CAPE RICHE DESALINATION PLANT
MARINE MAMMAL ASSESSMENT

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1.0 INTRODUCTION

1.1 DESALINATION PLANT OVERVIEW

A 12-gigalitre per year (GLY) desalination plant is proposed for development near Wellstead, Western Australia. The proposed location for the plant's brine discharge is along the southern coast of Cape Riche, selected for its highly energetic receiving water environment that may rapidly mix and disperse the brine discharge. The desalination plant will be based on reverse osmosis (RO) desalination technology, which is the standard technology applied to all large desalination plants constructed in Australia over the past seven years. Best management practices for RO desalination plants will derive from recent desalination projects and will be incorporated into the Cape Riche desalination plant.

The estimated product water capacity of the proposed desalination plant is 35 ML/day. The desalination plant will require approximately 90 ML/day of seawater to be brought in and approximately 55 ML/day of seawater concentrate (brine) to be discharged into the ocean. Over one year, it is likely that the production from the desalination plant (12 GLY) will intake 30 GL of seawater and discharge 18 GL of brine. In order to meet the annual production target, the desalination plant must operate at or close to its estimated capacity of 35 ML/day for most days of the year.

Currently, it is not known how this amount of annual brine discharge may impact marine mammal species in the coastal area, which includes Cape Riche, Cheynes Bay and Cheynes Island and surroundings (hereafter referred to as "the proposed area"). Therefore, this document identifies the marine mammal species that are likely to occur within the proposed area and conducts an assessment of the potential impacts that may result from the brine discharge of the proposed desalination plant.

1.2 SCOPE OF DOCUMENT

The primary scope and objectives of this assessment document are to:

- Provide a brief overview of the marine mammal species that are found in the region that includes Cape Rich, Cheynes Bay and Cheynes Island;
- Identify and assess the potential impacts of hyper-saline water from the proposed desalination outfall on marine mammals that are likely to be in the area; and
- Provide recommendations for potential conservation measures.

Note: This document does not assess the impacts of other actions that may be associated with the proposed desalination plant, such as wastewater treatment, construction of facilities (e.g., in- and outflow pipes, desalination plant) or acoustic disturbance. This document only addresses the potential impacts of hyper-saline water discharge on marine mammals in the area.

2.0 IDENTIFICATION OF MARINE MAMMAL SPECIES IN THE CAPE RICH, CHEYNES BAY AND CHEYNES ISLAND AREA

In Australia's Commonwealth waters, the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the primary legislation that protects and manages important flora, fauna, ecological communities and heritage places. Under the EPBC Act, all whale and dolphin species are protected within the Australian Whale Sanctuary, which includes all Commonwealth waters from the three nautical mile state waters limit to about 200 nautical miles, the boundary of the Exclusive Economic Zone. Of the marine mammal species that are listed under the EPBC Act, there are 14 species that may occur within the Cape Rich, Cheynes Bay and Cheynes Island areas (DSWEPAC 2011; see Table 1).

In the state waters of Western Australia, the *Wildlife Conservation Act of 1950* protects native plants and animals that are: a) under identifiable threats of extinction; b) are rare; or c) otherwise in need of special protection. This Act authorizes the State's Department of Environment and Conservation to provide separate lists of specially protected species in Western Australia. Four marine mammal species that are listed under this Act are likely to occur in the proposed area (Table 1).

Table 1. Marine mammal species that may occur in the proposed area and their listing status under Western Australia's *Wildlife Conservation Act of 1950* and the Commonwealth's EPBC Act.

Common Name	Scientific Name	Wildlife Conservation Act Status (Western Australia)	EPBC Act Status (Commonwealth)
Blue Whale	*Balaenoptera musculus*	Endangered	Endangered
Southern Right Whale	*Eubalaena australis*	Vulnerable	Endangered
Humpback Whale	*Megaptera novaeangliae*	Vulnerable	Vulnerable
Australian Sea Lion	*Neophoca cinerea*	Other Specially Protected Fauna	Vulnerable
Bryde's Whale	*B. edeni*	N/A	Migratory
Pygmy Right Whale	*Caperea marginata*	N/A	Migratory
Dusky Dolphin	*Lagenorhynchus obscurus*	N/A	Migratory
Killer Whale	*Orcinus orca*	N/A	Migratory
Minke Whale	*B. acutorostrata*	N/A	Migratory
Common Dophin	*Delphinus delphis*	N/A	Migratory
Risso's Dolphin	*Grampus griseus*	N/A	Migratory

Common Name	Scientific Name	Wildlife Conservation Act Status (Western Australia)	EPBC Act Status (Commonwealth)
Coastal Bottlenose Dolphin	*Tursiops sp.*	N/A	Migratory
New Zealand fur seal*	*Arctocephalus forsteri*	N/A	Migratory

** New Zealand fur seals are listed as specially protected fauna under the Wildlife Conservation (Specially protected fauna) Notice 2010(2).*

3.0 SENSITIVE MARINE MAMMAL SPECIES

Table 1 lists all marine mammal species that may occur within the proposed area. Of these, four species have a threatened status under both State and Commonwealth law and are listed as Endangered, Vulnerable, or Other Specially Protected. It is likely that these species may be sensitive to disturbance. This group includes the blue whale, the southern right whale, the humpback whale and the Australian sea lion. In addition, the biology and ecology of coastal bottlenose dolphins increases their vulnerability and sensitivity to potential risks of local disturbances in the environment. Therefore, these marine mammals will be the focus of following sections with regards to potential impacts from the brine discharge of the proposed desalination plant.

3.1 BLUE WHALES

The distribution of blue whales in Australia has been documented in nearly all waters around the continent. However, blue whales have been observed to aggregate in only a few feeding locations in Australian waters: along the southern continental shelf in the Perth Canyon, Western Australia, and the Bonney Upwelling and adjacent upwelling areas of Southern Australia (DEH 2005a). In these feeding areas, aerial surveys recorded approximately 40-50 whales at one time, indicating notable peaks from January – March (Jenner and Jenner 2004).

Blue whales also travel *between* their feeding areas. Vessel-based surveys identified more than 100 blue whales in Geographe Bay, Western Australia (Burton 2003), approximately 650 km from the proposed area. From September – December, blue whales were sighted closer than 2 km from land, most likely in transit as no obvious feeding behaviour was documented (Burton 2003). Therefore, blue whales may migrate through coastal waters and the continental shelf, possibly travelling between their feeding areas, and likely to occur in the waters offshore of Cape Riche, Cheynes Bay and Cheynes Island.

Blue whales (and possibly sub *species brevicaudus*) are observed off the south coast near Albany in May/June. Little is known of the ecological requirements of this species in the south coast but canyons of the continental shelf may be important foraging areas. They are highly likely to occur in the waters offshore from the proposed development site.

3.2 SOUTHERN RIGHT WHALES

Southern right whales occur in the coastal waters of Australia's southern coastline off Western Australia and South Australia, from Sydney to Perth and including Tasmania (Bannister 1979—2005; Bannister 1990; Burnell & Bryden 1997). From May – November each year, southern right whales concentrate in breeding areas located in Western Australia at Doubtful Island Bay (approximately 80 km from Cape Riche) and east of Israelite Bay, as well as in the Great Australian Bight in South Australia (Bannister 1979-2005; Burnell 1999). Smaller numbers of calving females are regularly seen in Western Australia at Twilight Cove, Flinders Bay, Albany/Cape Riche area, Yokinup Bay/Cape Arid area (Bannister 1979-2005), with several areas along the coast that are used intermittently between their regular calving grounds (DEH 2005b).

While there are a number of known aggregation sites for calving cows (e.g. Cheynes Beach, Point Anne, Doubtful Bay), individual cows and calves are also seen in protected embayments along the coast. Cows may remain in one area for up to 8 weeks while the calf feeds, grows, and develops a reduced respiratory rate that allows it to travel. Cows and calves are particularly vulnerable to predation by killer whales and white sharks during this period and are sensitive to anthropogenic disturbance such as vessel movement. Non calving southern right whales (e.g. bulls, juvenile males and females) may also aggregate in some areas of the south coast prior to undertaking their southward migration in October. These aggregations sites may vary between years). Southern right whales are slow moving and spend long periods at the surface resting or traveling and as such are more susceptible to vessel strike than other whale species.

The only marine protected area that contains a defined southern right whale calving ground is at the Head of the Bight in the Great Australian Bight Marine Park in South Australia (DEH 1999). However, considering the close proximity of the proposed area to known breeding areas along the southern coastline, there is a high possibility that the nearshore coastal waters of the proposed area may include southern right whales.

3.3 HUMPBACK WHALES

Every summer, humpback whales migrate between their feeding grounds in Antarctica to reach their tropical breeding grounds in winter. In Australia, the Group IV humpback whale population travels northward along the west coast through migration corridors that are within 30 km from shore (DEH 2005a). The whales are sighted in southern Australian waters in May, migrate up the west coast, and start their southward migration by October. Humpback whales are numerous in the south coast region from June to October each year and are generally migrating westward along the coast. While humpback whales may be present along the southern coastline, there are no known breeding areas, feeding areas, or significant habitats within the vicinity of the proposed area. Some cows may calve early in the migratory period and as such cows and calves are present in small numbers. Cows and calves are rarely stationary in an area for long periods and tend to actively avoid other migratory humpback whales, particularly bulls. Cows and calves are particularly vulnerable to predation by killer whales and white sharks during this period and are sensitive to anthropogenic disturbance such as vessel movement.

3.4 AUSTRALIAN SEA LIONS

The only endemic pinniped species to Australia is the Australian sea lion, whose breeding range extends from the Houtman Abrolhos Islands, Western Australia, to the Pages Islands, South Australia. The majority of the population occurs in South Australia, with the three largest colonies located at the eastern end of its range (DEWHA 2005) and more than 1,600 km away from the proposed area. This species is observed to have a fragmented distribution throughout its entire range, and there are no accurate population estimates available. There are no known breeding colonies or significant habitats for this species near Cape Riche, and it is likely that low numbers of Australian sea lions may be found within the proposed area.

3.5 COASTAL BOTTLENOSE DOLPHINS

The classification of species within the genus *Tursiops* is controversial and remains unresolved, as several species of bottlenose dolphins were described in the past based on wide distributions and variation in morphological characters. At present, there are two species that are accepted under this genus: 1) the Indian Ocean or Indo-Pacific bottlenose dolphin (*T. aduncus*); and 2) the common bottlenose dolphin (*T. truncatus*) (Rice 1998).

In Australia, coastal bottlenose dolphins commonly occur in estuarine and coastal waters of eastern, western and northern Australia (Hale et al. 2000), with recent evidence suggesting that the species also occurs in South Australia (Kemper 2004). The species' distribution consists of small populations that exhibit high site fidelity and philopatry, as some individuals remain within their area of birth for their entire lives (Möller et al. 2002). Populations are generally restricted to inshore areas (i.e. bays, estuaries, nearshore waters, and coastal areas), resulting in high levels of vulnerability and sensitivity to disturbance (Hale et al. 2000; Möller et al. 2002, Kogi et al. 2004). In 2008 and 2009, dolphin surveys frequently identified coastal bottlenose dolphins within 15 km of the proposed area (L.Bejder, pers. obs). Therefore, it is highly likely that resident populations of coastal bottlenose dolphins will occur within the proposed area.

4.0 POTENTIAL IMPACTS ON MARINE MAMMALS

There may be potential impacts of desalination plants to the marine environment through the release of brine and hyper-saline water into the ocean. Brine "pollution" results from the high-specific weight of the dissolved substances that may continuously enter the water in the vicinity of the outlet (Einav and Lokiec 2003). The accumulated substances have the potential to alter the benthic community at varying levels for different habitats, depending on the currents, waves and surrounding flora and fauna species. Coral reefs will have impacts distinct from those at a rocky shore or sandy beach, characterized by the habitat's vulnerability and resilience to hyper-saline water.

The potential impacts from hyper-saline water on marine mammals have not been investigated nor documented. However, at least four studies have documented bottlenose dolphin exposure to and use of areas with extremely **low** salinity: Galveston Bay, Texas, USA (Moreno 2006); Lake Pontchartrain, Louisiana, USA (Barry et al. 2008); Doubtful Sound, New Zealand (Rowe et al. 2010); and Swan River, Western Australia (Holyoake et al. 2010). Although individual bottlenose dolphins varied in their responses, there were suggestions that they remained in these low-saline areas for behavioral reasons, such as high site fidelity and restricted home ranges (Barry et al. 2008, Rowe et al. 2010). Two of the studies documented evidence supporting a possible correlation between an acute onset of skin conditions (e.g., skin lesions) and exposure to freshwater, low-saline conditions (Barry et al. 2008; Holyoake et al. 2010). Low-saline conditions may induce osmoregulatory disruption of epidermal cells and/or systemic physiological stress (Holyoake et al. 2010). Factors such as differences in diet, body condition, immunological functions may influence how individual dolphins respond to the stress of low salinity conditions. In the 2009 winter season, Western Australia's Swan Canning Riverpark recorded low salinity conditions that may have compromised the health of resident dolphins, leaving them susceptible to secondary bacterial/fungal infection that may have resulted in mortality of two dolphins (Holyoake et al. 2010).

These examples demonstrate that marine mammals may be sensitive to salinity changes in the environment. While no impacts from hyper-saline water have been reported, it is reasonable to presume that there may be osmoregulatory implications and *direct* impacts similar to low-saline conditions for marine mammals. Furthermore, there may be an additional risk of *indirect* impacts via alterations to the benthic environment that, in turn, may affect marine mammals through a trophic effect.

It is unknown if hyper-saline water may have long-term effects on the survival of benthic communities and the associated marine fauna. Plankton, crustaceans and invertebrates may experience osmotic challenges at the cellular level, pressure changes and death in elevated saline environments (Einav and Lokiec 2003). These physiological changes are critical for larvae and juveniles, eventually impacting higher trophic levels that rely on such species as a food resource. Baleen whales rely on krill and plankton as their primary food source and dolphins feed on squid and fish that reside in the benthic communities.

In regards to brine discharge and the resulting hyper-saline water, the coastal bottlenose dolphins may be most sensitive to negative impacts in the environment, given their restricted ranging patterns and documented impacts from low-saline conditions. It is a common aspect of coastal bottlenose dolphin behaviour and ecology to form complex

populations that contain combinations of migratory and resident dolphins (Hoelzel 1998, Chilver and Corkeron 2001, Zolman 2002, Sellas et al. 2005, Bearzi et al. 2009, Urian et al. 2009). Within estuaries and protected coastal areas (i.e. bays and sounds), resident dolphins form identifiable communities with small and over-lapping home ranges, long-term site fidelity, year-round residency, and stable relationships with the other dolphin members (Wells et al. 1999, Connor et al. 2000, Wisniewski et al. 2009, Zolman 2002, Urian et al. 2009). Some communities demonstrate distinct behavioural specializations (such as foraging and calving) that are only found within those communities. Furthermore, some resident populations are genetically distinct from other dolphins in nearby, surrounding areas, confirming the individuality of these populations and the lack of inter-breeding (Hoelzel 1998, Sellas et al. 2005, Möller et al. 2002; Wisniewski et al. 2009).

In summary, coastal bottlenose dolphins are long-lived, top predators in the marine environment (Wells et al. 2004). Given their high site fidelity and year-round presence, resident coastal bottlenose dolphins may occur in localized areas for prolonged periods of time. If coastal bottlenose dolphins reside in areas of brine discharge, they may be *directly* susceptible to salinity changes in the environment and compromised health conditions. Coastal bottlenose dolphins feed on a multitude of different prey species that are found in benthic habitats and throughout the water column. If plankton, invertebrates and fish are negatively impacted by brine discharge and hyper-saline water, important prey resources may be reduced for coastal bottlenose dolphins, with possible indirect consequences to the resident communities.

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5.0 RECOMMENDATIONS FOR POTENTIAL CONSERVATION RESEARCH

The potential impacts of hyper-saline water on marine mammals remain unknown, and any assessment of impacts and risks will lack scientific evidence. Thus, the proposed desalination plant at Cape Riche may present a conservation research opportunity. Scientific data may be collected and monitored to investigate possible risks or negative impacts result from the brine discharge of the proposed desalination plant. The following conservation research measures are recommended:

1. Conduct baseline monitoring of the proposed area ***prior*** to brine discharge to:
    - identify resident marine mammals species and/or populations;
    - determine distribution and relative abundance levels;
    - obtain baseline information on skin lesions occurrence; and
2. Conduct ***post***-brine discharge monitoring for the marine mammal species in the area and for potential changes to the parameters listed above.

5.1 PRE- AND POST-BRINE DISCHARGE MONITORING

Before the commencement of proposed desalination plant's brine discharge, it is critical to conduct baseline monitoring to provide sufficient and accurate information of marine mammals present in the proposed area, and in particular coastal bottlenose dolphins. The baseline monitoring would take place in Cape Riche, the proposed area for the brine discharge, and along the adjacent southwest coast of Western Australia. The following objectives may be considered for the monitoring approach:

- Identify all species of coastal dolphins and other marine mammals in the area;
- Quantify the distribution for each species;
- Calculate the numbers of each marine mammal species relative to the survey effort (relative abundance);
- Record the behavior of each species within the area;
- Obtain baseline information on skin lesion occurrence with photo-identification techniques (for resident coastal bottlenose dolphins).

Baseline monitoring will determine whale, seal and dolphin distributions and relative abundances. Data collected will verify if this area is an ecologically important habitat that supports calving, feeding and/or resting behaviours. Research would determine the animals' movement patterns and the amount of time during which they reside in the area. Because many of the marine mammal species will migrate through the area at different times, it is recommended to measure seasonal changes in species distributions by surveying for at least a 12-month period. Monitoring should be vessel-based and include photo-identification techniques to document individual dolphin residency, movement patterns

and the occurrence of skin lesions on animals in the proposed area. This data will provide a basis for comparison with monitoring conducted after the commencement of brine discharge.

Post-brine discharge monitoring should follow the same methods as pre-discharge monitoring. Comparison of data between the two monitoring periods will allow for an assessment of possible changes in abundance, residency times, habitat use, displacement into nearby habitats and acute onset of skin lesions as possible responses to disturbance.

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