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Grange Resources

Report for Cape Riche Seawater Desalination Plant

Operational Environmental Management Plan

December 2011

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

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Abbreviations and Acronyms

Shortened Form	Full Title
ACHM	Australian Cultural Heritage Management
AER	Annual Environmental Review
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BDMP	Brine Discharge Management Plan
dB (A)	Decibel
DIA	Department of Indigenous Affairs
DEC	Department of Environment and Conservation (formerly CALM and DoE)
DMP	Department of Mines and Petroleum
EPA	Environment Protection Authority (Western Australia)
EP Act	Environment Protection Act 1986
EPBC Act	Environment Protection and Biodiversity conservation Act 1999
EQC	Environmental Quality Criteria
FESA	Fire and Emergency Services Authority
Grange	Grange Resources Ltd
GL/y	Gigalitres per year
HEPA	High Ecological Protection Area
km	Kilometres
kV	Kilovolts
m	Metres
ML	Megalitres
ML/day	Megalitres per day
MSDS	Material Safety Data Sheets
OEMP	Operational Environmental Management Plan
OEPA	Office of Environmental Protection Authority
pH	Measure of the acidity or basicity in an aqueous solution

Shortened Form	Full Title
RO	Reverse Osmosis
SDJV	Southdown Joint Venture
WC Act	Wildlife Conservation Act 1950
WONS	Weeds of National Significance

1. Introduction

This Operational Environmental Management Plan (OEMP) has been prepared by GHD for the Southdown Joint Venture (SDJV) involving Grange Resources Ltd (Grange) and Sojitz Resources and Technology Pty Ltd to provide an ongoing operational framework for the environmental management of the Cape Riche Seawater Desalination Plant and its associated infrastructure (the Plant). The Plant includes a reverse osmosis (RO) desalination plant, an open channel seawater intake, a brine outfall, seawater intake pipeline, brine discharge pipeline and a desalinated water pipeline to the Southdown Magnetite mine site.

This document has been prepared as part of the environmental approvals process and is based on the management measures proposed in the environmental documentation at the time of writing. It is anticipated that following the receipt of Ministerial approval under the *Environment Protection Act 1986* (EP Act) and subsequent project approvals, including the Operating Licence required under Part V of the EP Act, updates and amendments will be made to the OEMP as required. The project is also being assessed under the *Commonwealth Environment Protection and Biodiversity Act 1999* (EPBC Act) and any relevant requirements arising from that assessment will also be included into the OEMP.

1.1 Background

The Southdown Magnetite Project produces a significant quantity of magnetite concentrate for export purposes.

SDJV has developed the Plant in order to provide a reliable, high quality water supply to its Southdown Magnetite mine site and for use in a slurry pipeline taking product to Albany for export. The Plant is designed to supply 12 gigalitres per year (GL/y) of treated water to the Southdown mine site via a pipeline from the desalination plant.

The desalinated water is used primarily as process water at the mine site, meeting 85% of make-up water requirements. If required, a small portion of the desalinated water can also be further treated at the mine site to provide water for potable use.

1.2 Plant Operations

The Plant is located in the South Coast region of Western Australia, approximately 90 kilometres (km) east north-east of Albany and approximately 19 km from the nearest town of Wellstead.

The major operational components of the Plant are:

- A RO seawater desalination plant that produces up to 12 GL/y of desalinated water;
- An open channel seawater intake (seawater intake) and pump station on the north side of Cape Riche with an intake capacity of 90 ML/day;
- A seawater transfer pipeline of approximately 5 km, from the seawater pump station to the desalination plant;
- A brine discharge pipeline, approximately 5.7 km from the desalination plant, with an outfall capacity of 55 ML/day feeding into an engineered channel, prior to discharging into the southern ocean;

- A treated water transfer pipeline of approximately 25.6 km, from the desalination plant to the Southdown mine site;
- A 33 kilovolts (kV) power line, situated within the treated water pipeline easement, from the Southdown mine site to the desalination plant; and
- A 33 kV power line consisting of a combination of overhead and underground cable from the desalination plant to the seawater intake.

The majority of the Plant is located on cleared grazing land approximately five kilometres west of Cape Riche. The seawater intake and pump station is located on private property approximately 500 m east of Cheyne Inlet (Eyre River), along the northern coastline of Cape Riche (**Figure 1**).

1.3 Purpose and Scope

This document is designed to assist all parties involved in the operation of the Plant to identify and manage the potential environmental impacts that may result from operational activities. This includes the provision of a number of contingency actions that may be used in the event that the proposed management actions do not achieve the desired outcome.

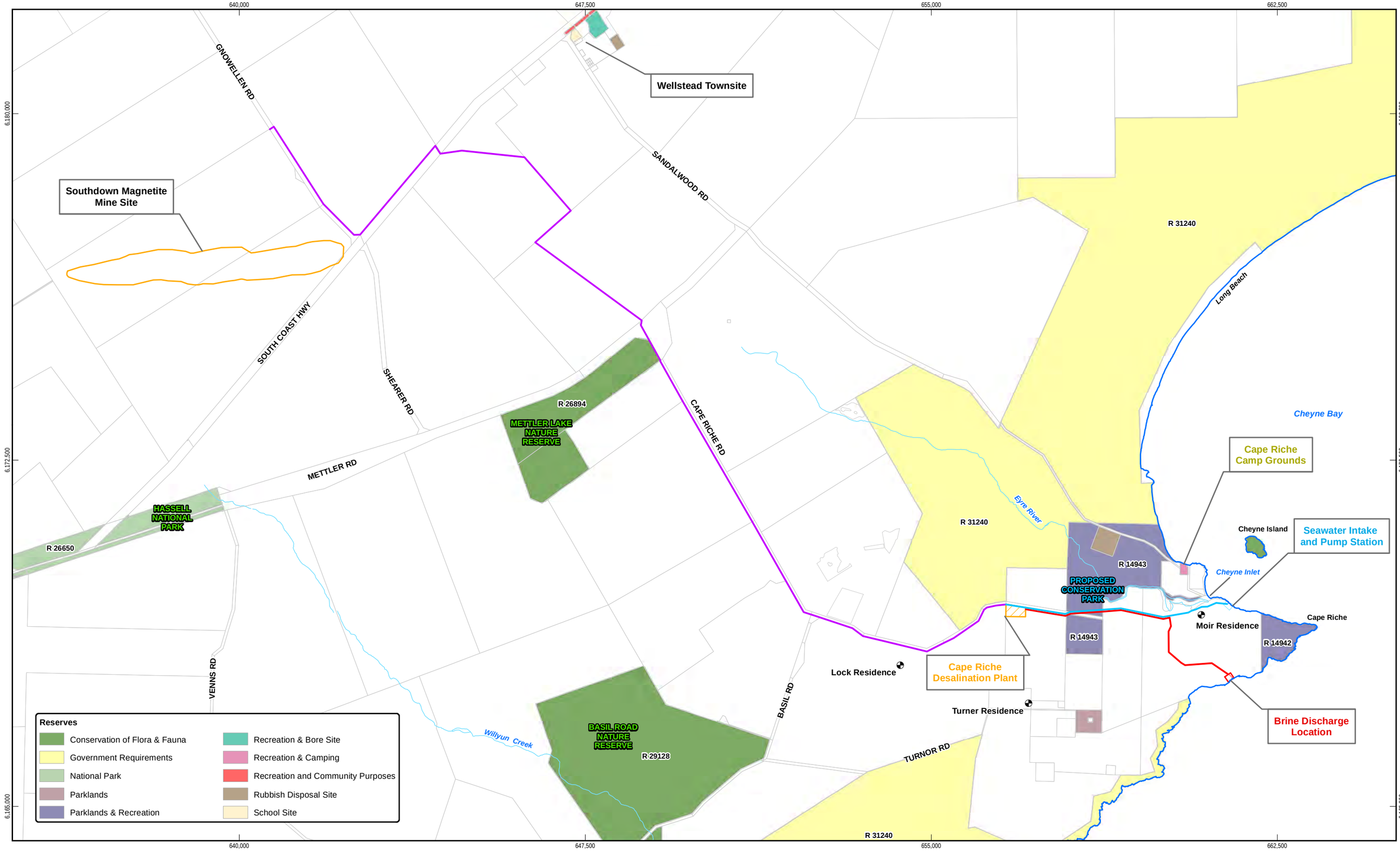
The specific aims of this OEMP are to:

- Summarise the relevant environmental values potentially affected by the operation;
- Detail prevention, minimisation and mitigation measures for potential environmental impacts of the operation;
- Detail who is accountable and responsible for these measures; and
- Detail the monitoring and reporting process.

A Brine Discharge Management Plan (BDMP) (Appendix A) has been developed in conjunction with this OEMP to detail all brine discharge monitoring and reporting requirements. The BDMP should be read in conjunction with the OEMP.

The key environmental values and management areas relevant to the operation of the Plant and covered in this OEMP are:

- Marine Water Quality;
- Benthic Habitat;
- Chemical and Dangerous Goods management;
- Waste management;
- Flora and Native Vegetation;
- Weed and Pathogen management;
- Fauna;
- Noise;
- Reserve and Conservation Areas;
- Indigenous Heritage and Native Title; and
- Visual Impact.



1:75,000 (at A3)

0.75 0.375 0 0.75 1.5 2.25 3

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- Residence
- Seawater Transfer Pipeline and Buried Power Line
- Treated Water Transfer Pipeline and Power Line
- Brine Discharge Pipeline
- Named Watercourse
- Coastline
- Desalination Plant
- Brine Discharge Location
- Pump Station
- Approved Pit Boundary
- Cadastre

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Cape Riche
Seawater Desalination Plant

Job Number	61-26005
Revision	2
Date	14 Oct 2011

Plant Location

Figure 1

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

G:\61\26005\GIS\Maps\MXD\6126005_G062_Fig01_Rev2.mxd

Data source: Landgate: Cadastre - 20101018, Reserves - 20110525; Coastline - 20110628; DoW: Water Courses - 2011; Grange Resources: Approved Pit Boundary - 20100812; Harley Global: Treated Water Transfer Pipeline and Powerline, Seawater Pipeline and Powerline, Brine Discharge Pipeline - 20110704; GHD: Desalination Plant, Brine Discharge Location - 20110527, Pump Station - 20110826 Residences - 20110623 Created by: tgoad, mczekaj

2. Environmental Setting

2.1 Physical Environment

2.1.1 Climate

The South Coast region of Western Australia experiences a Mediterranean-type climate characterised by warm summers and cool, wet winters (Bureau of Meteorology 2011). June is identified as the wettest month, with a long-term average rainfall of 72.9 mm. In winter it rains on average about one day out of every three. The driest month is January, with a long-term average rainfall of 21.6 mm. In summer it rains on average about one day in every six. Rainfall generally decreases northwards and eastwards across the region.

Yearly maximum and minimum temperatures are strongly influenced by distance from the coast, with inland parts of the region experiencing far greater range in mean temperatures than the coastal areas. Mean maximum temperatures range from 16.2°C in July to 25.1°C in January / February while mean minimum temperatures range from 6.1°C in August to 14.0°C in February.

2.1.2 Hydrology

There are no wetlands within the footprint of the Plant, however a number of south coast significant wetlands areas are adjacent the pipeline corridor, including a wetland located within Mettler Lake Nature Reserve (approximately 10 km from the desalination plant) and wetlands adjacent to Basil Road Nature Reserve, (approximately 4.5 km from the desalination plant). There are no RAMSAR wetlands within, or nearby, the Plant area.

There are numerous small unnamed and unmapped drainage lines existing within the Plant area. These comprise small ephemeral drainage or seepage lines. The locally recognised Eyre River is located to the north of the Plant.

2.2 Biological Environment

2.2.1 Terrestrial Environment

The Plant is located within the Esperance bioregion, which is characterised by myrtaceous and protaceous scrub and mallee heaths on sandplain.

The Cape Riche and Wellstead area has a long history of vegetation clearing and grazing and there have been significant losses of native vegetation, suppression of natural regeneration and weed invasion. The areas of remnant native vegetation contain a number of native flora species and native flora communities in a range of vegetation health conditions. Some of these areas contain weed infestations (including declared weeds) and, potentially, the plant pathogen *Phytophthora cinnamomi.*

The Plant (including the associated pipeline alignments) is largely located within existing highly disturbed areas, cleared paddocks, road verges and access tracks.

2.2.2 Marine Environment

The seawater intake is located in a sheltered bay between the north side of Cape Riche and Cheyne Island. The seawater intake channel is cut through the granite or gneissic rock shoreline.

Variations in salinity adjacent to the intake channel can be influenced by runoff or floods from Eyre Inlet entering Cheyne Bay. Variations in coastal seawater turbidity can be influenced by runoff from Eyre Inlet and breaking storm waves that frequently occur in the area.

The brine discharge is located on a granite or gneissic wave cut platform at the base of the cliffs on the south side of Cape Riche. Brine is pumped from the plant to the end of the brine discharge pipeline and discharged to the ocean via an engineered rock gutter and natural fissure in the wave cut platform. Wind waves and swell propagate from the Southern Ocean towards Cape Riche and break on or over the wave cut platform. This exposed coast experiences wave heights in the range of one to nine metres (m) throughout the year. Calm sea states are rare, on average occurring up to only four days per year.

The rocky coastline at the discharge location transitions to a mostly bare boulder substrate, with occasional patches of brown algae. Only a short distance from the platform edge, the rocky substrate transitions to barren sand planes, in an offshore direction. No seagrass or corals have been recorded in the immediate vicinity of the brine discharge location from previous site investigations.

2.3 Social Environment

2.3.1 Adjacent Land Use and Tenure

Land uses identified within the Cape Riche region are limited to either rural or parks and recreation categories (City of Albany 2011; DEC 2008). Most of the Cape Riche region is freehold land used for agriculture. The area between Wellstead and Cape Riche includes a small number of farming homesteads. The majority of the desalinated water pipeline, approximately 25.6 km, is located upon freehold land that is currently used (and almost all cleared) for agricultural purposes.

The majority of the Plant's infrastructure is located on private land, with the area having scattered residences associated with individual land holdings, including four cottages located on Cape Riche Homestead property, for holiday use.

The Cape Riche camp ground is located approximately 18 km south of Wellstead along Sandalwood Road. The camp ground is managed by the City of Albany and has direct access to the beach. The camp ground includes a number of camping sites and limited amenities. It is located approximately 4.5 km east of the desalination plant site, and approximately one km north-west of the seawater intake and pump station location.

There are two registered nature reserves in the vicinity of the Plant: Basil Road Nature Reserve (R291128), approximately 4.5 km from the desalination plant, and Mettler Lake Nature Reserve (R26894), which lies adjacent to part of the treated water transfer pipeline. Hassell National Park is located approximately 16 km from the proposed desalination plant site, adjacent to Mettler Road. A proposed conservation park (R14943) is located approximately one km east of the proposed desalination plant site.

2.3.2 Stakeholders

Consultation with stakeholders is undertaken in accordance with Grange's *Social Responsibility Policy* and the SDJV's *Stakeholder Consultation Strategy*. Grange (on behalf of the SDJV) continually engages its stakeholders in a two-way discussion and will continue to throughout the Plant's operation.

The key stakeholders relevant to the operation of the Plant include:

- Affected Land Owners;
- Wellstead Community;
- Cape Riche Camp Ground;
- Office of the Environmental Protection Authority (OEPA);
- Department of Environment and Conservation (DEC);
- Department of Mines and Petroleum (DMP);
- Department of Indigenous Affairs;
- City of Albany;
- South Coast Natural Resource Management;
- Western Power; and
- Wildflower Society of Western Australia (Albany Branch).

3. Legislative and Regulatory Framework

3.1 Environmental Legislation

The SDJV, its employees and contractors shall comply with all relevant Commonwealth, State and Local Government legal requirements that apply to the operation and management of the Plant. Legislation relevant to the operation and management of the Plant is summarised in **Table 1**.

Table 1 Legislation relevant to the operation and management of the Plant

Legislation	Brief Description	Regulatory Authority
Commonwealth Government Legislation		
Environment Protection and Biodiversity Conservation Act 1999	The Act protects the environment, particularly matters of National Environmental Significance	Department of Sustainability, Environment, Water, Population and Communities
Native Title Act 1993	The Act provides for the protection and recognition of native title to unallocated Crown land, providing that a continuous connection with that land can be established	National Native Title Tribunal
State Government Legislation		
Environmental Protection Act 1986	The Act makes provision for the establishment of the EPA, for the prevention, control and abatement of pollution and for the conservation, preservation, protection, enhancement and management of the environment. The Act also provides for the control and licensing of potentially polluting activities, land clearing and is the Act under which the State environmental approvals process operates.	Environmental Protection Authority
Aboriginal Heritage Act 1972	The Act provides for the preservation and protection of places or objects of historical significance to, or of traditional or customary use by the original inhabitants of Australia or their descents.	Department of Indigenous Affairs
Dangerous Goods Safety Act 2004 and Associated Regulations	The Act relates to the safe storage, handling and transport of dangerous goods and for related purposes.	Department of Mines and Petroleum

Environment Protection (Controlled Waste) Regulations 2004	These regulations list the types of controlled waste which must be stored, treated, transported and disposed of as set out in the regulations. DEC have developed a series of guidelines in support of the regulations for appropriate transport and disposal of controlled waste: ◗ Guideline for Controlled Waste Carriers (DEC, 2004a); ◗ Guideline for Controlled Waste Treatment or Disposal Sites (DEC, 2004b); ◗ User Guide: Controlled Waste Tracking System (DEC, 2006); and ◗ Landfill Waste Classification and Waste Definitions (DEC, 1996).	Department of Environment and Conservation
Health Act 1911	The Act provides appropriate management tools to tackle both traditional and emerging public health concerns of the 21st century.	Department of Health
Health (Treatment of Sewerage and Disposal of Effluent and Liquid Waste) Regulations 1974	Installation and operations are to be carried out in accordance with the Health Regulations 1974.	Department of Health
Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009)	This document is intended to provide guidance and criteria to be applied in determining the classification of wastes for acceptance to landfills licensed or registered in Western Australia in accordance with Part V of the *Environmental Protection Act 1986*	Department of Environment and Conservation

Western Australian Environmental Protection (Unauthorised Discharges) Regulations 2004	These regulations prohibit commercial activities from discharging certain wastes into the environment. The prohibited wastes include petrol, sewage, degreasers, detergents and food wastes. Specifically, it is an offence to discharge sediment into the marine environment, and to discharge brine in which are: acid with a pH less than 4; alkali with a pH more than 10; animal oil, fat or grease; compounds of solutions of cyanide, chromium, cadmium, lead, arsenic, mercury, nickel, zinc, copper; degreaser; detergent; dye; engine coolant or engine corrosion inhibitor; mineral oil; organic solvent; paint; petrol, diesel or other hydrocarbon; pesticide; vegetable oil, fat or grease.	Department of Environment and Conservation
Wildlife Conservation Act 1950 (WC Act)	The Act provides for the conservation and protection of wildlife (flora and fauna). Special provisions and schedules cover protection and management of gazetted rare flora and fauna.	Department of Environment and Conservation

3.2 Approvals and Licensing

As this is a working document, approval statuses and licence conditions will be reviewed at a minimum on an annual basis, and updated as required. Any changes will be incorporated into SDJV's induction and training procedures.

3.2.1 Ministerial Approvals (Part IV – EP Act)

This section will be updated following receipt of the Ministerial Statement.

3.2.2 Operating Licence (Part V – EP Act)

This section will be updated following receipt of the Operating License.

4. Responsibility and Accountability

During operations, environmental accountabilities within the SDJV management framework will be as follows:

- General Manager, Southdown Project – Overall responsibility for the ongoing environmental performance of the Plant.
- Environment Manager, Southdown Project – Responsible for day to day environmental performance and compliance of the Plant.
- Site Environmental Coordinator – Responsible for the day to day verification that the environmental performance of the site complies with the OEMP.

All staff and contractors associated with the ongoing operation of the Plant are responsible for environmental management with respect to their day to day activities in accordance with this OEMP.

4.1 Training of Operational Staff

Training on relevant sections of this management plan and monitoring programs will be undertaken by all staff involved in the operation of the Plant as part of the induction and training process. Upon completion, trained personnel will be signed off and recorded in an OEMP Training Log along with the date and the specific aspects for which training was conducted.

5. Environmental Management, Monitoring and Contingencies

5.1 Marine Water Quality

Marine water quality in the Cape Riche area is characterised by low turbidity, nutrient and metal levels and is considered of a high standard from both ecological and desalination source water perspectives (360 Environmental 2010; GHD 2011a). The nutrient, metals and chlorophyll-a concentrations of the inshore coastal waters of Cape Riche meet the default ANZECC/ARMCANZ (2000) Guidelines.

Although the seawater intake will not impact the surrounding marine water quality, there is potential for brine discharge to lead to chronic but reversible effects on the distribution, abundance and health of marine fauna and benthic primary producers if the discharge is uncontrolled. The potential impacts to marine water quality are:

- Change in seawater salinity and temperature in the marine waters around the outfall due to brine discharge; and
- Change in ambient seawater chemical composition in the marine waters around the outfall due to brine discharge.

Table 2 details the objectives, management, performance indicators, monitoring and contingencies for marine water quality associated with the Plant operations.

Table 2 Marine Water Quality

OEMP - 01	**Marine Water Quality**
Responsibilities	Implementation – Site Manager
	Compliance – Site Environmental Coordinator
Objectives • To maintain the integrity, ecological functions and environmental values of the benthic habitats in the vicinity of the Plant.	
Management • Sufficient maintenance of plant and equipment to ensure operational performance is maintained; • Regular monitoring of discharge brine quality at plant shall be undertaken to ensure operational performance is maintained; • Shock chlorination (or similar) shall only be undertaken within the confines of the seawater intake channel when intake pumps are running such that all chlorine is drawn into the pump station; and • Adherence to monitoring and management requirements outlined in the BDMP (Appendix A).	
Performance Indicators • Compliance with Environmental Quality Criteria (EQC) outlined in the BDMP (Appendix A).	

Monitoring

- Monitoring shall be conducted in accordance with the Brine Discharge Management Plan (Appendix A).

Contingency

Trigger	Action
Exceedance of EQCs outlined in the BDMP (Appendix A).	Undertake actions outlined in BDMP (Appendix A).

5.2 Benthic Habitats

Benthic habitats play an important role in maintaining the integrity of marine ecosystems and the supply of ecological services. There is strong evidence that the presence of benthic habitat is important to the maintenance of marine biodiversity, through the provision of structurally complex and diverse habitat, provision of refuge, and increased food supply (EPA 2009).

Dominant habitats identified within the high ecological protection area (HEPA) include areas of seagrass meadows within Cheyne Bay (on the north side of Cape Riche), which extend in a northerly direction along the coastline, hard coral outcrops along the northern shoreline of Cape Riche and various intertidal communities along the rocky wave-cut platform discharge site, including macro algae, coralline algae, crustaceans and gastropods.

The following operational aspects of the Plant which have the potential to impact benthic habitats are:

- The brine discharge into the marine environment; and
- The seawater intake.

The potential impacts to benthic habitats, as a result of the above operations include:

- Entrainment of coral spawn into the seawater intake;
- Change in physico-chemical parameters affecting local benthic communities due to brine discharge into the marine environment around the outfall; and
- Change in ambient seawater chemical composition due to treatment chemicals in the brine discharge into the marine environment around the outfall.

Table 3 details the objectives, management, performance indicators, monitoring and contingencies for benthic habitats associated with the Plant operations.

Table 3 Benthic Habitat Management

OEMP - 02	**Benthic Habitat Management**
Responsibilities	Implementation – Environment Manager
	Compliance – Site Environmental Coordinator
Objectives • To protect the integrity and biodiversity of the marine ecosystems in the Cape Riche area.	
Management • Maintenance of plant and equipment to ensure operational performance is achieved; • Regular monitoring of discharge brine quality at plant shall be undertaken to ensure operational performance is maintained; • Adherence to monitoring and management requirements, as outlined in the BDMP (Appendix A); and • Coral spawn dispersion modelling shall be undertaken pre-commissioning to confirm that there is an insignificant risk of entrainment of coral spawn associated with the seawater intake. If required, management measures recommended as part of this study will be incorporated into the final OEMP in consultation with DEC.	

Performance Indicators ◗ Compliance with EQCs outlined in BDMP (Appendix A).	
Monitoring ◗ Monitoring shall be conducted in accordance with the BDMP (Appendix A) which outlines Commonwealth and State legislative monitoring and management requirements.	
Contingency	
Trigger	**Action**
Exceedance of EQCs outlined in BDMP (Appendix A).	Undertake actions outlined in BDMP (Appendix A).

5.3 Chemical and Dangerous Goods Management

A range of chemicals and classified dangerous goods are stored and used for the operation of the Plant. Chemicals and classified dangerous goods have the potential to harm human health and the environment if released in an uncontrolled manner to land, water or the atmosphere.

Table 4 details the objectives, management, performance indicators, monitoring and contingencies for chemicals and dangerous goods associated with the Plant operations.

Table 4 Chemical and Dangerous Goods Management

OEMP - 03	**Chemical and Dangerous Goods Management**
Responsibilities	Implementation – Environment Manager
	Compliance – Site Environmental Coordinator

OEMP - 03	Chemical and Dangerous Goods Management

Objectives

- To safely manage, purchase, store, handle and dispose of fuels and chemicals and prevent the uncontrolled release of chemicals to the environment.

Management

- All licences required under the *Dangerous Goods Safety Act 2004 (WA),* shall be obtained from DMP prior to any storage or use of any dangerous goods;
- Liquid dangerous goods will be stored in a covered bund or compound area capable of containing 110% of the volume of the largest container;
- Dangerous goods shall be stored in the lowest practical quantities, to minimise the environmental impact if spillage occurs;
- Dangerous goods shall be stored and handled in a manner to prevent contamination of the atmosphere;
- Incompatible dangerous goods shall be segregated;
- Dangerous goods shall not be stored within 25 m of any watercourse or wetland;
- Material Safety Data Sheets (MSDS) shall be maintained for each dangerous good stored on site, with the MSDS to be located outside of the compound in which the material is stored;
- The Dangerous goods storage at each site shall be placarded in accordance with legislative requirements;
- Deliveries of dangerous goods shall only be accepted if they are accompanied by the relevant MSDS, or if there is an existing and current MSDS for that dangerous good already held on the site;
- Elimination of ignition sources in hazardous areas, where this is not practicable, the risk arising from the ignition source shall be controlled;
- All relevant operations staff shall be trained in the purchase, handling, storage or use of chemical substances and the risk associated with storage and handling of substances, including the necessary controls;
- Spill Response Kit shall be installed and maintained for the clean-up and containment of spills to land or water. Each spill kit shall contain as a minimum:
  - Universal absorbent pads or pillows or blankets;
  - Labelled plastic contaminated waste bags;
  - Safety gloves; and
- Disposal of all chemicals and dangerous goods shall be in accordance with Section 5.4 of this document.

Performance Indicators

- Compliance with relevant DMP licence requirements;
- Compliance with the *Dangerous Goods Safety Act 2004* and relevant regulations including *Dangerous Goods Safety (Storage and Handling of Non-Explosives) Regulations 2007*; and
- Compliance with any other related statutory conditions placed on the Plant.

OEMP - 03	Chemical and Dangerous Goods Management

Monitoring

- Monthly inspections of chemical and hydrocarbon storage areas shall be conducted against the requirements of the relevant Australian standards by the Site Environmental Coordinator; and
- A Dangerous Goods Incident Log(s) shall be maintained for all dangerous goods held on the site. The Log(s) will be stored in a secure location at the site entrance or in the main office. The Log(s) will identify the:
  - Date on which the goods were received;
  - Location at which the goods are stored;
  - Volume/quantity stored at each location;
  - Date and volume/quantity removed whenever goods are removed from storage; and
  - Name of the person receiving/removing goods to/from storage on each occasion.

  A site plan that identifies the storage location of each dangerous good shall accompany the Dangerous Goods Incident Log.

Contingency

Trigger	Action
Chemical Spill/Fire	1. Any spills to be contained and cleaned up immediately. Contaminated runoff and contaminated soil will be collected and remediated or disposed of in in accordance with the Waste Management requirements (Section 5.4); 2. Fire and Emergency Services Authority (FESA) will be notified of any incident involving dangerous goods that has had, or has the potential, to have a significant impact on the environment or human safety; 3. A DMP Resources Safety dangerous goods officer shall be notified as soon as practicably possible following incidents outlined in **Table 5**, and for: – Any dangerous goods incident that, but for intervening events, could have resulted in unreasonable harm to people, environment or property; – Any incident that results in a dangerous situation; – Any incident identified in specific regulations (DMP 2010). A dangerous goods officer can be contacted on (08) 9358 8002 or dgsb@dmp.wa.gov.au;

OEMP - 03	Chemical and Dangerous Goods Management
	4. The cause of spills shall be investigated; and 5. An appropriate remedy shall be implemented, which may include: – Repairing defective equipment; – Upgrading chemical and fuel storage handling procedures; and – Relocate fuel or chemicals to appropriately bunded or approved storage areas.

Table 5 Reportable quantities of dangerous goods losses (DMP 2010)

Dangerous Goods	Report any loss exceeding amounts below	
	Loss not contained on site	Loss contained on site
Flammable gas (Division 2.1)	50 m^3	50 m^3
Non-flammable non-toxic gas (Division 2.2)	100 m^3	100 m^3
Toxic gas (Division 2.3)	5 m^3	5 m^3
Dangerous goods classified as Packing Group I	5 L/kg	50 L/kg
Dangerous goods classified as Packing Group II or III, or C1 combustible liquids	100 L/kg	1000 L/kg
Goods too dangerous to transport	5 L/kg/m^3	50 L/kg/m^3

5.4 Waste Management

Wastes generated from the operation of the Plant include:

- Brine discharge water;
- Solid waste from the seawater intake screens;
- Thickened sludge resulting from the desalination process;
- Small quantities of miscellaneous general solid and liquid waste; and
- Chemicals and dangerous goods waste.

Successful management of these waste streams is important to minimise impacts to the environment, prevent odour issues impacting the community, and to provide a safe/clean working environment for staff and contractors.

Table 6 details the objectives, management, performance indicators, monitoring and contingencies for wastes associated with the Plant operations.

Table 6 Waste Management

OEMP - 04	**Waste Management**
Responsibilities	Implementation – Environment Manager
	Compliance – Site Environmental Coordinator
Objectives ◗ To effectively manage waste streams from the operation of the Plant to ensure that the associated environmental impact is as low as reasonably practical; and ◗ To manage solid wastes to ensure odour does not negatively impact local receptors.	
Management ***Brine Discharge Water*** ◗ Brine discharge water is to be managed in accordance with the BDMP (Appendix A). ***Intake Screen Solid Waste*** ◗ This waste shall be collected and stored in suitable purpose built covered and sealed skip bins for disposal at a licensed offsite facility; and ◗ Screen waste removal shall be undertaken at appropriate intervals to ensure odour is not an issue (this is likely to be more frequently in summer). ***General Waste*** ◗ General wastes shall be collected on-site in clearly marked and covered waste bins to prevent odour emissions and attraction of vermin; and ◗ Recyclables, including glass, paper and plastic, shall be collected onsite and disposed of at an appropriate recycling facility. ***Thickened sludge*** ◗ If alternative uses cannot be found for the thickened sludge, it shall be de-watered and collected on site, and disposed of at an offsite licensed disposal facility, in accordance with the *Landfill Waste Classification and Waste Definitions 1996* (DEC 2009) and *Environmental Protection Regulations 1987*; ◗ When (if) required to be temporarily stored on site, thickened sludge waste shall be stored in purpose built, covered and sealed storage; and ◗ Thickened sludge removal shall be undertaken at appropriate intervals to ensure odour is not an issue. ***Chemicals/Dangerous Goods*** ◗ A licensed Controlled Waste Carrier shall remove all chemical and dangerous good waste product generated on site for disposal at an appropriately licensed disposal facility; and ◗ Prior to collection, chemicals and dangerous goods waste product shall be clearly labelled and stored in bunded areas or purpose built skip bins.	

Performance Indicators

- Compliance with relevant waste disposal legislative requirements.

Monitoring

- Odour monitoring at the intake pump station using drum odour sampling following commissioning of the plant to provide measureable emission rates and validate odour modelling results; and
- The site environmental coordinator shall undertake weekly audits/inspections of each of the waste stream processes to ensure:
  - Timeliness of any required waste stream collection;
  - Correct disposal methods and reporting requirements are being followed in line with relevant regulations; and
  - Records of waste collection and disposal volumes and classifications are kept up to date.

Contingency

Trigger	Action
Complaint received concerning odour or waste	Manage complaint and response as detailed in Section 6.4.
Odour emanating from the storage of intake screen waste at the pump station becomes significant and cannot be mitigated by increasing removal frequency.	Investigate and retro-fit appropriate odour abatement technology. This may involve a purpose built shed/building being constructed for the storage of the intake screening skip bins, with odorous air from the building passed through an odour control plant to reduce odours to acceptable levels.
Odour emanating from the storage of thickened sludge at the plant becomes significant.	Investigate and retro-fit appropriate odour abatement technology. This may involve changing the building design such that odorous air is treated by an odour control plant prior to discharge.

5.5 Noise and Vibration

The primary operational noise and vibration sources present during the operation of the Plant include:

- Seawater intake pump station;
- Desalination plant – ultra filtration (UF) pre-treatment;
- Desalination plant – RO membranes;
- Transfer (permeate) pump station; and
- Wastewater sludge collection and dewatering.

The operational aspects outlined above, have the potential to cause invasive noise and vibration impacts upon the nearby sensitive receivers including local residents and the Cape Riche camp ground.

Table 7 details the objectives, management, performance indicators, monitoring and contingencies for noise and vibration associated with the Plant operations.

Table 7 Noise and Vibration Management

OEMP - 05	**Noise and Vibration Management**
Responsibilities	Implementation – Environment Manager
	Compliance – Site Environmental Coordinator
Objectives ◗ To minimise noise generated by the operation of the Plant to ensure operating noise is below the assigned noise levels stipulated in the *Environmental Protection (Noise) Regulations 1997*.	
Management ◗ Selective procurement of plant, equipment and vehicles to limit noise emission where possible. ◗ All plant, equipment and vehicles on site shall be kept properly serviced and fitted with effective exhaust mufflers to suppress noise emissions; ◗ Plant equipment and vehicles found to produce excessive noise compared to industry standard, shall be removed from the site or stood down until repairs or modifications can be made; ◗ The use of loud tools, such as impact wrenches, shall be limited when carrying out Plant repairs within close proximity to sensitive receptors. Hand tools or quiet hydraulic torque units should be the preferred option where suitable; ◗ Loading and unloading areas shall be located far as is practicable from noise sensitive receptors; ◗ Where practical and feasible, motor drives, gearboxes, pumps etc. shall be specified and selected to achieve a noise level of less than 85 dB(A) at a distance of one metre; ◗ Where the above point cannot be achieved, purpose built acoustic enclosures shall be provided, where required, for large plant items in order to achieve noise levels of less than 85 dB(A) at one metre, consistent with occupational health and safety requirements; and ◗ Maintenance and construction works during operations shall be carried out in accordance with *Environmental Protection (Noise) Regulations 1997*.	
Performance Indicators ◗ Compliance with the Environmental Protection Act 1986 through adherence to the Environmental Protection (Noise) Regulations 1997.	
Monitoring ◗ Noise monitoring shall be undertaken at the commencement of the plant operation to validate the noise model undertaken by GHD (2011b) as part of the PER process; and ◗ A noise Log(s) shall be maintained for all noise related complaints received. The Log(s) will be stored in a secure location at the site entrance or in the main office. The Log(s) will identify: – Complainant's name and contact details; – Nature of complaint; and – Investigation undertaken in response to complaint.	
Contingency	

OEMP - 05	Noise and Vibration Management
Trigger	**Action**
Noise monitoring shows exceedance of the following noise criteria (GHD 2011b): ◗ 65 db(A) at the boundary of the plant; or ◗ 35 db(A) at any sensitive receptor.	1. Investigation into cause of excessive sound; 2. Plant equipment and vehicles found to produce excessive noise compared to industry standard, shall be removed from the site or stood down until repairs or modifications can be made; and/or 3. Investigate and implement appropriate acoustic enclosures to mitigate excessive noise; and 4. Undertake further noise monitoring with additional management measures in place to confirm efficacy of mitigation.
Complaints received concerning noise or vibration.	Manage complaint and response as detailed in Section 6.4.

5.6 Flora and Native Vegetation

Although no vegetation clearing is planned during the operation of the Plant, there is a potential that maintenance practices may impact terrestrial flora and native vegetation if not managed appropriately. Potential impacts include undetected leaks from pipelines, alteration of drainage patterns and the introduction of weeds, diseases and exotic species. The management of weeds and diseases are considered under Section 5.7.

Should vegetation clearing be required during operation of the Plant, the flora and vegetation management measures stipulated in the Construction Environmental Management Plan shall be followed. The SDJV's Site Environmental Coordinator shall obtain the necessary *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* approvals prior to any clearing being undertaken.

Table 8 details the objectives, management, performance indicators, monitoring and contingencies for flora and native vegetation associated with the Plant operations.

Table 8 Flora and Native Vegetation Management

OEMP - 06	Flora and Native Vegetation Management
Responsibilities	Implementation – Environment Manager
	Compliance – Site Environmental Coordinator
Objectives ◗ To minimise and manage the impact to flora and native vegetation habitats in line with the EP Act;	

OEMP - 06	Flora and Native Vegetation Management
and ◗ To protect conservation significant flora populations consistent with the provisions of the WC Act and the EPBC Act.	
Management ◗ Progressive rehabilitation of previously cleared land using locally occurring species; ◗ Flow meters to be installed on seawater intake, brine discharge and treated water pipeline; ◗ Repair leaks to pipeline where identified; and ◗ Vehicles and machinery shall use designated access routes and will be parked in designated parking areas only.	
Performance Indicators ◗ No unauthorised clearing and/or ground disturbance to flora and native vegetation.	
Monitoring ◗ Ongoing visual inspections to ensure no unauthorised clearing and/or ground disturbance occurs; and ◗ Implement routine (monthly) seawater intake, brine discharge and treated water pipeline inspections to enable early identification leaks.	
Contingency	
Trigger	**Action**
Non-compliance with management measures detailed above.	1. Immediately investigate the cause of the non-compliance; 2. Implement contingency actions which may include: – Review management measures practicality or relevance; – Improve training and education for all personnel; 3. Monitor the success of these actions; and 4. Initiate rehabilitation of effected flora and vegetation areas if required.
Major breach or failure of pipeline	1. Immediate shutdown of pumps to prevent further water loss from breach; 2. Investigate impact of water loss to the environment (including potential for erosion and flora impact) and undertaken rehabilitation as necessary; 3. Undertake required maintenance to fix

OEMP - 06	Flora and Native Vegetation Management
	the pipeline breach prior to re-starting pumps; and 4. Monitor the success of these actions.
Minor leak in pipeline	1. Site Environmental Coordinator to undertake initial assessment of impacted area; 2. If signs of major water spread (i.e. significant water logging or erosion), treat as major breach (above); 3. If minor localised water spread undertake required maintenance to fix the leak; and 4. Monitor the success of these actions.

5.7 Weed and Pathogen Management

The movement of vehicles and equipment during operation has the potential to facilitate the introduction and/or spread of weed species. Three Weeds of National Significance (WONS) are known to occur within the surrounding area. Hence, weed control is necessary to prevent the introduction of new species and the spread of those existing within the area.

Phytophthora cinnamomi, commonly known as Dieback, is found throughout the southern region of Western Australia in areas hosting susceptible plant species and which receive rainfall in excess of 400 mm/year (Dieback Working Group, 2005). Dieback infestations are spread through bushland either naturally, through soil water movement, or artificially, through vector movement of soil on vehicles and, occasionally, via foot traffic.

To enable appropriate dieback management procedures, SDJV have undertaken a Dieback survey to identify high, medium and low priority areas. High and medium priority areas are sites in or adjacent to bushland and remnant vegetation; and will be associated with management procedures. Low priority areas are sites that have no remnant vegetation and are not subject to specific dieback management procedures.

Table 9 details the objectives, management, performance indicators, monitoring and contingencies for weeds and pathogens associated with the Plant operations.

Table 9 Weed and Pathogen Management

OEMP - 07	Weed and Pathogen Management
Responsibilities	Implementation – Environment Manager
	Compliance – Site Environmental Coordinator
Objectives	

OEMP - 07	Weed and Pathogen Management
◗ To prevent the introduction and spread of weed species and pathogens.	
Management ◗ Site inductions shall include hygiene information to educate relevant operational staff and subcontractors regarding the requirements to avoid the spread and introduction of weeds and Dieback; ◗ A weed control program shall be conducted on a regular basis. Spot spraying where appropriate shall be done in consultation with a preferred service provider; ◗ Signage shall be used where necessary to communicate high risk weed and dieback infestation areas, including hygiene requirements, thereby reducing the potential for vegetative and seed dispersal; ◗ Should a Dieback area be identified within the Project area, it shall be treated as a restricted area and managed in accordance with current Dieback management practices; ◗ Any equipment or vehicle considered to have been working in a Dieback or high risk weed area shall be appropriately cleaned down before being remobilised to other parts of the Plant; and ◗ All plant material sourced for rehabilitation purposes shall be from suppliers with appropriate *Phytophthora cinnamomi* and weed control certification.	
Performance Indicators ◗ No new weed infestation or dieback spread associated with operation of the Plant; and ◗ All plant and machinery coming from a Dieback or high risk weed area are inspected and cleaned as required prior to site entry.	
Monitoring ◗ Weed infestation inspections shall be carried out by or at the direction of the Site Environmental Coordinator as part of routine site environmental inspections.	
Contingency	
Trigger	**Action**
Signs of significant weed and/or pathogen introduction associated with operation.	1. Notify Environment Manager; 2. Undertake remedial works to control and eradicate introduced weeds; and 3. Investigate possible introduction pathway and determine measures to prevent re-occurrence.

5.8 Reserve and Conservation Area Management

There are two registered nature reserves in the vicinity of the Plant: Basil Road Nature Reserve (R291128), approximately 4.5 km from the desalination plant, and Mettler Lake Nature Reserve (R26894), which lies adjacent to part of the desalinated water pipeline. The seawater intake pipeline and brine discharge pipeline traverse a proposed conservation park (R14943), however they follow an

existing road corridor that passes through the area. The desalinated water pipeline runs within the road corridor that lies adjacent to the southern boundary of Reserve R31240, for approximately 1.5 km.

Operation and maintenance of the Plant has the potential to impact reserve and conservation areas through vehicle damage or pipeline leaks, if uncontrolled.

Table 10 details the objectives, management, performance indicators, monitoring and contingencies for adjacent reserve and conservation areas associated with the Plant operations.

Table 10 Reserve and Conservation Areas Management

OEMP - 08	**Reserve and Conservation Areas Management**
Responsibilities	Implementation – Environment Manager
	Compliance – Site Environmental Coordinator
Objectives ◗ No unauthorised disturbance of nearby reserves and conservation areas	
Management ◗ No access to reserves or conservation areas shall be permitted without prior approval from the Site Environmental Coordinator; ◗ All vehicles are to stay on formed roads within the proposed conservation area; ◗ Vegetation shall be pruned with a chainsaw, if interfering with operations, in preference to clearing; ◗ The access of any personnel into protected areas containing significant flora and fauna habitat shall be controlled; ◗ Monthly visual inspections shall be undertaken along the seawater intake and brine discharge pipeline alignments; ◗ Monthly visual inspections of bird diverter devices along the 33 kV powerline shall be undertaken and maintenance scheduled accordingly; and ◗ Further management in regard to flora and native vegetation is outlined in Section 5.6.	
Performance Indicators ◗ No flora or native vegetation impact within nearby reserves and conservation areas.	
Monitoring ◗ Monthly visual pipeline leak inspections along the seawater intake and brine discharge pipeline routes; and ◗ Inspections of operational areas adjacent to reserves and conservation areas will be undertaken by the site Environmental Coordinator as part of routine site environmental inspections.	
Contingency	
Trigger	**Action**
Non-compliance with management measures detailed above.	1. Immediately investigate the cause of the non-compliance;

OEMP - 08	Reserve and Conservation Areas Management
	2. Implement contingency actions which may include: – Review management measures practicality or relevance; – Improve training and education for all personnel; – Improve and implement increased protective measures as necessary; 3. Monitor the success of these actions; and 4. Initiate rehabilitation of effected flora and vegetation areas.

5.9 Indigenous Heritage and Native Title

Aboriginal heritage sites are protected under the *Aboriginal Heritage Act 1972*. An ethnographic and archaeological cultural heritage survey involving members of Noongar families, Australian Cultural Heritage Management (ACHM) representatives, Grange Resources and the South West Aboriginal Land and Sea Council identified several nearby ethnographic sites. These identified Aboriginal heritage sites are not expected to be impacted by operational activities, although additional surveys are planned prior to construction which will further inform the OEMP.

SDJV will continue to consult with the original aboriginal survey participants, and undertake additional archaeological and ethnographic surveys of new construction and/or operational areas, if required.

Table 11 details the objectives, management, performance indicators, monitoring and contingencies for indigenous heritage and native titles associated with the Plant operations.

Table 11 Indigenous Heritage and Native Title Management

OEMP - 09	Indigenous Heritage and Native Title Management
Responsibilities	Implementation – Environment Manager
	Compliance – Site Environmental Coordinator
Objectives ◗ To minimise impacts on Aboriginal Heritage and comply with the requirements of the *Aboriginal Heritage Act 1972*.	
Management ◗ Training will be provided to all personnel, detailing the importance of avoiding heritage sites and	

OEMP - 09	Indigenous Heritage and Native Title Management
reporting of any suspected unknown heritage sites. Training will highlight nearby existing archaeological and ethnographic heritage sites (if any) to all operational staff; ◗ Aboriginal Heritage sites shall be fenced off if they lie within 50 m of the operation activities to prevent any unauthorised access; ◗ If suspected skeletal remains are found, operations shall cease in the immediate area and the find reported immediately to the WA Police Service and the Department of Indigenous Affairs (DIA). Works will not resume until the Police, DIA and archaeologists have provided appropriate advice; ◗ If skeletal remains found are to be an Aboriginal Heritage matter and not a police matter, they will be managed according to the wishes of the local indigenous communities and left as is until a decision is made about how to proceed; and ◗ The location and details of any newly discovered objects or remains shall be reported to the WA Museum and DIA.	
Performance Indicators ◗ No unauthorised disturbance to any indigenous heritage site.	
Monitoring ◗ At this stage no Aboriginal Heritage sites have been identified associated with Plant operations and/or work areas, therefore no monitoring is proposed; and ◗ Following the completion of further ethnographic and archaeological surveys, the requirement for monitoring will be re-assessed.	
Contingency	
Trigger	**Action**
Identification of any potential Aboriginal heritage site within close proximity to the Plant operations.	1. Works shall cease in the immediate area; 2. Advice shall be sought from a cultural monitor; and 3. Works shall only re-commence when the go-ahead is received from the cultural monitor.

5.10 Visual Amenity

The management of visual amenity includes both maintaining view sheds of the surrounding landscape and providing screening of invasive operational activities from residential properties. Night time lighting levels at the desalination plant will be at the minimum level necessary to meet safety, security and operational requirements, while giving consideration to nearby residences and other vantage points.

Impacts of light emissions depend upon distance from the light source, strength of lighting and the type of lighting impact. There are three distinct types of lighting impacts, namely direct light, indirect light and night glow.

Table 12 details the objectives, management, performance indicators, monitoring and contingencies for visual impacts associated with the Plant operations.

Table 12 Visual Amenity Management

OEMP - 10	**Visual Amenity Management**
Responsibilities	Implementation – Environment Manager
	Compliance – Site Environmental Coordinator
Objectives ◗ To maintain view sheds of the surrounding landscape and provide screening, where possible, of operational activities from nearby sensitive receptors.	
Management ◗ Progressive rehabilitation of disturbed areas shall be undertaken during construction; ◗ The minimum lighting requirements shall be determined to minimise light spill; ◗ Lighting positioning and direction will be determined with consideration of nearby stakeholders visual amenity, in consultation with the appropriate stakeholders where appropriate; ◗ Any lighting shall be directed toward the intended target; and ◗ Lighting that is not required and has no impact on operations and / or personnel health and safety will be switched off.	
Performance Indicators ◗ No visual impact related complaints.	
Monitoring ◗ No specific monitoring is proposed with respect to visual amenity; ◗ A visual impact Log(s) shall be maintained for all complaints received. The Log(s) will be stored in a secure location at the site entrance or in the main office. The Log(s) will identify: – Complainant's name and contact details; – Nature of complaint; and – Investigation undertaken in response to complaint.	
Contingency	
Trigger	**Action**
Complaints received concerning visual impact of Plant operations.	Manage complaint and response as detailed in Section 6.4.

6. Reporting and Response

6.1 Annual Environmental Reporting

Annual Environmental Reporting (AER) provides progress on environmental management and monitoring results. Each AER is to produce systematic, comprehensive and informative results of environmental monitoring and the operational activities of the Plant as a whole.

6.2 Performance Reporting

Regular performance reports will be provided to the Environment Manager by the Site Environmental Coordinator in relation to compliance with the OEMP. These performance reports will include:

- Results from any internal and/or external audits, including any environmental management compliance and monitoring results;
- Monthly environmental compliance reports summarising performance against indicators, monitoring results, any incidents occurring within the period, including comments on response procedures and remedial actions; and
- Compliance and performance reporting to the OEPA will be undertaken in accordance with applicable and relevant legislative requirements, including any requirements of the Ministerial Statement.

6.3 Environmental Incidents

Environmental incidents shall be reported and investigated as soon as practicable following identification, enabling effective actions to be implemented without delay. Environmental incidents are defined as events that cause or could potentially cause harm to the environment, with the level of significance assigned according to the definitions provided in **Table 13**.

The Environment Manager and/or Site Environmental Coordinator shall conduct suitable response, notification and investigation of causes in the event of an environmental incident.

Details of all incidents shall be entered into a report register to facilitate the overall reporting and tracking of project incident trends and performance.

Table 13 Environmental Incident Classification

Level	Nature of incident
3	Minor non-adherence to procedure, and/or a negligible environmental impact
2	Moderate breach of procedure and/or an environmental impact that requires management/mitigation to be rectified.
1	(Serious incident) Extreme breach of procedure and/or environmental impact that could lead to a breach of environmental approval conditions.

The Site Environmental Coordinator shall make themselves, or an appropriate representative, contactable outside of their usual working hours and ensure that a prompt response to an environmental incident can occur. Incident details will be collected as soon as practicable from the scene of the incident and personnel involved to limit the potential for information to be lost or forgotten.

The Site Environmental Coordinator will also notify the appropriate authorities of the nature of the Level 1 or Level 2 incident. These authorities may include, but not limited to:

- Office of the Environmental Protection Authority;
- Department of Environment and Conservation;
- Department of Fisheries;
- Department of Water;
- Department of Indigenous Affairs;
- Fire and Emergency Services Authority; and
- City of Albany.

Based on preliminary information, an Investigation Team shall be selected by the Environment Manager and Site Environmental Coordinator. The Investigation Team will seek expert advice if required to complete the investigation within a satisfactory timeframe and taking into consideration the level of severity of the incident as defined by **Table 13**.

Environmental incidents shall be communicated to relevant site personnel during the regular toolbox meetings and any specially organised forums. Incident trends will be monitored and evaluated, with remedial action undertaken and, where appropriate, standard works procedures revised and publicised.

The Incident Investigation Report will clearly identify the responsibility and deadlines for approved closeout actions.

6.4 Complaint Handling

The complaint and response system used during construction will be amended and implemented during the operational phase to establish and maintain a system of records, documenting all information of complaint handling. For each complaint received, the following information will be recorded:

- Date and time of complaint;
- Name of staff member who received the complaint;
- Method by which the complaint was made;
- Nature of complaint;
- Action to be undertaken in relation to the complaint, including staff responsible in taking that action; and
- Potential for environmental incident.

Following investigation of the complaint, the complaints register will be updated to include:

- A summary of the investigate undertaken;
- The action undertaken relevant to the complaint;

- Weather conditions at the time and place of the event, if relevant to the complaint, and any operation related activities;
- If no action was undertaken, the reasons for this decision;
- Time and date of follow-up contact and resolution with the complainant;
- Nature of and outcomes from follow-up contact with the complainant; and
- Environmental incident report number, if relevant.

If the complaint investigation determines that the nature of the complaint justifies its inclusion as an Environmental Incident, it will be acted on without delay in line with the procedure detailed in Section 6.3.

6.5 Auditing

Auditing of the management measures outlined in this management plan shall be undertaken as follows:

- Regular site OEMP compliance audits;
- Audits of Contractor environmental management performance; and
- Daily and weekly work area inspections.

Persons responsible for environmental auditing will be suitably qualified.

Where audit findings show environmental management actions not being effective, the audit may recommend changes to procedures.

7. References

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GHD (2011b) *Grange Resources Cape Riche Seawater Desalination Plant, Marine Habitat Assessment*, May 2011, Perth, Western Australia.

Appendix A

Brine Discharge Management Plan

Cape Riche Seawater Desalination Plant

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Grange Resources

Cape Riche Seawater Desalination Plant

Brine Discharge Management Plan

February 2012

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

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Abbreviations and Acronyms

Shortened Form	Full Title
AER	Annual Environmental Review
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BDMP	Brine Discharge Management Plan
BHMP	Benthic Habitat Monitoring Program
BPPH	Benthic Primary Producer Habitat
°C	Degrees Celsius
CEMP	Construction Environmental Management Plan
DEC	Department of Environment and Conservation (formerly CALM and DoE)
DO	Dissolved Oxygen
EPA	Environmental Protection Authority (Western Australia)
EPBC Act	Environment Protection and Biodiversity conservation Act 1999
EQC	Environmental Quality Criteria
EQG	Environmental Quality Guidelines
EQO	Environmental Quality Objective
EQMF	Environmental Quality Management Framework
EV	Environmental Values
GL/y	Gigalitres per year
ha	Hectares
HEPA	High Ecological Protection Area
km	Kilometres
LEPA	Low Ecological Protection Area
m	Metres
mg/L	milligrams per litre

Shortened Form	Full Title
ML	Megalitres
ML/day	Megalitres per day
MWQMP	Marine Water Quality Monitoring Program
NWQMS	National Water Quality Management Strategy
OEPA	Office of Environmental Protection Authority
PER	Public Environmental Review
pH	Measure of the acidity or basicity in an aqueous solution
ppt	parts per thousand
PSU	Practical Salinity Units
RO	Reverse Osmosis
TRE	Toxicity Reduction Evaluation
WET	Whole of Effluent Toxicity

1. Introduction

This Brine Discharge Management Plan (BDMP) has been prepared on behalf of the Southdown Joint Venture (SDJV) involving Grange Resources Ltd and Sojitz Resources and Technology Pty Ltd to manage the ongoing operation of the Cape Riche Seawater Desalination Plant (the Project), which will supply desalinated water to the Southdown Magnetite mine site. The desalination plant will discharge brine that has different salinity and temperature to the receiving environment, both of which could potentially have an adverse effect on the local marine environment at Cape Riche if not managed appropriately.

1.1 Management Plan Purpose and Scope

The BDMP focuses on managing potential impacts to the receiving marine environment associated with brine discharge from the desalination plant.

Specifically, this management plan will:

- Identify project related stressors (causes of environmental impacts) and potential impacts to the receiving environment;
- Outline management strategies that will be adopted to mitigate the identified potential impacts associated with the operation of the desalination plant; and
- Provide a management framework to enable Grange and its contractors to detect and mitigate any impact on the receiving marine environment from the desalination plant.

1.2 Proponent Commitments

The following commitments from the Project's Public Environmental Review (PER) are addressed in this BDMP.

Management Strategy	Section of BDMP
Prepare and implement a Brine Discharge Environmental Management Plan to manage ongoing operation of the brine discharge from the Cape Riche Seawater Desalination Plant.	Current Document
Prepare and implement a Marine Water Monitoring Program to monitor seawater in the High Ecological Protection Area (HEPA) and reference site to confirm that temperature and salinity do not exceed site specific Environmental Quality Criteria (EQC). Any monitoring of the marine environment will be subject to safe operating conditions.	Section 6.1
Identify the chemicals to be used in the Reverse Osmosis (RO) process and undertake Whole of Effluent Toxicity (WET) testing of actual brine discharge prior commissioning, to confirm the findings from the tests done with simulated brine. Once the chemicals in the brine have been determined, assess their toxicity on the marine environment consistent with the water quality recommendations of ANZECC/ARMCANZ (2000).	Section 6.2

Management Strategy	Section of BDMP
Prepare and implement a Benthic Habitat Monitoring Program.	Section 6.4
Prepare and implement a visual monitoring program of communities on the wave-cut platform adjacent the outfall.	Section 6.4.3
Undertake further studies related to the local coral species and their spawning cycles to verify that there is insignificant entrainment of coral spawn associated with the seawater intake.	Section 6.4.5

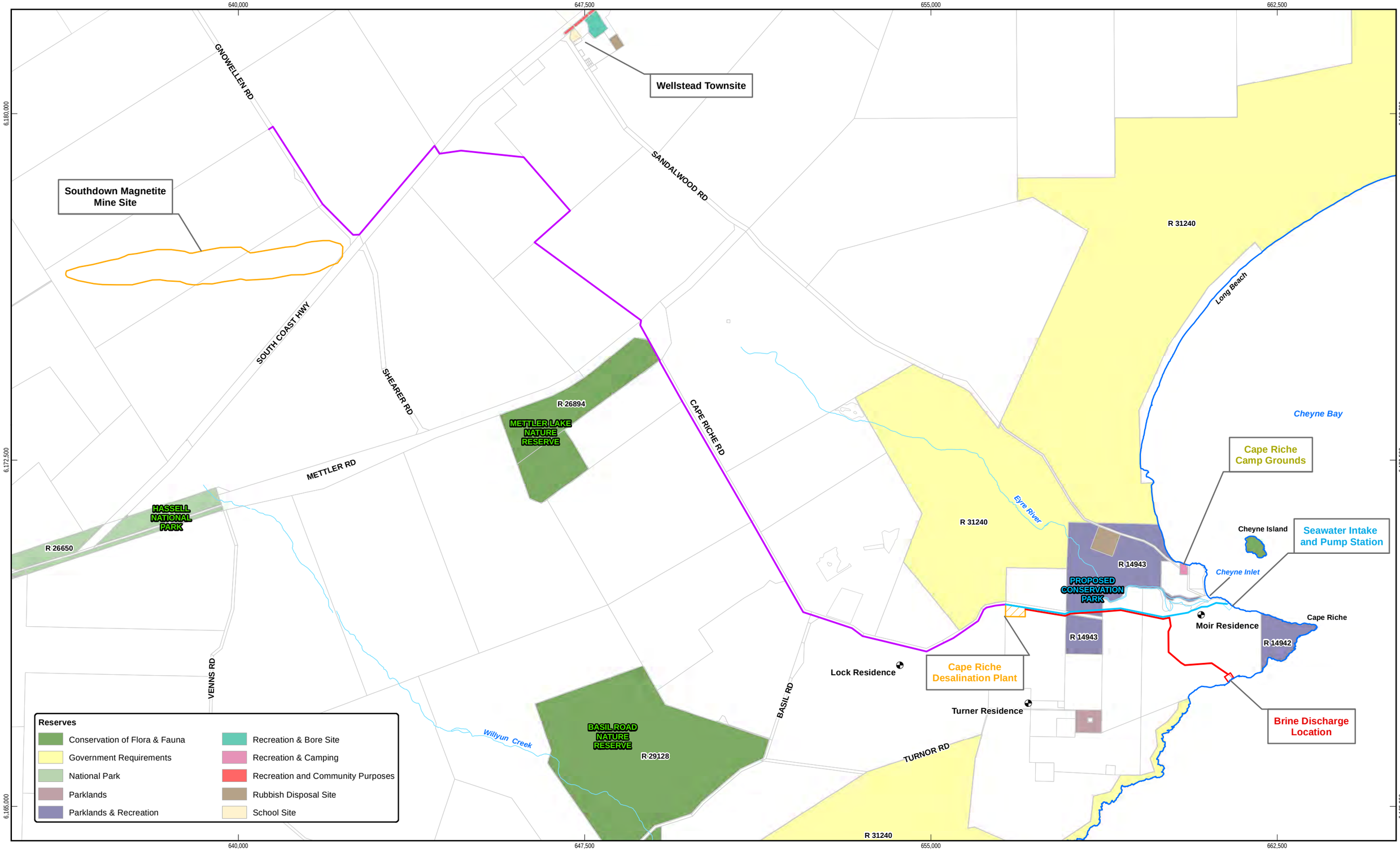
In addition to the commitments highlighted above, this BDMP includes a monitoring program aimed at demonstrating recovery of the BPPH impacted during the construction of the seawater intake. This component is addressed within Section 6.4.4.

1.3 Background/Project Description

The SDJV proposes to develop the Project in order to provide a reliable, independent water supply to its Southdown Magnetite mine site (**Figure 1**). The Project will supply 12 Gigalitres per year (GL/y) of treated water to the Southdown mine site via a pipeline from the proposed Cape Riche Seawater Desalination Plant.

Major components of the Project include:

- Pipelines for seawater intake, outfall and treated water supply;
- Open channel seawater intake on the north side of Cape Riche;
- Desalination plant; and
- Brine discharge on the south side of Cape Riche.



1:75,000 (at A3)

0.75 0.375 0 0.75 1.5 2.25 3

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- Residence
- Seawater Transfer Pipeline and Buried Power Line
- Treated Water Transfer Pipeline and Power Line
- Brine Discharge Pipeline
- Named Watercourse
- Coastline
- Desalination Plant
- Brine Discharge Location
- Pump Station
- Approved Pit Boundary
- Cadastre

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Cape Riche
Seawater Desalination Plant

Job Number	61-26005
Revision	1
Date	05 Oct 2011

Project Location

Figure 1

G:\61\26005\GIS\Maps\MXD\6126005_G062_Fig01_Rev1.mxd

Data source: Landgate: Cadastre - 20101018, Reserves - 20110525; Coastline - 20110628; DoW: Water Courses - 2011; Grange Resources: Approved Pit Boundary - 20100812; Harley Global: Treated Water Transfer Pipeline and Powerline, Seawater Pipeline and Powerline, Brine Discharge Pipeline - 20110704; GHD: Desalination Plant, Brine Discharge Location - 20110527, Pump Station - 20110826 Residences - 20110623 Created by: tgoad, mczekaj

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1.4 Cape Riche Seawater Desalination Plant Description

The desalination plant has a nominal design capacity of 35 ML/day. This is based on producing 12 GL/y of treated water with a plant availability of 95%. The Project will use RO desalination technology which is the standard technology adopted for all the large desalination plants either constructed in Australia over the past seven years or currently being constructed in Australia. Best practices for RO desalination plants derived from the recent desalination projects around Australia will be incorporated into the Project.

The plant will consist of two main processes:

- A pre-treatment plant to remove suspended solids from the seawater; and
- A RO desalination plant to remove salt from the seawater.

Both the pre-treatment and RO plants will be configured as multiple trains (modules) to provide operational flexibility while at the same time maintaining peak production.

Table 1 provides an indication of the typical intake and brine discharge characteristics of the desalination plant.

Table 1 Typical seawater intake and brine discharge characteristics of the seawater desalination plant

Parameter	Discharge Characteristic[1]
Intake	87 ML/day
Discharge	52 ML/day
Salinity ppt[2]	Up to 70 ppt
pH	6 to 8
Temperature ($^{\circ}$C)	± 5 $^{\circ}$C above ambient#
Typical water treatment chemicals	Listed in **Table 2**

estimated brine temperature changes due to seasonal diurnal heating and cooling of buried brine discharge pipe

The nominal annual production from the desalination plant (12 GL) translates to an annual seawater intake of 30 GL and an annual brine discharge of 18 GL. To meet the annual production target the desalination plant will be required to operate at or close to its nominal capacity of 35 ML/day for most days of the year. During certain times, governed by demand from the Southdown mine site, production rates will be lower, which will result in lower seawater inflow and brine discharge rates.

A number of chemicals are required for the efficient and effective operation of the desalination plant. These may include the chemicals listed below in **Table 2** which shows the potential maximum dosing rates and frequencies. These chemicals are in common use at all currently operating seawater desalination plants within Australia.

[1] All discharge characteristics are subject to final design

[2] A practical relationship between common salinity units is: 1 PSU (Practical Salinity Unit) ~ 1 ppt (part per thousand).

Table 2 Typical Dosing Rates of Water Treatment Chemicals

Chemical	Dosing Frequency – Potential Maximum	Dosing Rate – Potential Maximum
Sulphuric Acid	continuous	10 mg/L
Ferric Sulphate/Chloride	continuous	≤ 5 mg/L
Polyelectrolyte	continuous	≤ 1 mg/L
Antiscalant	continuous	≤ 1.5 mg/L
Sodium Hypochlorite	Intermittent (0.5h per week)	5 mg/L
Sodium Metabisulphite	Intermittent (0.5h per week)	12 mg/L

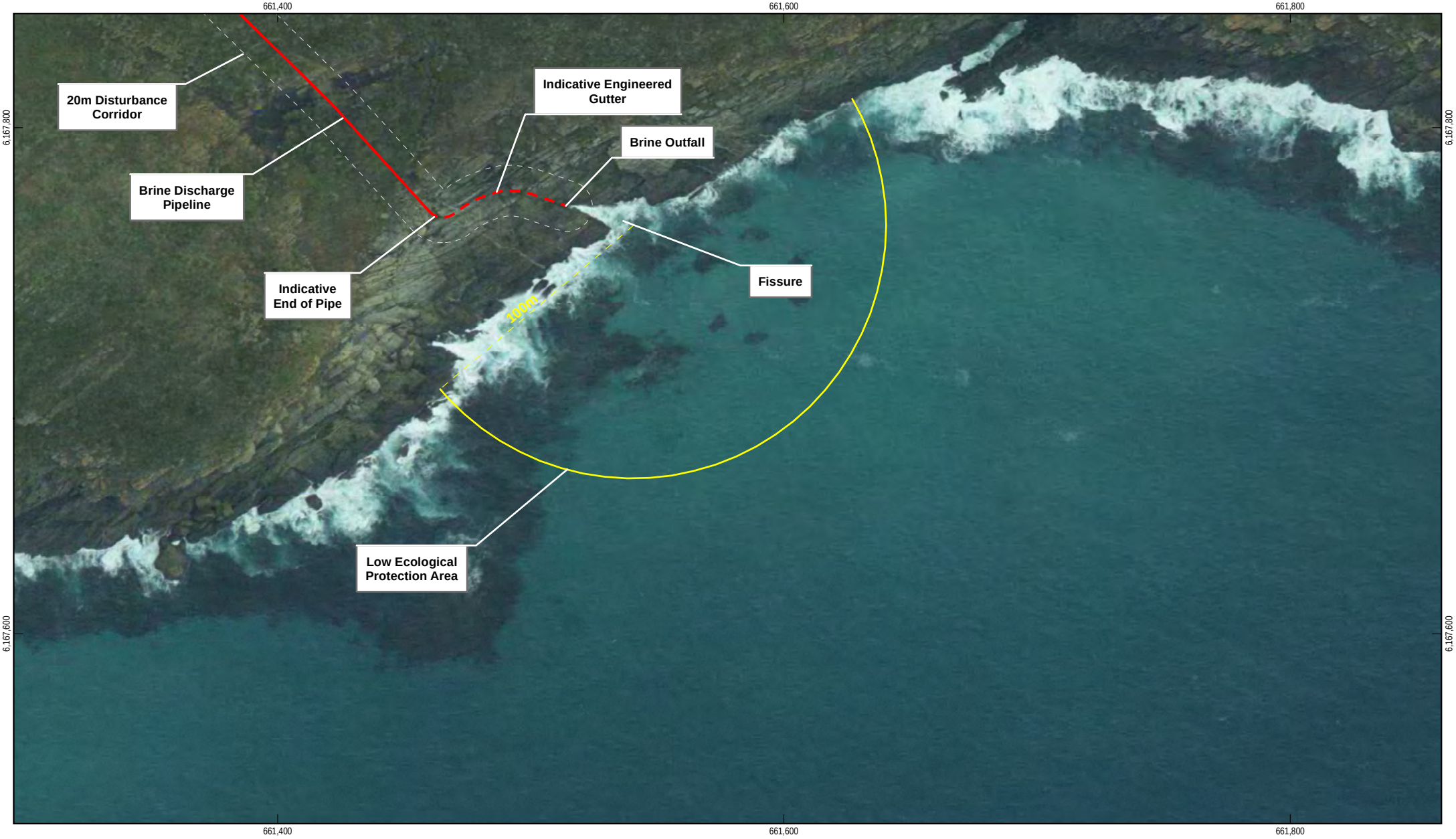
Brine will be pumped from the plant to the end of the brine discharge pipeline and discharged to the ocean via an engineered rock gutter and natural fissure in a wave cut platform on the south side of Cape Riche (**Figure 1**). The layout of the brine discharge arrangements is shown in **Figure 2**.

Towards the seaward end of this gutter the bottom deepens from approximately 2 m above Australian Height Datum (+2 m AHD) to -3 m AHD and broadens into a substantial fissure approximately 15 m wide at the entrance to the sea. Swell and wind waves propagating from the Southern Ocean enter the fissure and often over-top the wave cut platform.

The pipeline will direct brine into the drainage engineered rock gutter up to 100 m back from the shoreline at approximately 15 m AHD. During construction, the gutter will be cleared of loose rocks and deepened.

An engineered gutter is used to transport the brine across the rock platform to the fissure for a number of reasons, including the following:

- The shoreline up to 15 m AHD is exposed to significant wave forces which have the potential to damage the pipeline and, in some circumstances, could destroy the pipeline;
- Debris in the form of large boulders may be dislodged in the area and could be thrown against the pipe by waves with the potential to damage and block the pipeline;
- Debris may enter the end of the pipe during a storm event, blocking the end of the pipeline and interfering with discharge flow in a situation where access to unblock the pipeline may be too dangerous and supply could be interrupted for some time;
- In heavy seas the performance of the discharge system may be affected by pressure surges in the pipe caused by the large swells impacting the shoreline; and
- Construction and fixing of a pipe in the high impact wave zone will be a higher safety risk to workers than the creation of an engineered channel on the upper sections of the wave cut platform, away from breaking waves.



1: 2,000 (at A4)

0 10 20 40 60 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- Indicative Engineered Gutter
- Brine Discharge Pipeline
- 20m Disturbance Corridor
- Low Ecological Protection Area

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GRANGE RESOURCES

Cape Riche
Seawater Desalination Plant

Job Number 61-26005
Revision 6
Date 06 Feb 2012

Brine Discharge Layout and Boundary of Low Ecological Protection Area Around the Discharge Point

Figure 2

G:\61\26005\GIS\Maps\MXD\6126005_G061_Fig2_Rev6.mxd

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Data source: Grange Resources: 20cm Aerial Mosaic - 20100901; GHD: Indicative Engineered Gutter - 20110623, Low Ecological Protection Area - 20120123, 20m Disturbance Corridor - 20110629, Brine Discharge Pipeline - 20110623. Created by: mczekaj

1.5 Key Environmental Legislation and Guidelines

The SDJV, its employees and contractors will comply with all Commonwealth and State legislation that applies to the Project. Legislation relevant to effluent discharge and water management is summarised in **Table 3**.

Table 3 Key Environmental Legislation and Guidelines

Legislation	Responsible Government Authority	Aspect
Commonwealth Government Legislation		
Environment Protection and Biodiversity Conservation Act 1999	Department of Sustainability, Environment, Water, Population and Community	Matters of National Environmental Significance. ◗ Listed threatened species and ecological communities ◗ Migratory species
State Government Legislation		
Environmental Protection Act 1986	Office of the Environmental Protection Authority (OEPA), Western Australia	Primary environmental legislation within Western Australia, relating to the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment.
Western Australian Environmental Protection (Unauthorised Discharges) Regulations 2004	Western Australia Department of Environment and Conservation (DEC)	These regulations prohibit commercial activities from discharging certain wastes into the environment. The prohibited wastes include petrol, sewage, degreasers, detergents and food wastes. Specifically, it is an offence to discharge sediment into the marine environment, and to discharge brine in which are: acid with a pH less than 4; alkali with a pH more than 10; animal oil, fat or grease; compounds of solutions of cyanide, chromium, cadmium, lead, arsenic, mercury, nickel, zinc, copper; degreaser; detergent; dye; engine coolant or engine corrosion inhibitor; mineral oil; organic solvent; paint; petrol, diesel or other hydrocarbon; pesticide; vegetable oil, fat or grease.
Environment Protection (Controlled Waste) Regulations 2004	DEC, Western Australia	These regulations list the types of controlled waste which must be stored, treated, transported and disposed of as set out in the regulations. DEC have developed a series of guidelines in support of the regulations for appropriate transport and disposal of controlled waste: ◗ Guideline for Controlled Waste Carriers (DEC, 2004a); ◗ Guideline for Controlled Waste Treatment or

		Disposal Sites (DEC, 2004b); ◗ User Guide: Controlled Waste Tracking System (DEC, 2006); and ◗ Landfill Waste Classification and Waste Definitions (DEC, 1996).
Guidelines		
National Water Quality Management Strategy – the Environmental Quality Management Framework (EQMF)	DEC, Western Australia	The EQMF is underpinned by the principles of the National Strategy for Ecologically Sustainable Development (ESD Steering Committee 1992). The State Government has endorsed the progressive implementation of the EQMF for all of the State's marine waters on a priority basis. Consistent with the National Water Quality Management Strategy (NWQMS), a tiered approach has been adopted for the Environmental Management Framework. To this end, the State Government has developed a set of Environmental Values (EV) and Environmental Quality Objectives (EQO) for use in Western Australia's coastal waters. The intent is that Proponents will agree to maintain the EVs and EQOs through adherence to appropriate Environmental Quality Guidelines (EQG) and Environmental Quality Standards (EQS).
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000)	Commonwealth Australia	The ANZECC/ARMCANZ (2000) guidelines "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." The Water Quality Guidelines were prepared as part of Australia's NWQMS.

2. Receiving Environment

2.1 Regional Overview

The Project is located in the South Coast region of Western Australia, approximately 90 kilometres (km) east north-east of Albany and approximately 19 km from the nearest town of Wellstead.

The brine discharge is located along the south side of Cape Riche. The brine discharge location is categorised as having high granite or gneissic headland exposed to the open ocean swells with wave-swept slopes, steep to shores, cliff and small lunate bays between projecting elements of headland (Colman 1998). This is a typical feature of the southwest coast and is a high energy environment with steep slopes, particularly around the headlands.

The marine setting can be summarised as follows:

- Rock platform, with a natural fissure, highly exposed to seas and winds;
- Benthic habitat comprising bare boulders and sand, with occasional strands of brown macroalgae within metres of the rock platform; and
- Sloping seabed transitioning within several metres of the wave cut platform to a barren sand plane.

The marine ecosystem in the regional vicinity of the outfall supports both commercial and recreational uses.

2.2 Water Quality

The water quality along the south west coast receives only limited influence from land-derived water sources because of the relatively small number of significant streams in the region. Further, these streams tend to flow intermittently and typically only have a short-term transient influence on local marine water quality (DEWHA 2007). The marine water quality is most strongly influenced by the character of the major coastal oceanographic currents (e.g. Leeuwin, Cresswell).

To improve the limited understanding of the marine water quality in the Cape Riche area, Grange commenced a monitoring program within Cheyne Bay, north of Cape Riche, in 2009. Baseline water quality surveys of the Cape Riche region were undertaken during the seasonal periods of 2009, 2010 (autumn only) and 2011 (360 Environmental 2010; GHD 2011a).

Comparison of the water quality data at Cape Riche with the ANZECC/ARMCANZ (2000) default water quality guidelines indicates that the water quality of the coastal waters is good from both an ecological and desalination source water perspective.

Water quality data from the GHD (2011a) survey, as well as comparisons of this data with the 360 Environmental (2010) data, are presented in Appendix A.

Water Temperature

The water temperatures surrounding Cape Riche vary seasonally, with a range of approximately 15 to 22 ºC (360 Environmental 2010). An anomalous increase in water temperature in Cheyne Bay over a two-month logging period from mid-February to mid-March 2011 was the result of an unusually warm March and April, and a cool February (GHD 2011b). Further, a strong La Niña event may have led to the Leeuwin Current penetrating further east than it might during typical years.

Salinity

Salinity measurements, as taken from continuous loggers in Cheyne Bay, ranged from approximately 35.6 to 35.7 ppt[3] from mid-February to mid-March 2011 (GHD 2011b), similar to SLOCUM Seaglider measurements during the November-December 2010 and February-March 2011 deployments of 35.6 to 35.8 ppt (GHD 2011b), and within the 2009 seasonal range of 35.5 to 36.3 PSU (360 Environmental 2010).

Dissolved Oxygen

It is unlikely that prolonged stratification events will occur in the energetic coastal waters adjacent the brine outfall on the south side of Cape Riche. The percentage saturation of dissolved oxygen (DO) within the marine waters of Cape Riche was recorded during 2009 (360 Environmental 2010) and 2011 (GHD 2011a). Measurements were within a range of 91.5% to 113.9% DO saturation, thus within the ANZECC/ARMCANZ (2000) guideline ranges for inshore marine waters of south Western Australia (GHD 2011a).

[3] For the practical purposes of this report it is assumed that 1 PSU = 1 ppt.

3. Potential Environmental Impacts

3.1 Overview

The main potential source of impacts to the marine environment from the Project is the discharge of brine from the desalination plant. The brine from the desalination plant will be returned to the sea on the south side of Cape Riche via a pipeline and engineered gutter flowing naturally into a high energy seawater fissure. This location will enable mixing of the brine stream in a high energy wave environment with good water exchange.

Potential impacts from brine discharge may occur if the brine plume does not mix adequately with the receiving environment and this leads to changes in the physical and chemical properties of the receiving waters beyond those normally experienced. Physical impacts may include increases in salinity and temperature and decreases in DO concentration of the receiving marine water. Chemical impacts may include increases in the concentration of metals and introduction of other chemicals such as antiscalants and biocides.

There is potential for brine discharge to lead to chronic effects on the distribution, abundance and health of marine fauna and benthic primary producers if the discharge is uncontrolled.

4. Management

The objective of this BDMP is to protect ecosystem integrity around Cape Riche from potential impacts from the desalination plant brine discharge.

To achieve this objective a series of management actions have been identified and are summarised in **Table 4**. The monitoring program outlined in Section 6 provides the methods for assessing compliance of the desalination plant against the Environmental Quality Objectives defined in Section 5.

Table 4 Key Management Actions

Action	Accountability	Timing
Prepare a Brine Discharge Management Plan.	Grange Environment Manager	Completed – current document
Undertake WET testing of simulated brine to determine dilution required to meet high level of ecological protection.	Grange Environment Manager	Completed PER (2011)
Undertake desalination plant discharge modelling to demonstrate that the required dilution (as determined by WET testing) will be met.	Grange Environment Manager	Completed PER (2011)
Conduct WET testing of actual brine discharge to confirm the findings from initial tests undertaken with simulated brine.	Grange Environment Manager	During commissioning and prior to discharge
Prepare and implement a water quality monitoring program to confirm that the desalination plant discharge is meeting modelling predictions (subject to calm weather, state safety laws and company policies) and that the discharge is compliant with the proposed HEPA requirements.	Grange Environment Manager	Baseline monitoring. During operation, four times per annum.
Prepare and implement a Benthic Habitat Monitoring Program to demonstrate that the brine discharge has no significant effect on the biological communities within safely accessible areas of the wave cut platform.	Grange Environment Manager	Baseline monitoring. During operation, four times per annum during operation, and limited to the first three years of operation.

5. Environmental Values, Objectives and Criteria

5.1 Environmental Values

An environmental value (EV) is a “particular value or use of the environment that is important for ecosystem health or public use, welfare, safety or health which requires protection from the effects of pollution, waste discharges and deposit” (ANZECC/ARMCANZ 2000). The most stringent EV of relevance to the Project is Ecosystem Health.

5.2 Environmental Quality Objectives and Levels of Ecological Protection

Environmental Quality Objectives (EQO) represent the management goals needed to protect the EV identified in Section 5.1 and are aligned with the EPA marine water quality objectives.

For the Project’s brine discharge, the EQO is the maintenance of ecosystem integrity.

Assessment of monitoring data will provide insight into whether the EQO is being achieved. The environmental quality indicators selected for monitoring will correlate to the EQO and the stressor (e.g. brine input) which threatens its achievement. For each of the environmental indicators monitored, Environmental Quality Criteria (EQC), either descriptive or quantitative, have been provided as benchmarks against which the monitoring data can be compared to determine whether the EQO has been met. If the EQO is deemed not to be met, then this signals the need for corrective management actions (e.g. reduction or alteration of waste discharge) in order to achieve the desired management goal.

To achieve the EQO of maintenance of ecosystem integrity, it is necessary to provide a high level of ecological protection to the marine waters around Cape Riche beyond an initial mixing zone, in which lower ecological protection may occur. Although the design and operation of the brine discharge will minimise changes to water quality, it is recognised that some change will be detectable in the near-field area immediately surrounding the point of discharge.

A low level of ecological protection has been set for an area that extends 100 m from the point where the Fissure discharges to the Southern Ocean, as shown in **Figure 2** . This area is defined as the Low Ecological Protection Area (LEPA). Outside of the LEPA, all water will be assigned a high level of ecological protection. This area will be managed as a High Ecological Protection Area (HEPA)

The levels of protection provided within the LEPA and HEPA are described by EPA (2005) as follows:

Low ecological protection area (LEPA)

LEPA will *allow for large changes in contaminant concentrations causing large changes beyond natural variation in the natural diversity of species and biological communities, rates of ecosystems processes and abundance of marine life, but does not result in bioaccumulation in nearby high ecological protection areas.*

High ecological protection area (HEPA)

HEPA will *allow for small changes in contaminant concentrates with no resultant detectable changes beyond natural variation in diversity of species and biological communities, ecosystems processes and abundance of marine life.*

5.3 Environmental Quality Criteria (EQC)

EQC are established to provide benchmarks against which environmental quality and environmental performance can be measured. The BDMP has adopted a tiered approach whereby environmental quality is assessed against two levels of quantitative environmental protection: Environmental Quality Guidelines (EQGs) and Environmental Quality Standards (EQSs). EQC have been developed for explicit use within the HEPA, as outlined below.

Environmental Quality Guidelines (EQGs)

EQGs are quantitative criteria which, if exceeded, indicate that there is a risk that the EQO is not being met. If an EQG is exceeded, a more detailed assessment is triggered.

Environmental Quality Standards (EQSs)

EQSs are quantitative criteria which, if exceeded, indicate a significant risk that the EQO is not being met. If an EQS is exceeded a management response is triggered.

EQCs have been determined for measurable stressors relevant to the brine discharge: salinity and temperature using the dilution requirements of the WET testing in order to achieve a high level of ecological protection (i.e. 99% species protection as per ANZECC/ARMCANZ 2000).

5.4 Achieving the EQOs – Implementation Strategy

For this BDMP, EQGs have been developed such that exceedance of an EQG is a 'trigger' for further investigation against the corresponding EQS.

If an EQS is exceeded, it is considered that there is a significant risk that the associated EQO is not being achieved and an immediate investigation into the cause is needed as well as management actions to remedy the loss in quality and meet the EQO.

A summary of the EQC established as part of the PER process is provided in **Table 5**. Section 6 includes the monitoring, management and contingency management responses should the EQC be exceeded.

Table 5 Site specific Environmental Quality Criteria based on biological effects data

Environmental Quality Indicator	Environmental Quality Criteria	Measurement Method
Salinity (as an indicator for whole of effluent toxicity)	Environmental Quality Guideline: Salinity shall not exceed +0.4 ppt above background salinity (measured at the reference sites). Environmental Quality Standard: Salinity shall not exceed +0.6 ppt above background salinity (measured at the reference sites).	Salinity measurement at surface and bottom (nominally 0.5 m from surface and 0.5 m from bottom) at three putative impact sites located as close as safely practical to the LEPA-HEPA boundary and at reference sites at locations unlikely to be affected by the brine discharge. Monitoring program is discussed in Section 6.
Temperature	Environmental Quality Guideline: Temperature shall not exceed +1 ^{0}C above background temperature (measured at the reference sites). Initial Environmental Quality Standard: Temperature shall not exceed +2 ^{0}C above background temperature (measured at the reference sites).	Temperature measurement at surface and bottom (nominally 0.5 m from surface and 0.5 m from bottom) at three putative impact sites located as close as safely practical to the LEPA-HEPA boundary and at reference sites at locations unlikely to be affected by the brine discharge. Monitoring program is discussed in Section 6.

6. Monitoring

The monitoring program described in the following sections has been developed to identify any significant changes to the coastal waters around Cape Riche that may be attributable to the brine discharge.

The SDJV will use a tiered approach to determine whether or not the brine discharge is operating within the EQC. The HEPA is the critical area of assessment given it is not safe to monitor within the LEPA due to dangerous swell and backwash closer to the cliffs. Water quality monitoring will be undertaken as close as safely practical to the HEPA-LEPA boundary, which is likely to be at a distance of 100 m from the shoreline.

The monitoring program comprises of four components to enable ongoing assessment of performance against the EQO outlined in Section 5. These four components include:

1. Conducting WET testing to confirm the toxicity of the discharge and number of dilutions required to achieve a high level of ecological protection;
2. Final brine discharge monitoring of primary contaminants of concern, to ensure constituents of the brine are within range determined during WET testing and hence predicted concentrations of constituents will continue to meet HEPA ECQ at the boundary of the LEPA;
3. Water quality monitoring four times per annum to verify that actual dilution is sufficient and EQC are being met within the HEPA; and
4. Benthic habitat monitoring at the wave cut platform, four times per annum for a period of three years, to demonstrate no impact from the discharge.

The initial three stages of monitoring have been developed to assess whether the plant is operating in accordance with design specifications and that the desalination plume modelling has accurately described the plume behaviour and dispersion. Compliance with the targets and objectives of these three stages of monitoring will provide sufficient confidence in the accuracy of modelling and performance of the natural mixing within the Fissure. Following three years of monitoring with favourable results, it is anticipated that this monitoring program will be reviewed and potentially reduced, in consultation with the OEPA and DEC through its Operating Licence required under Part V of the *Environmental Protection Act 1986* (EP Act).

The benthic habitat monitoring program will be conducted four times per annum for a period of at least three years, to demonstrate that the brine discharge has no effect on the biological communities on the wave cut platform outside of the area consistent with the size of the LEPA. Following three years of monitoring with favourable results, it is anticipated that this monitoring program will be scaled back, or ceased.

6.1 Marine Water Quality Monitoring Program (MWQMP)

6.1.1 Objective

The objective of the MWQMP is to monitor the water quality of the receiving environment and detect if the EQC are maintained at designated HEPA sites.

In addition to the EQC indicators of salinity and temperature, a broad suite of parameters (including pH, dissolved oxygen (DO), nutrients and metals) will be monitored to develop a baseline of water quality in the Cape Riche area for potential use in any future studies relevant to the brine discharge. It is noted that there is currently no cause/effect pathway identified for the additional water quality parameters. These parameters are being monitored at SDJV's discretion to better understand the environment and to provide additional baseline data should it be necessary to set EQCs for new parameters when the final brine discharge is tested.

6.1.2 Methodology

Monitoring locations

Six monitoring locations will be established for the MWQMP, including:

- Three putative impact locations within the HEPA, positioned as close as safely practical to the HEPA-LEPA boundary. Based on existing site experience, these locations have been positioned approximately 100 m offshore; and
- Three reference locations within the greater HEPA. One site approximately 1 km west of the LEPA, one site approximately 1 km east of the LEPA and one site within Cheyne Bay.

Proposed sampling locations are illustrated in **Figure 4** with further detail listed in **Table 6**.

Table 6 Coordinates of Sampling Locations

Sampling ID	Site description	Easting	Northing
CR-A	Cape Riche Impact Site HEPA	661551	6167653
CR-B	Cape Riche Impact Site HEPA	661639	6167676
CR-C	Cape Riche Impact Site HEPA	661594	6167699
CR-RW	Cape Riche Reference Site West	660778	6167085
CR-RE	Cape Riche Reference Site East	662928	6168185
CR-RN	Cape Riche Reference Site North (Cheyne Bay)	662922	6169204

Survey Timing

Due to risks associated with accessing and working in the vicinity of Cape Riche, sampling activities associated with water quality monitoring will only take place when all safety requirements of both SDJV and the monitoring contractor are met.

Baseline monitoring will be undertaken on a quarterly basis for 12 months prior to commissioning of the plant and continue quarterly thereafter. Should adverse conditions inhibit or delay the prescribed quarterly monitoring schedule, sampling efforts will be rescheduled to take place at the earliest opportunity in which it is safe to do so, such that a minimum of four sampling events are undertaken each year of the program.

Following three years of monitoring with favourable results, it is anticipated that this monitoring program will be reviewed and potentially reduced, in consultation with DEC through its Operating Licence required under Part V of the EP Act.

Survey Parameters

Vertical Profiling

Vessel-based vertical profiles of the water column will be undertaken at each site by using a calibrated water quality meter. As a minimum, target parameters will be:

- Temperature;
- Salinity;
- pH; and
- Dissolved Oxygen.

Laboratory Analysis

In addition to vertical profiling of the water column, 'grab' samples will be collected at each monitoring site for the quantitative assessment of:

- Nutrients: total nitrogen, ammonium, nitrite, nitrate, total phosphorus and ortho-phosphorus;
- Dissolved metals: Al, As, B, Cd, Cr, Cu, Pb, Mn, Hg, Mo, Ni, Se, Ag, V, Zn; and
- Those chemicals / compounds identified within the brine matrix as being chemicals of concern following commissioning analysis.

Water samples will be collected at the near surface (-1 m) and near bottom (+1 m) of the water column using a Niskin-type water sampler. Samples will be stored in a chilled cooler aboard the vessel and refrigerated overnight prior to transfer to a NATA accredited laboratory for analysis.

6.1.3 QA/QC

All samples are to be collected following quality assurance/quality control (QA/QC) measures as recommended in AS/NZS 5667.1 and the *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC & ARMCANZ 2000). Strict sample hygiene protocols will be established in discussion with the analytical laboratory for the collection and treatment of dissolved metals samples to avoid potential contamination.

All samples are to be accompanied by completed Chain of Custody (CoC) documentation and analysed at a suitable NATA accredited laboratory.

Two duplicate samples will be collected during each sampling event from sites and water depths randomly selected prior to each survey. Results from these samples will be utilised to verify internal laboratory procedures and subsequent accuracy of analysis.

No ‘field split’ samples or third party laboratory analysis for inter-laboratory comparison is proposed as part of this monitoring program.

6.1.4 Compliance Assessment

Following each monitoring event the salinity and temperature data from the impact sites will be compared to EQG and EQS values and to the reference site data.

Salinity

The surface and bottom salinity for each monitoring site will be taken as a point from the salinity profile approximately 0.5 m from surface and 0.5 m from bottom respectively.

A reference surface salinity will be calculated using the mean of the surface salinities of the three reference sites. A reference bottom salinity will be calculated using the mean of the bottom salinities of the three reference sites.

To assess compliance against the salinity EQG and EQS, the surface salinity for each impact site will be compared with the reference surface salinity and the bottom salinity for each impact site will be compared with the reference bottom salinity.

Temperature

The surface and bottom temperature for each monitoring site will be taken as a point from the temperature profile approximately 0.5 m from surface and 0.5 m from bottom respectively.

A reference surface temperature will then be calculated using the mean of the surface temperatures of the three reference sites. A reference bottom temperature will be calculated using the mean of the bottom temperatures of the three reference sites.

To assess compliance against the temperature EQG and EQS, the surface temperature for each impact site will be compared with the reference surface temperature and the bottom temperature for each impact site will be compared with the reference bottom temperature.

6.1.5 Environmental Quality Criteria Decision Scheme and Actions

Once a level of compliance has been established following water quality monitoring, the decision scheme shown in **Figure 3** will be used to select the appropriate actions listed in **Table 7**.

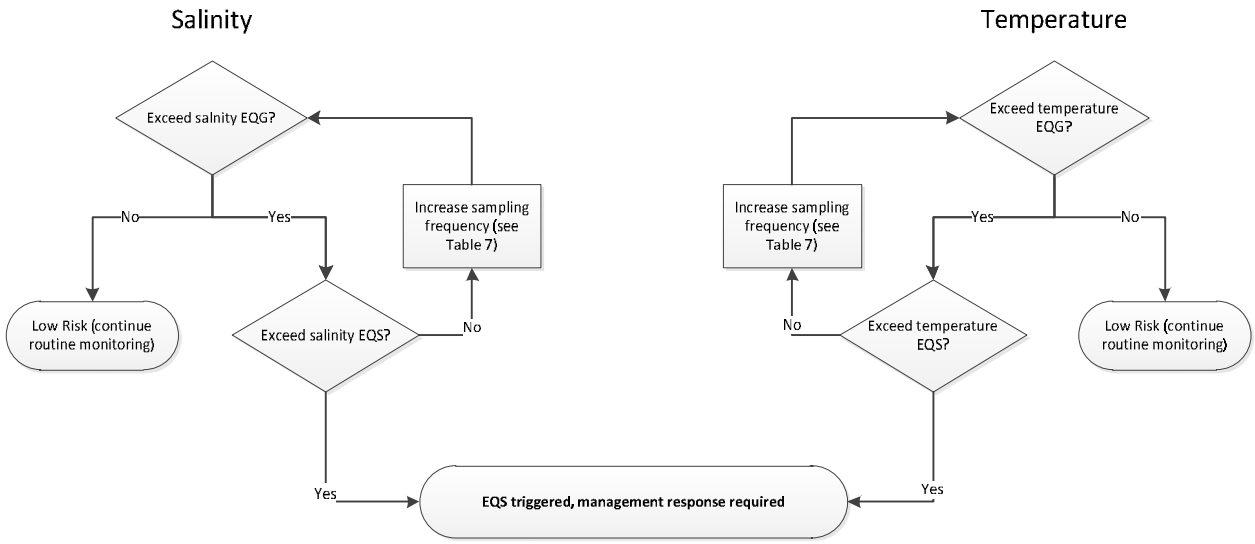

Figure 3 Decision scheme for applying the EQC for salinity and temperature

Table 7 Marine water quality monitoring program actions

Trigger	Action	Responsibility
EQG for salinity in **Table 5** is exceeded	The following more detailed assessments will be triggered: ◗ A more detailed assessment of salinity in the HEPA and reference sites, including additional measurements, to confirm EQS is being met. ◗ Increased sampling frequency to monthly until below EQG.	Site Environmental Coordinator
EQG for temperature in **Table 5** is exceeded	The following more detailed assessments will be triggered: ◗ A more detailed assessment of water temperature in the HEPA and reference sites, including additional measurements, to confirm EQS is being met. ◗ Increased sampling frequency to monthly until below EQG.	Site Environmental Coordinator
An EQS in **Table 5** is exceeded.	The following management responses will be triggered: ◗ Inform the OEPA and DEC as soon as practicable. ◗ Re-analyse brine discharge and review the current plant operations to identify if brine discharge composition has changed. ◗ Assess possibility of altering process to re-achieve design standard discharge. ◗ Undertake Toxicity Reduction Evaluation (TRE) tests to identify contaminants of concern and review management required to reduce to acceptable levels (see Section 6.1.6). ◗ Assess and implement alternate options to aid brine dilution, including: – 'Shandying' of the brine with untreated intake water prior to discharge; or – Introducing a second discharge point on the opposite end of the	Site Environmental Coordinator

		wave cut platform (utilising a 2nd existing fissure) to halve the quantity of brine being discharged at each point, thereby significantly increasing initial dilution. ◗ Continue increased water quality monitoring within the HEPA and reference sites during implementation of contingency strategies to demonstrate the efficacy of the management measures.

6.1.6 Toxicity Reduction Evaluation (TRE)

In the event an EQS is exceeded, a step-wise TRE will be undertaken which will include:

1. Identification of the contaminant(s) of concern and the management required to reduce them to acceptable levels. This would include a detailed examination of the waste stream and potentially include a Stage 1 Toxicity Identification Evaluation.
2. Management measures to reduce the contaminant(s) of concern will be implemented, along with monitoring to confirm that the required results are being achieved. The monitoring could include brine characterisation, further WET tests and/or in situ monitoring, subject to further consultation with EPA.
3. Management actions may include (a) the option of introducing a second discharge fissure to increase dilution and/or (b) identifying the source of the major contaminant with the intention of reducing its input and/or neutralising the toxicity of the contaminant chemically and/or (c) 'shandying' the brine with untreated intake water to provide dilution prior to discharge.

If required, additional management actions will be discussed and implemented with advice from the OEPA.

6.1.7 Reporting

Compliance and performance reporting to the OEPA will be undertaken in accordance with applicable and relevant legislative requirements, including any requirements of the Ministerial Statement.

Quarterly Reporting

Within 5 working days of the completion of water quality monitoring, survey data obtained from the vertical profiling component of works will be assessed for compliance with the prescribed EQC.

A brief Quarterly Report, summarising the activities undertaken, general observations, data analysis and any issues, hazards or opportunities identified will be submitted to the SDJV Environment Manager within 10 working days of receiving the results from the laboratory.

Should EQC levels be exceeded, however, the SDJV Environment Manager will be contacted by telephone (within 24 hours of data analysis), followed by written correspondence (Exceedance Report) including the data obtained, analysis performed and type of exceedance(s) identified (within 5 working

days). Given the relatively rapid turnaround timeframes required of this Exceedance Report, no information obtained from the laboratory analysis component of the sampling program is required. However, these data will be incorporated into the reporting associated with the next scheduled quarterly survey.

The SDJV Environment Manager will report EQC exceedances to the CEO of the OEPA and DEC as soon as practicable, in accordance with the requirements of the Ministerial Statement and Operating Licence required under Part V of the EP Act. The exceedance report will be accompanied by a description of the management measures that will be implemented in response to the exceedance and associated timelines.

Annual Reporting

An Annual Report summarising all results from the previous four quarterly monitoring surveys will be prepared. This report will provide a general description of the water quality monitoring program to date, results obtained and conclusions based on their analysis and interpretation. Actions taken to address any issues, hazards or opportunities will also be included.

The Annual Report will be completed in accordance with the requirements and timing to be detailed in the Ministerial Statement, when approved. The Annual Report will include all raw data, photographs and other relevant information (e.g. CoC forms) associated with the previous four quarterly surveys in suitable electronic format.

1:15,000 at A4

0 150 300 450 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

- Water Quality Impact Sites
- Water Quality Reference Sites
- Brine Discharge Pipeline
- LEPA
- Seawater Transfer Pipeline and Buried Power Line
- Pump Station Area
- Cadastre

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Cape Riche
Seawater Desalination Plant

Job Number 61-26005
Revision 5
Date 02 Feb 2012

Marine Water Quality Monitoring and Reference Sites

Figure 4

G:\61\26005\GIS\Maps\MXD\6126005_G065_Fig04_Rev5.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Cadastre - 20101210, Mosaic 2008 Cheyne - 20110927; GHD: Water Quality Impact Sites - 20111212, Water Quality Reference Sites - 20111212, Brine Discharge Pipeline - 20110623, Seawater Transfer Pipeline and Buried Power Line - 20110704, LEPA - 20120123, Pump Station Area - 20110826. Created by: vdinh, mczekaj

6.2 Whole of Effluent Toxicity (WET) Testing

6.2.1 Objective

During commissioning of the desalination plant and other select times (detailed below), WET testing of the brine to be discharged will be undertaken to confirm the findings of the WET testing done with simulated brine (as reported in the 2011 PER) and to confirm the number of dilutions required to achieve a high level of species protection within the HEPA. This dilution requirement (i.e. number of dilutions required to achieve 99% species protection) will then form the basis for the salinity EQS.

As with the WET testing completed for the PER (2011), chemical measurements will be compared to the ANZECC/ARMCANZ (2000) water quality guideline trigger values to identify any adverse changes in water quality and contaminants of potential concern. Both acute and chronic species protection trigger values at 99, 95, 90 and 80% species protection levels will be derived using the Effect Concentration 10[4] (EC10) data.

6.2.2 Performance Indicator

As a high level of protection is required within the HEPA, the performance indicator is for the WET testing to show that the dilution required for a high level of species protection is less than the minimum dilution predicted within the LEPA (i.e. <60 times dilution, see Section 8.8 of the PER).

6.2.3 Methodology

Sampling design

The WET testing will comprise the following tests:

- 48 hour macroalgal germination test using the marine brown kelp *Ecklonia radiata*;
- 72 hour sea urchin zygote development into pluteus larvae using the marine echinoderm *Helicidaris erythogramma*;
- 48 hour brine survival and larval development of fertilised larvae using the blue mussel *Mytilis edulis*;
- 21 Day copepod survival and reproduction using the estuarine copepod *Gladioferens imparipes*; and
- 7 day larval fish growth test using the marine fish pink snapper *Pagrus auratus*.

Monitoring requirements

The WET testing will be undertaken under the following circumstances:

- During commissioning;
- Within one year of full operation; and
- Upon change in the desalination treatment process or the chemical additives used in the water treatment process.

[4] Effect Concentration that causes an observable adverse effect in 10% of the test organisms.

6.2.4 Reporting

Following receipt of WET testing results, a summary report will be prepared that records and describes the testing results. Dilution requirements will be compared to the dilution predicted in the hydrodynamic modelling undertaken for the PER (2011), or to actual water quality monitoring data, to confirm that a high level of protection can be expected within the HEPA.

The SDJV Environment Manager will report EQC exceedances to the CEO of the OEPA and DEC as soon as practicable, in accordance with the requirements of the Ministerial Statement and Operating Licence required under Part V of the EP Act. The exceedance report will be accompanied by a description of the management measures that will be implemented in response to the exceedance and associated timelines.

6.3 Final Brine Discharge Monitoring

6.3.1 Overview

Following analysis of the actual brine to be discharged and the receipt of WET testing results obtained during commissioning, the primary contaminants of concern within the final brine effluent will be identified and EQCs developed.

6.3.2 Objective

The objective of the final brine discharge monitoring is to monitor the composition of the brine to demonstrate that the chemical composition of the brine being discharged is within the range considered by the WET testing, and hence that the salinity EQC (as an indicator of whole of effluent toxicity) is still valid.

The salinity of the brine is also required for comparison with reference site and impact site salinity levels recorded as part of the MWQMP for determination of compliance with the salinity EQS.

6.3.3 Methodology

Identification of Contaminants of Concern

As part of the WET testing to be undertaken during commissioning of the plant, chemical measurements of the brine to be discharged will be compared to the ANZECC/ARMCANZ (2000) water quality guideline trigger values to identify contaminants of potential concern.

During this stage, the analytical laboratory will be consulted with to determine appropriate contaminants of concern and corresponding trigger levels at which WET testing should be re-done.

In addition, real-time measurements of the following parameters will be taken at the plant immediately prior to the brine entering the outfall pipeline:

- Temperature;
- Salinity;
- pH; and
- Dissolved Oxygen.

Final Brine Discharge Sampling

Samples of the final brine discharge will be taken at a sampling point located at the plant immediately prior to the brine entering the outfall pipeline.

Samples will be refrigerated prior to transfer to a NATA accredited laboratory for analysis.

6.3.4 Compliance Assessment

Results of the final brine discharge analysis will be assessed against the determined EQC (when developed). It is anticipated that the:

- The EQG will be a concentration determined in consultation with the analytical laboratory, which if met, may affect the findings of the original WET testing; and
- EQS will be for WET testing (triggered by exceedance of the EQG) and actual dilution calculations to confirm 99% of species are likely to be protected at LEPA-HEPA boundary.

6.3.5 Reporting

Reporting for this component of the BDMP will be undertaken in conjunction with the quarterly and annual reports discussed in Section 6.1.7.

The SDJV Environment Manager will report EQC exceedances to the CEO of the OEPA and DEC as soon as practicable, in accordance with the requirements of the Ministerial Statement and Operating Licence required under Part V of the EP Act. The exceedance report will be accompanied by a description of the management measures that will be implemented in response to the exceedance and associated timelines.

6.4 Benthic Habitat Monitoring Program (BHMP)

6.4.1 Overview

Similar to that of the MWQMP, the purpose of the BHMP is to undertake a regular assessment of the receiving environment of the desalination plant brine discharge and ensure the 'maintenance of ecosystem integrity', the primary EQO commitment of Grange.

In order to achieve this EQO, the EQC to be measured for this component of the program is to demonstrate no detectable effect from the brine discharge on dominant benthic habitat types within the HEPA.

Dominant habitats within the HEPA include relatively large areas of seagrass meadows and small hard coral outcrops within Cheyne Bay on the north side of Cape Riche (several kilometres from the discharge location and well outside the modelled area of influence) and various intertidal communities along the rocky wave-cut platform, including macro algae, coralline algae, crustaceans and gastropods.

The BHMP focuses on the safely accessible areas of the rocky wave-cut platform at the brine discharge location.

Monitoring of the seagrass and coral communities on the north side of Cape Riche is not included in the BDMP, as modelling undertaken during the PER process demonstrates that there is a negligible risk of impact to the seagrass and coral communities. Monitoring of these components will be undertaken at the discretion of SDJV to provide information for their on-going stakeholder engagement process.

Also included in the BHMP, but unrelated to brine discharge management, is the benthic habitat recovery monitoring of the temporary rockfill platform footprint to be used during construction of the seawater intake and a coral spawn assessment to verify that there is an insignificant risk of entrainment of coral spawn associated with the seawater intake.

6.4.2 Objective

Wave Cut Platform Monitoring

The objective of wave cut platform monitoring is to monitor the sensitive biological communities within safely accessible areas of the wave cut platform to demonstrate that ecosystem integrity is being maintained.

Seawater Intake Construction Footprint Recovery Monitoring

The objective of the seawater intake construction footprint recovery monitoring is to assess the extent of initial impact (if any) and monitor the benthic habitat recovery in the subtidal area impacted by the construction of the seawater intake.

Coral Spawn Entrainment Assessment

The objective of the coral spawn entrainment assessment is to verify the PER assumption that there is an insignificant risk of entrainment of coral spawn associated with the operation of the seawater intake.

6.4.3 Wave Cut Platform Monitoring Methodology

The wave-cut platform adjacent the discharge fissure will be monitored by comparing percentage cover of biota, species presence/absence and counts of individuals in quadrats adjacent the fissure, with quadrats from a reference site, located at the western end of the wave cut platform. This is a land-based assessment of safely accessible areas on the wave cut platform and no subtidal surveys within the LEPA are proposed.

Specifically, a 1 x 1 m permanent quadrat will be installed on the wave cut platform starting at approximately 40 m from the edge of the fissure. Additional quadrats will then be installed at approximately 10 m intervals across the wave cut platform heading west. It is anticipated that up to six quadrats will be monitored, however this will be determined based on available space on the wave cut platform. If possible, sites will continue beyond 100 m from the fissure (i.e. extending beyond the distance corresponding to the 100 m LEPA). The quadrats to be located on the far eastern end of the wave cut platform will act as reference sites as they are at the furthest accessible point from the discharge. An indicative layout of the sampling sites is provided in **Figure 5**.

No monitoring is required to the east of the fissure as the area is dominated by cliffs and is not accessible. Similarly, further west beyond the extent of the wave cut platform is dominated by cliffs and no further monitoring is required. Monitoring of the lower seaward extent of the platform is not safely possible due to the exposed nature of the wave cut platform. Specific monitoring locations will be determined by appropriately qualified scientists and will be heavily dependent on safe access, given the exposed nature of the location. The quadrats will be established by installing four steel pegs into the rocky substrates, or another appropriate method as determined on site.

During monitoring events, tape will be placed around the steel pegs (to be used as a reference in the analysis of percentage cover) and photographs taken at a height sufficient to include the whole quadrat area. Monitoring will only be undertaken if all safety requirements are met in the field.

Percentage biological cover within each quadrat will be determined using suitable photographic software and species presence/absence and counts of individuals will be recorded. This assessment is to be repeated on a quarterly basis and comparative analysis is to be undertaken to detect any significant change between study and reference sites over time.

This survey will be undertaken in conjunction with the water quality monitoring program, including baseline surveys for one year prior to operation. After three years of monitoring, it is anticipated that the program will be reviewed and a decision made in conjunction with the regulatory authorities on its continuance.

6.4.4 Seawater Intake Construction Footprint Recovery Monitoring Methodology

A baseline assessment of the proposed subtidal impact area at the seawater intake channel location will be undertaken prior to any habitat disturbance by use of diver video transects and/or quadrat photography. A marked transect will be installed through the centre of the proposed construction footprint within the rocky reef macro-algae habitat, running parallel to the shoreline extending to 20 m either side of the footprint. To ensure the survey is repeatable, the transect end markers will be left in place. As the markers will be outside the footprint area, they will not be lost during the construction process. During post construction surveys, the tapes will be re-laid between the endpoints, providing a repeatable measures survey.

Divers will film and/or photograph quadrats from the beginning of the transect, noting the start location. The diver will aim to capture 0.5 m either side of the marked transect in the video process or a 0.5 x 0.5 quadrat photograph every five metres along the transect. The transect line will be marked at regular intervals to provide reference and scale for the video footage and/or photo quadrats.

A still photographic survey will also be conducted by divers throughout the footprint prior to disturbance to catalogue existing species. These images will be used to assist with identifying species from the video transect survey and as a reference for future surveys.

The transect footage and/or photo quadrats will be analysed by estimating percentage cover of algae for each metre of video footage or each photo quadrat. This data will subsequently be compared with baseline data to provide an indication of algal recovery on the rocky substrate. The appropriate statistical analysis for this comparison will be determined by the monitoring consultant prior to commencement of the program.

After the removal of the rockfill platform, the transect survey should be repeated on a biannual basis for three years, or until it can be established that algal recovery is occurring. A nominal full-recovery period of five years has been adopted, with measureable recovery period of two years (i.e. visual evidence of re-colonisation and increasing percentage cover). Contingencies for the absence of recovery are covered in **Table 8**.

6.4.5 Coral Spawn Entrainment Assessment Methodology

Coral spawn dispersion modelling will be undertaken to verify that there is an insignificant risk of entrainment of coral spawn associated with the seawater intake.

An initial desktop study will aim to estimate the spawning characteristics of local coral species by considering likely:

- Timing of spawn;
- Dates of spawn;
- Density of spawn; and
- Spawn buoyancy characteristics.

The information derived from the desktop study will be used as inputs into the dispersion modelling.

A particle model will be setup utilising the existing Cape Riche numerical model. Several scenarios, including 'normal and expected' and 'worst case', will be run with the model to determine the likelihood of coral spawn entrainment occurring under differing conditions.

Percentages of estimated coral spawn entrainment will be reported for several scenarios and outputs will include areal graphics of snapshot and probability distributions, time series of entrainment into the seawater intake and animations.

The report will provide a conclusion of the likelihood of the seawater intake impacting on the spawning of the coral formations on the northern side of Cape Riche.

6.4.6 Reporting

Compliance and performance reporting to the OEPA will be undertaken in accordance with applicable and relevant legislative requirements, including any requirements of the Ministerial Statement.

Post-construction Report

A post-construction report will be issued to the CEO of the OEPA reporting to findings of the post construction Seawater Intake Construction Footprint Survey.

Quarterly Reporting

A brief Quarterly Report, summarising the activities undertaken, general observations, data analysis and any issues, hazards or opportunities identified relative to the benthic habitat monitoring will be submitted to the Grange Environment Manager in coordination with the submission of the Quarterly MWQMP report (Section 6.1.4).

Annual Reporting

As with the MWQMP, an Annual Report summarising all results from the previous four quarterly monitoring surveys will be prepared. This report will provide a general description of the benthic habitat monitoring program to date, results obtained and conclusions based on their analysis and interpretation. Actions taken to address any issues, hazards or opportunities will also be included.

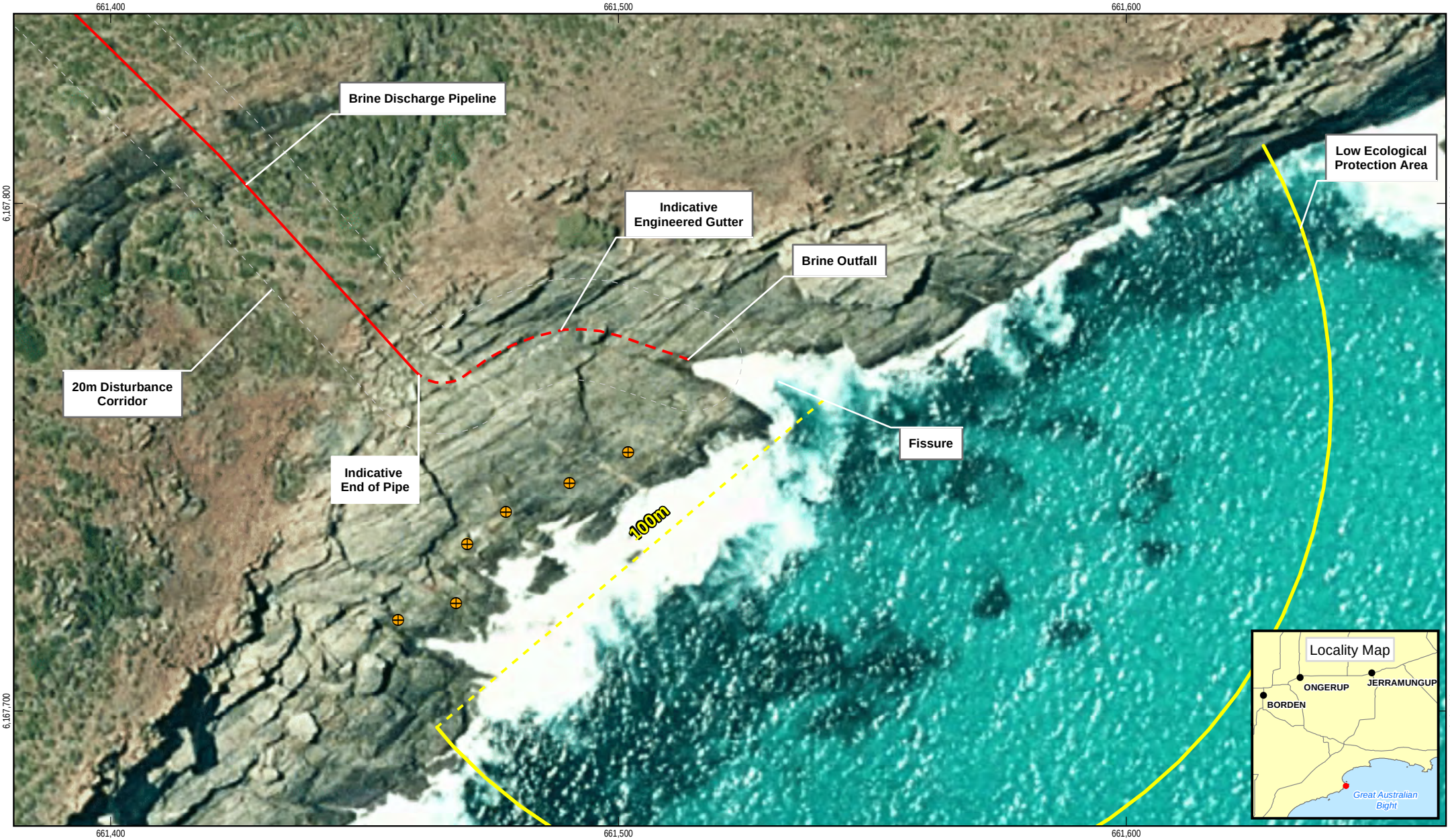
The Annual Report will be completed in accordance with the requirements and timing to be detailed in the Ministerial Statement, when approved. The Annual Report will include all raw data, photographs and other relevant information (e.g. CoC forms) associated with the previous four quarterly surveys in suitable electronic format.

6.4.7 Actions

The following actions, outlined in **Table 8**, will be implemented should significant loss or change in sensitive habitat occur as a result of the brine discharge.

Table 8 Benthic habitat monitoring contingency actions

Trigger	Action	Responsibility
No re-colonisation of benthic primary producer habitat within the Seawater Intake Construction Footprint after two years of monitoring	Consult with OEPA and/or DEC and appropriate industry specialists to determine potential rehabilitation options to aid recovery. Implement rehabilitation and recovery actions.	Environment Manager
Percentage cover impacts on the wave cut platform attributable to the brine discharge are recorded at 100 m from the discharge fissure.	The following management responses will be triggered: ◗ Review water final brine discharge water quality data to assess for changes in quality. ◗ Assess adequacy of the engineered channel (prior to the fissure) to contain brine and direct into fissure. ◗ Undertake additional work on engineered channel to prevent overflow.	Environment Manager



1:1,000 (at A4)

10 5 0 10 20 30

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- Indicative Monitoring Locations
- Indicative Engineered Gutter
- Brine Discharge Pipeline
- 20m Disturbance Corridor
- Low Ecological Protection Area

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Cape Riche
Seawater Desalination Plant

Job Number 61-26005
Revision 1
Date 06 Feb 2012

Wave Cut Platform
Indicative Monitoring Location

Figure 5

G:\61\26005\GIS\Maps\MXD\6126005_G088_Fig05_Rev1.mxd
239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Kalbarr and Bremer Bay Coastline - 20110817; GHD: Indicative Monitoring Location - 20120202, Low Ecological Protection Area - 20120123, 20m Disturbance Corridor - 20110527, Indicative Engineered Gutter - 20110623, Brine Discharge Pipeline - 20110623; GA - Topo 250k series III - 2006. Created by: mczekaj

7. Reporting

Reporting associated with the monitoring programs discussed in the previous sections will be conducted in accordance with **Table 9**.

Table 9 Reporting requirements for the desalination plant monitoring program

Key Management Action	Performance Indicator	Reporting Evidence	Responsibility	Status (update in reporting)
Desalination plant discharge modelling to provide an indication of the dilution achieved within the LEPA	Brine stream achieves a dilution of at least 60:1 within the LEPA.	Report summarised in the Public Environmental Review (GHD, 2011c). The report provides evidence from hydrodynamic modelling that the dilution is likely to be achieved in practice.	Environment Manager	Completed
WET testing of actual brine to be discharged.	WET testing confirms that dilution required for high level of species protection is <60 times.	WET testing summary report will be provided to the OEPA.	Environment Manager	To be completed during commissioning.
MWQMP to confirm that the desalination brine discharge is compliant within the HEPA zone.	EQC met within the HEPA.	Results summarised in Annual Environment Report (AER) to be provided to OEPA / DEC. Exceedance of EQC to be reported to CEO of OEPA as soon as practicable.	Environment Manager	Baseline report and annually during operation. As soon as practicable following exceedance.
BHMP to demonstrate that the brine discharge has no significant effect on the biological communities within safely accessible areas of the wave cut platform.	No changes to the biological communities on the wave cut platform outside of the area consistent with the size of the LEPA.	Results summarised in AER to be provided to OEPA / DEC. Photographic displays to be shown at the Grange office in Albany for public interest.	Environment Manager	Baseline report and annually during operation.

Key Management Action	Performance Indicator	Reporting Evidence	Responsibility	Status (update in reporting)
BHMP to demonstrate recovery of the benthic habitat associated with the rockfill platform.	Recovery / Recolonisation of algae on the rocky substrate.	Post-construction report will be issued to the CEO of the OEPA reporting the findings of the post construction survey. Results of recovery monitoring to be summarised in AER to be provided to OEPA / DEC.	Environment Manager	Baseline report, post construction report and annually during operation
Compliance and performance reporting to the OEPA in accordance with applicable and relevant legislative requirements, including any requirements of the Ministerial Statement.	Compliance with BDMP performance indicators and relevant conditions within the Ministerial Statement	Report to be provided to OEPA in accordance with requirements of the Ministerial Statement	Environment Manager	During operation

8. BDMP Auditing and Review

This BDMP will be audited annually for the first three years. Future audit timing would be agreed with the OEPA and DEC based on compliance achieved in the first three years.

The Audits will consider whether the:

- Monitoring programs have been implemented in accordance with the BDMP;
- Results of the monitoring programs indicate that the EQC have been met and the EV protected, as documented within the BDMP;
- All required actions have been taken as specified in Sections 6 and 7;
- Reporting has been completed and distributed to all relevant parties as stipulated in the BDMP; and
- The BDMP has been subject to adequate review in accordance with requirements specified in the BDMP.

This BDMP will be reviewed at a minimum after five years of operation to confirm it is performing to expectations. The plan may be reviewed within the first five years to accommodate operation/design/capacity changes and changing standards, or if the monitoring results indicate that the BDMP should be reviewed to address the outcomes from those results.

9. References

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Colman, JG (1998) South Coast Terrestrial and Marine Reserve Integration Study. Marine Reserve Implementation South Coast. CALM Marine Conservation Branch and South Coast Region.

Department of Environment, Water, Heritage and the Arts (2007) The South-west Marine Bioregional Plan: Bioregional Profile. A Description of the Ecosystems, Conservation Values and Uses of the South-west Marine Region. Available from http://www.environment.gov.au/coasts/mbp/publications/south-west/pubs/sw-profile-full.pdf, Accessed 17 December 2010.

GHD (2011a) Grange Resources Cape Riche Seawater Desalination Plant, Water Quality Monitoring, May 2011, Perth, Western Australia

GHD (2011b) Grange Resources Cape Riche Seawater Desalination Plant, Hydrodynamic Modelling Report, April 2011, Perth, Western Australia.

GHD (2011c) Grange Resources Cape Riche Seawater Desalination Plant, Public Environmental Review, October 2011, Perth, Western Australia.

Kohler, K.E. and S.M. Gill (2006) Coral Point Count with Excel Extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Computers and Geosciences. 32(9):1259-1269.

Appendix A

Water Quality Data

Table A1 - February 2011 (GHD 2011a)

Table A2 - Comparison between 2009 and 2011 (360 Environmental 2010; GHD 2011a)

Table A1 February 2011 water quality monitoring results. Pink shading indicates exceedance of ANZECC (2000) guidelines.

Parameters	Units	LOR	ANZECC (2000) Marine	ANZECC (2000) Estuarine	E1	E2	R1-SRF	R1-BOT	R2-SRF	R2-BOT	R3-SRF	R3-BOT	S1-SRF	S1-BOT	S2-SRF	S2-BOT	S3-SRF	S3-BOT	S4-SRF	S4-BOT
Date	---	---			13-2-11	13-2-11	15-2-11	15-2-11	16-2-11	16-2-11	16-2-11	16-2-11	15-2-11	15-2-11	15-2-11	15-2-11	15-2-2011	15-2-2011	16-2-2011	16-2-2011
Time	---	---			12:40:22	12:53:42	13:45:48	13:44:01	9:41:49	9:36:39	9:10:25	9:06:38	14:10:43	14:09:15	14:30:19	14:29:06	14:53:19	14:50:49	9:25:28	9:18:56
Depth	m				0.2	8.6	0.3	16.5	0.2	4.1	0.2	7.4	0.9	8.5	0.4	10.1	0.4	10.0		9.9
Water Position	---	---			Surface	Surface	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Physico-chemical																				
Temperature	°C	---			20.45	21.77	21.23	20.96	21.04	21.01	21.08	21.02	21.29	21.19		21.28	21.26	20.95	21.06	21.05
Turbidity	NTU	---	1-2	1-2	4.4	8.4	0.9	1.4	0.8	0.7	0.5	0.9	0.9	1.3	0.5	0.9	1.1	1.2	0.9	2
DO	mg/L	---			11.14	10.56	7.57	7.82	7.53	7.42	7.34	7.35	7.22	7.32	7.45	7.45	7.59	7.7	7.41	7.34
DO Sat	% Sat	---	>90	90-110	140.6	136.4	100.9	103.6	101.4	99.5	99.4	96.7	96.2	97.5	99.3	99.0	100.7	101.8	99.6	98.6
Conductivity	µS/cm	---			36162	35728	43269	43149	47176	46967	41898	41887	42765	43328	42280	42249	41977	42747	46730	46778
TDS	mg/L	-			31400	31500	45400	42000	40700	42400	41800	42200	42500	41200	42000	43300	42000	41700	42700	41900
PAR (Average)	µE/m^2/s						540	173	241	150	259	148	505	134	478	169	201	114	356	152
LAC (calculated)	1/m	---	0.09-0.13	0.3-1.0	---	---	0.07	---	0.12	---	0.08	---	0.17	---	0.11	---	0.06	---	0.09	---
Nutrients																				
NH_X-N	mg/L	0.1[5]	0.005	0.04	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
NO_3-N	mg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NO_2-N	mg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NO_X-N	mg/L	0.01	0.005	0.045	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TKN-N	mg/L	1[5]			NR[6]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
TN-N	mg/L	1[5]	0.23	0.75	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
TP-P	mg/L	0.1[5]	0.02	0.02	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
FRP-P	mg/L	0.01	0.005	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Metals																				
Arsenic	µg/L	10			---	---	---	---	---	---	---	---	---	---	<10	<10	---	---	---	---
Cadmium	µg/L	1	0.7	0.7	---	---	---	---	---	---	---	---	---	---	<1	<1	---	---	---	---
Chromium	µg/L	10	4.4	4.4	---	---	---	---	---	---	---	---	---	---	<10	<10	---	---	---	---
Copper	µg/L	10	1.3	1.3	---	---	---	---	---	---	---	---	---	---	22[7]	22	---	---	---	---
Nickel	µg/L	10	7	7	---	---	---	---	---	---	---	---	---	---	<10	<10	---	---	---	---
Lead	µg/L	10	4.4	4.4	---	---	---	---	---	---	---	---	---	---	<10	<10	---	---	---	---
Zinc	µg/L	50	15	15	---	---	---	---	---	---	---	---	---	---	<50	<50	---	---	---	---
Mercury	µg/L	0.1	0.1	0.1	---	---	---	---	---	---	---	---	---	---	<0.1	<0.1	---	---	---	---
Other																				
TSS	mg/L	<0.5			5.7	9.7	1.4	<0.5	0.6	0.5	<0.5	0.7	1	1.5	0.6	0.8	<0.5	1.5	<0.5	<0.5
Chlorophyll a	µg/L	<1	0.7	3	3	6	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	---

[5] LOR raised due to possible matrix effect from 0.01 to 0.1 mg/L for NH_X and TP and from 0.1 to 1 mg/L for TN and TKN.

[6] Not reported because of matrix effects from marine salinity levels not accounted for by the laboratory.

[7] March 2010 copper values at S2 from alternative labs (NMI, MAFRL) indicate copper results from primary lab are suspect.

Table A2 Comparison between 2009 and February 2011 water quality monitoring

	Period	All 2009		16 February 2009		15-16 February 2011		15-16 February 2011	
	Stations	Marine		Marine		Marine		Inlet	
	Source	360 Environmental		360 Environmental		GHD		GHD	
Parameter	**Units**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Physico-Chemical									
Temp	°C	15.52	21.64	21.09	21.64	20.95	21.29	20.45	21.77
Turb	NTU	0	10.3	0	10.3	0.5	2	4.4	8.4
DO Sat	% Sat	91.5	113.9	91.5	103.2	96.2	103.6	136.4	140.6
TDS	mg/L	31200	64000	41800	45000	41887	47176	35728	36162
LAC	1/m	0.04	0.16	0.07	0.16	0.06	0.17	NA	NA
Nutrients									
TN	mg/L	0.07	0.17	0.09	0.17	NR[8]	NR	NR	NR
TP	mg/L	<0.005	0.017	0.01	0.017	NR	NR	NR	NR
Dissolved Metals									
Cu	ug/L	7	21	17	21	22	22	NA	NA
Other Parameters									
TSS	mg/L	0.5	9.1	2.4	9.1	<0.5	1.5	5.7	9.7
Chla	µg/L	0.1	1.2	0.4	1.2	<1	<1	3	6

[8] Not reported because of matrix effects from marine salinity levels not accounted for by the laboratory.

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