormwater entering PM248 from offsite degrading water quality on site	No impact expected	Negligible
SW2	Changes to surface water flows affecting adjoining land uses.	No unmanaged offsite surface water flows expected	Negligible

20.4.5 Control and Management Strategies

Existing surface water management structures will be maintained where needed during bulk earthworks. This will include external bunding to ensure stormwater from adjoining areas does not enter the site or leave in an uncontrolled way. As noted above, the Bulk Earthworks plan will be reviewed by a hydrologist and any further management measures identified through that review will be implemented.

Erosion and sediment control measures will be used to ensure any runoff from bulk earthworks has low turbidity. If discharge from the site is required, this will be via an EPA licensed point at Dry Creek or North Arm and will be monitored to ensure there is no adverse impact on the marine environment.

20.4.6 Uncertainties and Limitations

Uncertainties relate to the design of the bulk earthworks and these will be addressed through the review process.

20.4.7 Risk Assessment

Any unplanned incursion of external stormwater onto the site would be minor and able to be readily addressed. Unplanned hydrological impacts on surrounding land uses could potentially require longer to rectify, should they occur, and have been assessed as a moderate consequence. Given the site is currently a managed system that prevents impacts occurring without control, and any filling will be reviewed by a hydrology expert, this consequence is assessed as having a rare likelihood.

Table 20-6 summarises the risks of greater surface water impacts than expected.

Table 20-6: Surface water risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
SW1	Stormwater entering the salt fields from offsite degrading water quality on site	Negligible	Unlikely	Low	Negligible
SW2	Changes to surface water flows affecting adjoining land uses.	Negligible	Rare	Moderate	Low

20.4.8 Proposed Outcomes

As there are no environmental values on site relevant to surface water, the outcome for closure operations is to ensure there are no adverse impacts to use of adjacent land or waters.

The proposed mine completion outcome is the final landform ensures no adverse impacts on adjoining land uses from changed surface water flows or quality.

20.4.9 Measurement Criteria

The measurement criteria for the closure operations are based on a review of the Bulk Earthworks Plan by an appropriately qualified and experienced hydrological engineer to confirm there will be no adverse impacts on the use of adjacent land or waters as result of:

- Consequential changes to stream flows, flood management and stormwater management outside the site
- Consequential changes in the quality and quantity of any water discharge from the site
- Erosion or sedimentation caused by the bulk earthworks.

For each stage of Bulk Earthworks, an endorsed Construction Environment Monitoring and Management Plan will set out how, where and when impacts to adjacent land use will be monitored, prevented and managed.

Mine completion will require a suitably qualified and experienced hydrological engineer to confirm:

- that the As Constructed landform will accommodate the tidal and stream levels and flows, flood levels and flows and stormwater flows associated with the intended land use
- the quality of water within and discharged from the As Constructed landform will not have adverse impacts on the use of land or water within or outside the site.

20.5 Groundwater

20.5.1 Sources of Potential Impacts

Sources of potential impact include:

- Use of groundwater impacting other users
- Contamination impairing quality of infiltration to groundwater at the site
- Changes to groundwater impacting groundwater dependent ecosystems
- Changes to groundwater quality and pressure impacting surface water and/or the marine environment.

20.5.2 Pathways

The pathway for the impact events above is water. Seepage and leaching of water to groundwater also occurs.

20.5.3 Receptors

There are no groundwater environmental values that can be impacted by bulk earthworks. Shallow groundwater in the area is hypersaline and unsuitable for any use. Given the compacted clay / calgrit layer under the crystallising ponds, seepage is minimal and will be further reduced by bulk earthworks.

The only other receptors are current users of groundwater from the T1 aquifer. No further abstraction of groundwater would be required beyond the current licenses for the residual operations and holding operations. Consequently, these receptors will not be impacted.

20.5.4 Potential impacts

Given the absence of groundwater receptors that will be impacted by the bulk earthworks on PM248, no further impact assessment has been undertaken.

20.6 Noise

20.6.1 Sources of Potential Impacts

Sources of noise include:

- earthmoving machinery for bulk earthworks
- trucks transporting fill material.

20.6.2 Pathways

The pathway for transmission of noise is through the air.

20.6.3 Receptors

The main receptors are adjoining residents. Fauna on or near PM248 could also be receptors, however, activities on the site will be away from important roosting and foraging sites. Consequently, fauna are not considered further.

20.6.4 Potential Impacts

Historical noise from salt-making operations has rarely exceeded ambient levels due to the adjoining traffic on Port Wakefield Road and the Port River Expressway. Housing at Mawson Lakes, however, is approximately 200 m away from the boundary of the crystallising area and occasional noise issues have been reported in the past by residential neighbours.

Noise from bulk earthworks will be similar to the historical operations and may potential cause limited nuisance impacts.

Table 20-7: Expected noise impacts

Event ID	Impact Event	Expected Impact	Significance
N1	Noise from machinery used in bulk earthworks adversely affects adjoining residents	Within regulatory limits and generally within background levels	Low

20.6.5 Control and Management Strategies

All equipment, including that used by contractors, is required to comply with relevant noise control policies and guidelines issued by the EPA. Night operation of construction equipment in investigations and trials is not proposed. A complaints register for noise will be maintained along with action taken.

20.6.6 Uncertainties and limitations

The equipment to be used in bulk earthworks has not yet been determined but can be reasonably assumed. Measures to manage construction noise are well developed and their effectiveness understood.

20.6.7 Risk Assessment

As the levels of uncertainty around existing noise levels are low, there is a negligible risk that greater noise impacts may result.

Table 20-8: Noise risks

Event ID	Impact Event	Expected Impact	Likelihood of greater impact	Consequence of greater impact	Risk rating
N1	Noise from machinery used in bulk earthworks adversely affects adjoining residents	Low	Unlikely	Low	Negligible

20.6.8 Proposed Outcome

Residents near PM248 expect their amenity will be maintained. Consequently, the following outcome is proposed:

- No adverse public health or significant nuisance impacts due to noise.

A mine completion outcome is not proposed as there will be no noise sources.

20.6.9 Proposed Measurement Criteria

Outcomes and proposed measurement criteria are presented in Table 21-1. As noise issues are only sporadic, the measurement criteria rely on maintenance of a complaints register and demonstration of appropriate action to respond to complaints.

20.7 Other Potential Impacts

20.7.1 Heritage

Heritage items could potentially be impacted by any excavation works. There will be no excavation associated with the bulk earthworks other than scraping of salt from the crystallising pans. This will only affect the surface and will not extend to the natural soil below the compacted clay / calgrit layer. Consequently, there are no sources of impacts to heritage items.

20.7.2 Traffic

External traffic access to the bulk earthworks in PM248 is from the Salisbury Highway. This is a major arterial road and salt field traffic accounts for a small percentage of overall traffic. Access to other areas of the salt fields is occasional and vehicle numbers are low. Consequently, the salt fields operations will have a negligible impact on traffic movement in the area around the salt fields.

20.7.3 Public Safety

The salt fields area is fenced and the public excluded. The operating site is secured with heavy duty gates and padlocking at all road entry points and agricultural fencing along property boundaries that are accessible. Signage is provided along accessible fence lines at regular intervals. Residual operations occur on PM248 meaning there is a consistent presence on site.

While illegal access does occur, there are no significant risks on site other than vehicular traffic (e.g. there are no pit voids or other hazards normally associated with a mining operation). A vehicle speed limit of 40 km/h is enforced across the site. Consequently, no public safety impacts are expected and risks are considered to be negligible.

20.7.4 Visual Amenity

The bulk earthworks will have an impact on the visual amenity of the site but it will be observable to a small number of receptors. The more significant changes will occur when the area is developed in accordance with the Master Plan. Whether the loss of the crystallising pans represents an adverse impact on visual amenity depends on the views of the observer. It is an inevitable consequence of the change in land use for the area.

20.7.5 Conservation Areas

The Adelaide Dolphin Sanctuary and Barker Inlet Aquatic Reserve are located to the west of PM248. As they are hydraulically isolated from PM248 by a sea wall, there is no potential for bulk earthworks to impact on these conservation areas.

20.7.6 Waste Management

The bulk earthworks will generate relatively small quantities of waste. Any fuel drums will be recycled. The contractor involved will be responsible for disposal of any unserviceable tyres and other waste

Risks to the environment from management of wastes are considered to be negligible.

21 Environmental Outcomes and Measurement Criteria

This chapter provides the outcomes and measurement criteria for closure operations (Table 21-1) and for mine completion (Table 21-2). As such, this chapter complements the outcomes and measurement criteria for the Holding Pattern and Residual Operations.

This structure:

- enables the tables to be adjusted (in future PEPR Revisions) to include further information as each (part of) a Section as the Salt Field moves from its Holding Pattern and Residual Operations Phase to its Closure and Completion Phase
- allows for different parts of the site (even in the same Section of the site) to be in different phases
  - in the Holding Pattern and Residual Operations Phase
  - Closure Phase
  - Completion Phase.

Table 21-1: Environmental Outcomes and Measurement Criteria – Closure Activities

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
No adverse public health and or significant nuisance impacts due to air emissions, dust, pest insect species, odour, or noise (A significant nuisance impact is considered to be one that generates a complaint that is confirmed as attributable to the closure operations and cannot be addressed within the timeframes specified in the measurement criteria.)	**Closure operations in Section 1** **Dust** No visible dust generated by closure activities in Section 1 leaves the site, or Register demonstrates that in respect of complaints relating to impacts outside site boundary from dust: ▪ complaint initially responded to within 48 hours; ▪ issues underlying complaint investigated and causes identified within 2 weeks or other time frame agreed by DSD; ▪ complaint closed out within 4 weeks or other time frame agreed by DSD **Pest Insects** Register demonstrates that in respect of complaints relating to impacts outside site boundary from pests:	**Closure operations in Section 1** **Dust** Observer will monitor and record if dust is visible at the site boundary. Register of complaints received and response actions taken **Pest Insects** Register of complaints received and response actions taken **Odour** Register of complaints received and response actions taken **Noise** Register of complaints received and response actions taken. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure operations in Section 1** **Dust** Dust will be monitored at the mine boundary as specified in the endorsed[2] Construction Environment Monitoring and Management Plans for each Stage of Bulk Earthworks. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure operations in Section 1** **Dust** Monitoring of dust from closure activities in Section 1 is undertaken at the frequency specified in the endorsed Construction Environment Monitoring and Management Plan. **Pest Insects** Entries in register are triggered by complaints **Odour** Entries in register are triggered by complaints **Noise** Entries in register are triggered by complaints **Closure Operations in Section 2**	**Closure operations in Section 1** **Dust** As specified in the endorsed Construction Environment Monitoring and Management Plans for each Stage of Bulk Earthworks **Pest insects** Not required **Odour** Not required **Noise** Not required **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4**	**Closure operations in Section 1** **Incident reporting** ▪ any dust, pest insect, odour or noise complaints reported to DSD within 48 hours of receipt ▪ progress reporting on resolution of complaint provided as directed by DSD ▪ report closing out complaint provided to DSD within 4 weeks, or timeframe otherwise agreed. ▪ any non-compliances with Measurement Criteria reported to DSD within 48 hours of occurrence. ▪ progress reporting on remedial action

[2] Reference throughout this table to an 'endorsed' plan means a plan contained in a minor change notification that has been endorsed by DSD or in an approved PEPR.

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	**What will be measured and how**	**Location**	**Frequency**		
	▪ complaint initially responded to within 48 hours; ▪ issues underlying complaint investigated and causes identified within 2 weeks or other time frame agreed by DSD; ▪ complaint closed out within 4 weeks or other time frame agreed by DSD **Odour** Register demonstrates that in respect of any complaints relating to odour received outside the site boundary: ▪ records show that all reasonable and practicable measures have been taken to reduce odour from closure activities in Section 1. **Noise** Register demonstrates that in respect of any complaints relating to noise received outside the site boundary:			TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	TBA	taken as directed by DSD. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	**What will be measured and how**	**Location**	**Frequency**		
	▪ records show that all reasonable and practicable measures have been taken to reduce noise from closure activities in Section 1. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA					
No adverse impacts to use of adjacent land or waters	**Closure Operations in Section 1** Internal audits completed at the specified intervals during each stage of bulk earthworks for closure confirm that the requirements of the Construction Quality Assurance Plan are being met and that bulk earthworks are consistent with the endorsed Bulk Earthwork Plan. No discharge from the site occurs other than at the EPA Licensed discharge	**Closure Operations in Section 1** As specified in the Construction Quality Assurance Plan for each stage of bulk earthworks. Parameters for monitoring of any discharge will be as specified in the EPA Licence. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** As specified in the Construction Quality Assurance Plan for each stage of bulk earthworks. The North Arm Creek Discharge compliance point is at: Lat: -34.826173, Long: 138.565533 Dry Creek Discharge compliance point" is at:	**Closure Operations in Section 1** As specified in the Construction Quality Assurance Plan for each stage of bulk earthworks. Monitoring of any discharge at frequency specified in the Construction Environmental Monitoring and Management Plan. **Closure Operations in Section 2** TBA	**Closure Operations in Section 1** As specified in the Construction Quality Assurance Plan for each stage of bulk earthworks. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** **Incident reporting** ▪ Any non-compliances with requirements in the Construction Quality Assurance Plan and Construction Environment Monitoring and Management Plans reported to DSD within 48 hours of occurrence.

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
	points. Quality of discharge water meets the EPA Licence criteria. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA		Lat: -34.826173° Long: 138.565533 **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA		▪ Progress reporting on remedial action taken as directed by DSD. ▪ Any changes to the Bulk Earthworks Plan are reported to DSD within 7 days. **Compliance reporting** ▪ As specified in the Construction Environment Monitoring and Management Plans for each Stage of Bulk Earthworks
No adverse impacts on other groundwater users	**Closure Operations in Section 1** Not required **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** Not required **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** Not required **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** Not required **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** Not required **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** Not required **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA
No loss of abundance or diversity of native	**Closure Operations in Section 1** Not required	**Closure Operations in Section 1** Not required	**Closure Operations in Section 1** Not required	**Closure Operations in Section 1** Not required	**Closure Operations in Section 1** Not required	**Closure Operations in Section 1** Not required

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
vegetation on or off Sections 2 to 4 of salt field through clearance arising from Holding Pattern, unless prior approval under relevant legislation is obtained	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA
No adverse impacts on the environmental values of marine waters due to water discharge	**Closure Operations in Section 1** Compliance with the Environmental Outcome "**No adverse impacts to use of adjacent land or waters"** Closure Operations in Section 2 TBA Closure Operations in Section 3 TBA Closure Operations in Section 4 TBA	**Closure Operations in Section 1** Compliance with the Environmental Outcome "**No adverse impacts to use of adjacent land or waters"** Closure Operations in Section 2 TBA Closure Operations in Section 3 TBA Closure Operations in Section 4 TBA	**Closure Operations in Section 1** Compliance with the Environmental Outcome "**No adverse impacts to use of adjacent land or waters"** Closure Operations in Section 2 TBA Closure Operations in Section 3 TBA Closure Operations in Section 4 TBA	**Closure Operations in Section 1** Compliance with the Environmental Outcome "**No adverse impacts to No adverse impacts to use of adjacent land or waters"** Closure Operations in Section 2 TBA Closure Operations in Section 3 TBA Closure Operations in Section 4 TBA	**Closure Operations in Section 1** Compliance with the Environmental Outcome "**No adverse impacts to use of adjacent land or waters"** Closure Operations in Section 2 TBA Closure Operations in Section 3 TBA Closure Operations in Section 4 TBA	**Closure Operations in Section 1** Compliance with the Environmental Outcome "**No adverse impacts to use of adjacent land or waters"** Closure Operations in Section 2 TBA Closure Operations in Section 3 TBA Closure Operations in Section 4 TBA
No adverse impacts to avifauna using the site beyond internationally recognised impact	**Closure Operations in Section 1** Not required	**Closure Operations in Section 1** Not required **Closure Operations in Section 2** TBA	**Closure Operations in Section 1** Not required	**Closure Operations in Section 1** Not required	**Closure Operations in Section 1** Not required	**Closure Operations in Section 1** Not required

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
thresholds, or outside historic ranges of variability in Species and bird numbers	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA
No compromise to potential future land use	**Closure Operations in Section 1** Internal audits completed at the specified intervals during each stage of bulk earthworks for closure confirm that the requirements of the Construction Quality Assurance Plan are being met. All chemical and hydrocarbon spills greater than 20 L are remediated within 48 hours of the spill, or a longer time agreed by the Director of Mines. Spills are considered to be remediated when an EPA Accredited Auditor confirms that affected area does not represent site contamination, as defined	**Closure Operations in Section 1** As specified in the Construction Quality Assurance Plan for each stage of bulk earthworks. As determined by an EPA Accredited Auditor for a chemical or hydrocarbon spill. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** As specified in the Construction Quality Assurance Plan for each stage of bulk earthworks. As determined by an EPA Accredited Auditor for a chemical or hydrocarbon spill. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** As specified in the Construction Quality Assurance Plan for each stage of bulk earthworks. As determined by an EPA Accredited Auditor for a chemical or hydrocarbon spill. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** As specified in the Construction Quality Assurance Plan for each stage of bulk earthworks. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA	**Closure Operations in Section 1** **Incident reporting:** ▪ Any non-compliances with requirements in the endorsed Construction Quality Assurance Plan and Construction Environment Monitoring and Management Plan reported to DSD within 48 hours of occurrence. ▪ Progress reporting on remedial action taken as directed by DSD. ▪ Any changes to the endorsed Bulk Earthworks Plan

Environmental Outcome	Outcome Measurement Criteria				Leading Indicator Criteria	Compliance Reporting
	Measurement Criteria	What will be measured and how	Location	Frequency		
	in the Environment Protection Act 1993. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA					are reported to DSD within 7 days. **Compliance reporting** As specified in the endorsed Construction Quality Assurance Plan and Construction Environment Monitoring and Management Plan for each Stage of Bulk Earthworks. **Closure Operations in Section 2** TBA **Closure Operations in Section 3** TBA **Closure Operations in Section 4** TBA

Table 21-2: Environmental outcomes and measurement criteria – mine completion, Section 1

Environmental Outcome	Outcome Measurement Criteria		
	Measurement Criteria	What will be measured and how	Locations
The Bulk Earthworks have created a landform that is	**Geotechnical** An As Constructed Report (ACR), prepared by a suitable qualified Geotechnical Inspection	**Geotechnical** The ACR will as a minimum include the following:	As defined in the relevant endorsed Bulk Earthworks Plan and associated Construction Quality

Environmental Outcome	Outcome Measurement Criteria		
	Measurement Criteria	**What will be measured and how**	**Locations**
suitable for the intended land use.	Testing Authority (GITA) consistent with AS 3798-2007, confirms that: ▪ The Bulk Earthworks have been completed in accordance with the appropriate endorsed[3] Bulk Earthworks Plan and associated Construction Quality Assurance Plan and Construction Environmental Monitoring and Management Plan; and ▪ The produced land form is geotechnically suitable for the intended land use (to be considered as "Residential" unless documented otherwise in an approved Master Plan or other suitable document). **Landform** A licensed or registered surveyor confirms the finished ground levels accord with the design finished levels in the appropriate endorsed Bulk Earthworks Plan and associated Construction Quality Assurance Plan **Environmental** An audit of the as constructed bulk earthworks, conducted in accordance with EPA Guidelines (www.epa.sa.gov.au/files/4771800_guidelines_sc_audit.pdf) by an EPA Accredited Auditor using criteria in the National Environment Protection (Assessment of Site Contamination) Measure and other relevant EPA policies and guidance, confirms it is suitable for the intended land use (to be considered as "Residential" unless	▪ All data and information produced by implementation of the Bulk Earthworks Plan, and associated Construction Quality Assurance Plan and Construction Environmental Monitoring and Management Plan ▪ Results of all observations, testing, and calculations necessary to demonstrate the extent to which the constructed bulk earthworks comply with the technical specifications. **Landform** The licensed or registered surveyor will either review and check a survey of the finished ground levels provided by the contractor for the bulk earthworks; or / and will conduct his / her own survey of the finished ground levels. **Environmental** The Auditor's report for each stage of Bulk earthworks for closure is to comply with EPA's guidelines for the conduct of Audits under the Environment Protection Act. It will review data in the ACR and produced by the implementation of the Construction Environmental Monitoring and Management Plan. **Hydrological** A suitably qualified and experienced hydrological engineer will base his / her report on a review of the ACR and the survey of the as constructed landform.	Assurance Plan and Construction Environmental Monitoring and Management Plan for each stage of bulk earthworks

[3] Endorsed as defined in Table 21-1

Environmental Outcome	Outcome Measurement Criteria		
	Measurement Criteria	**What will be measured and how**	**Locations**
	documented otherwise in an approved Master Plan or other suitable document). **Hydrological** A suitably qualified and experienced hydrological engineer confirms: ▪ that the As Constructed landform will accommodate the tidal and stream levels and flows, flood levels and flows and stormwater flows associated with the intended land use (to be considered as "Residential" unless documented otherwise in an approved Master Plan or other suitable document). ▪ The quality of water within and discharged from the As Constructed landform will not have adverse impacts on the use of land or water within or outside the site		
Final landform ensures no adverse impacts on adjoining land uses from changed surface water flows or quality.	Compliance with the Environmental Outcome **"The Bulk Earthworks have created a landform that is suitable for the intended land use"**.[4]		As defined in the relevant endorsed Bulk Earthworks Plan and associated Construction Quality Assurance Plan and Construction Environmental Monitoring and Management Plan for each stage of bulk earthworks

[4] This is because this compliance means that the intent of the endorsed Bulk Earthworks Plan has been achieved; and the endorsements of that plan included one by a suitably qualified and experienced hydrological engineer to the effect that the Bulk Earthworks will not cause adverse impacts on adjacent land uses as result of:

- Consequential changes to stream flows, flood management and stormwater management outside the site; or
- Consequential changes in the quality and quantity of any water discharge from the site; or
- Erosion or sedimentation caused by the Bulk Earthworks.

Environmental Outcome	Outcome Measurement Criteria		
	Measurement Criteria	**What will be measured and how**	**Locations**
No adverse impacts on adjoining land uses from dust or soil erosion and sediment transport	An As Constructed Report (ACR), prepared by a suitable qualified Geotechnical Inspection Testing Authority (GITA) consistent with AS 3798-2007, confirms that the soil surfaces following bulk earthworks have been stabilised in accordance with the endorsed Environmental Monitoring and Management Plan. :	As defined in the endorsed Construction Environmental Monitoring and Management Plan for each stage of bulk earthworks	As defined in Construction Environmental Monitoring and Management Plan for each stage of bulk earthworks