Northern Water Supply

Site Assessment

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Executive Summary

The purpose of this assessment has been to undertake a brief desktop review of a range of potential desalination plant sites that could support the supply of water to the Gawler Craton area of the far north of South Australia. Potential off takers include BHP's Olympic Dam and OZ Minerals' Carrapateena mines.

This assessment draws on publicly available information including BHP's 2009 Environmental Impact Statement (EIS) for their proposal to site a desalination plant at Port Bonython. It also assimilates information provided by Infrastructure South Australia (ISA) from BHP's 2006 siting studies. This report provides a high-level comparison of sites including Port Bonython and several further locations recently identified by ISA.

For the purposes of this site assessment study, a plant capacity of 150 ML/d has been assumed to provide consistency in the assessment, noting that system demands for the Northern Wate Supply (NWS) are still being assessed by ISA.

ES-1. Site Selection – Key Considerations

In the development of a seawater desalination project, site selection is perhaps the most critical aspect. Selection of a site that is not well suited due to oceanic conditions, environmental, heritage and social values, and its proximity to inputs and outputs can impact a project's feasibility. Selection of the site may also be open to question during subsequent environmental and community assessment if the selection process has not been broad enough or sufficiently robust.

Whilst at this level of investigation all sites still have many unknowns, it is valuable to understand what features could constrain the project such that what is known can be applied to the site selection process.

The key considerations for siting a seawater reverse osmosis (SWRO) desalination plant that have been used to assess the feasibility of sites for a desalination plant to service the Gawler Craton in this report, comprise:

- Proximity to the ocean for the seawater intake and seawater concentrate outlet
- Oceanic features that provide required intake water quality and where the return concentrate can be rapidly diluted and dispersed
- Accessibility and constructability of a water supply pipeline and proximity to treated water storage
- Proximity to a power supply, roads, and telecommunications infrastructure
- Land features
- Community concerns
- Terrestrial and marine environmental impact

ES-2. Ocean Environments

A fundamental requirement for a seawater desalination project is access to the ocean for the intake of seawater and disposal of seawater concentrate. The regions under consideration for the NWS involve taking water from - and returning seawater concentrate from the plant to - three major water bodies, namely the Spencer Gulf, Upper Spencer Gulf, and Great Australian Bight.

In general, water quality for intakes and management of environmental issues is usually more easily achieved in the open ocean versus bays. Drawing from seawater in open ocean water generally results in better quality raw seawater. Bays are also more 'unique' compared to open ocean and therefore tend to have more unique and potentially sensitive ecology.

Tidal patterns in the Upper Spencer Gulf are unique and uncommon. Upper Spencer Gulf is also the only location in southern Australia where the shape and depth profiles of the Gulf result in significantly greater than expected tides, with ranges of more than 4 m occurring at Port Augusta and 3 m at Point Lowly. Spencer Gulf and Gulf St Vincent are two of the few coastal areas in the world where there are regular periods of minimal tidal movement. It is one of the few coastal locations in the world that experience what is locally known as 'dodge' tides, where diurnal effects almost completely cancel one another out during neap tides. These periods of limited tidal movement can impact diffusion of the seawater concentrate that is discharged back into the ocean, and so need to be accounted for in site assessment, impact assessment, and ultimately in design of the facility.

ES-3. Potential Site Locations

Based on assessment of the key site selection considerations and a review of available land and marine environment data, the following site options were identified in consultation with ISA for discussion and evaluation in the assessment:

- Whyalla
- Port Bonython
- Crag Point – north of Point Lowly
- Port Augusta (ex Northern Power Station site)
- Cowleds Landing – vicinity (south of Whyalla)
- Myponie Point (south of Port Pirie)
- Weeroona (ex. SAMAG site north of Port Pirie)
- Ceduna Region (Point Brown)
- Elliston
- Cape Hardy ('Iron Road' project port site)

These sites represent a mix of 'Gulf' and 'Open Ocean' site options. The relative locations of the potential sites considered are illustrated in **Figure ES- 1**.

ES-4. Site Review Outcomes

Assessment of each potential site has been undertaken employing two individual and distinct processes. The different assessment processes have been used as a form of independent cross check on the outcome to see if there are any common themes. The results of each process are discussed and then summarised in the Outcomes of the report. The assessment processes undertaken were:

- An initial qualitative assessment of the feasibility uncertainty of each site against a range of criteria that influence the viability of development of a desalination project in a given area or site.
- A multi-criteria risk assessment, to assess technical risks and anticipated environmental impacts associated with each potential site.

The cost differential between each option and a 'baseline' option of a plant sited at Port Bonython was also assessed.

Feasibility Uncertainty Assessment Outcomes

Key outcomes of the feasibility uncertainty assessment include:

- A Port Augusta site is considered to provide significant challenges with respect to the raw water quality available at the site, and also the ability to effectively mix and diffuse the brine discharge and manage its impacts.

- The bathymetry of Spencer Gulf around Port Augusta, Myponie Point and Weeroona is shallow, meaning the length of intakes and outlets required to reach locations and depths of water that would provide for good quality seawater feed to the plant are very significant compared to the other site options. This aspect is considered to impact the feasibility of these site options.
- Ceduna and Elliston require long delivery pipelines and significant works to enable a suitable power connection to be provided. They are also in locations that are generally remote from the logistical support necessary for operation of a desalination plant. This includes access to skilled operators, maintenance staff, chemicals, and consumables supplies. Truck transport for water treatment chemical deliveries and waste product removal required for a plant of this scale will be frequent activities, potentially weekly. The transport distances involved will impact operating cost.
- The Whyalla site is constrained by current ongoing industrial metal processing, and acquisition of this land has yet to be tested with the current owner. Local eddy currents within the Whyalla embayment and the potential for contaminated sediments present challenges that are not present at other site locations.
- The Crag Point site area is significantly constrained as it is bounded by the shoreline to the east and the Defence Training area to the west. The terrain is anticipated to have significant slopes to the shoreline and is traversed by a major gully, which affect the useable area of the site. More detailed site inspection may show these constraints can be managed. Ability to access or acquire of a portion of defence land to expand the site area has not yet been tested.

Multi-Criteria Risk Assessment Workshop Outcomes

A multi criteria risk assessment was undertaken with members of the ISA project team and their environmental assessment advisers, JBS&G, to assess risks that may impact completion of the project, and terrestrial and aquatic environmental impacts. The assessment utilised criteria based on the key siting consideration factors and assessed the information on each site gathered to date.

Key outcomes of the risk assessment include:

- The risk workshop outcomes were considered generally consistent with the initial feasibility uncertainty assessment screening, in that the sites considered as having a lower risk profile were similar to those indicated to have a higher degree of feasibility in the initial assessment.
- Sites with intake / outlet structures located toward the centre or in open areas of the Gulf (Cowleds Landing, Myponie, Weeroona, and potentially Cape Hardy) were noted to potentially have localised impacts on commercial prawn fishing. The fishing operations involve trawl nets that are pulled along the seafloor right across the Gulf south of Point Lowly. Navigation exclusion zones would have to be set up around the structures, which would impact trawling activities.
- The Crag Point site was rated as having a high potential for cultural heritage impact as it is located on the foreshore, as foreshore areas around the Gulf were noted to commonly have high cultural heritage value. Further evaluation of the site may enable this rating to be revised. The Port Bonython site by comparison is located inland from the foreshore and it may be possible to avoid impacts by tunnelling under sensitive areas.
- The assessed terrestrial environmental impact at Cowleds Landing was rated as high, however this was noted to have potential to be reduced with further investigation work.
- Water delivery complexity for the Point Brown, Elliston and Cape Hardy sites was rated as high on the basis that the significant length of pipeline infrastructure required would translate to a higher project risk profile. Additional work to optimise the infrastructure required and refine the route, particularly in the case of Cape Hardy (lesser amount of infrastructure, and more direct route to Whyalla) may enable a lower risk rating.

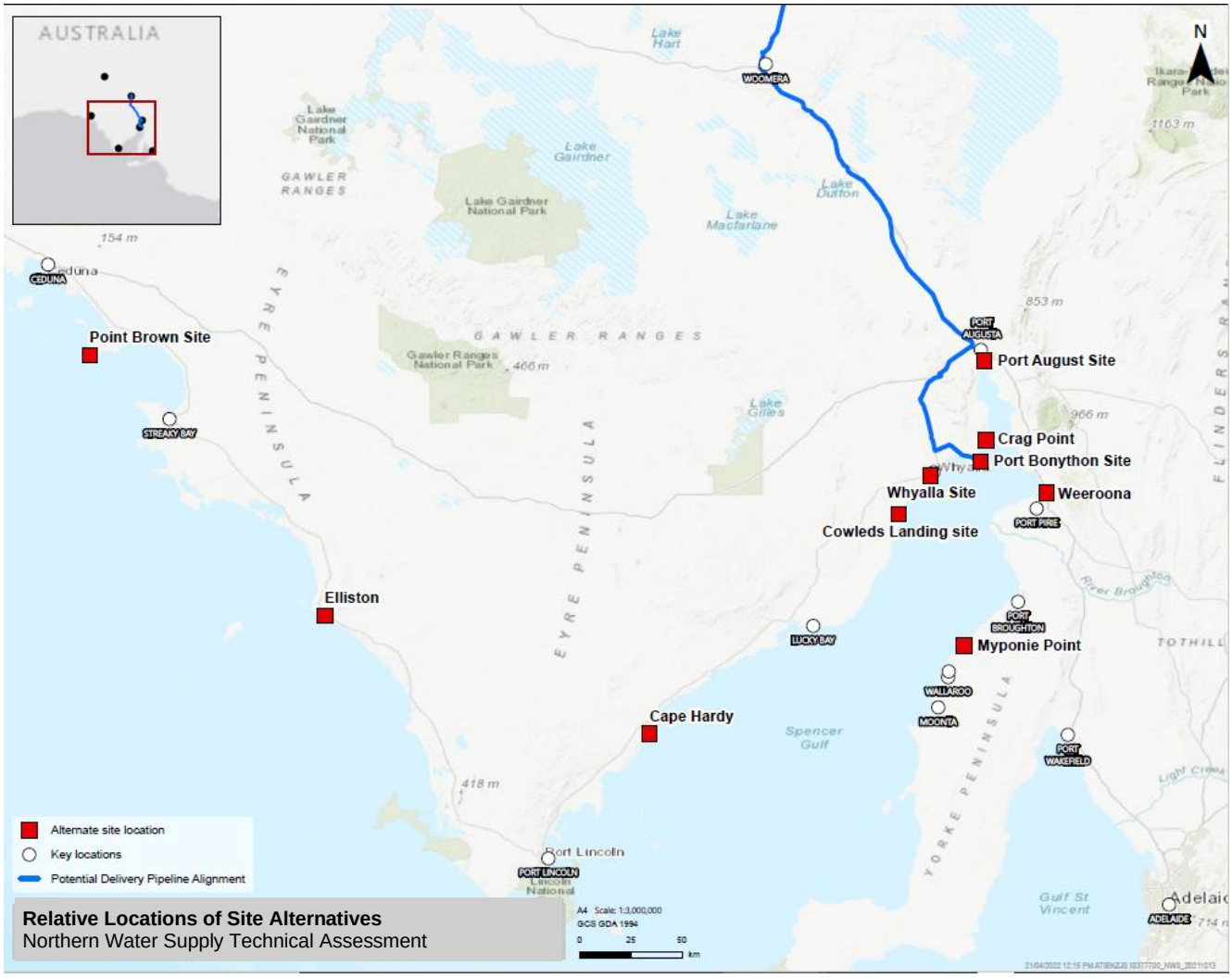


Figure ES- 1 Relative Locations of Potential Site Alternatives

Cost Differential Assessment

This assessment considered the anticipated cost differential between the desalination plant and delivery system option configuration required for each potential site location with that required for the 'baseline option' of a plant located at Port Bonython.

This cost assessment has only focussed on the differences in the primary components of infrastructure between each option configuration and that required for a plant at Port Bonython (intakes, outlets, power supply delivery system).

The cost differences are primarily driven by the cost for the delivery system infrastructure, and the length of intake and outlet tunnels required from the plant site to reach the preferred depth of water. It is noted that these estimates of cost have been developed from high-level concepts which have not been optimised, and so further work may influence the result indicated in this assessment.

Port Bonython was seen to have the lowest relative cost – no other site options were lower in relative cost. Whyalla, Crag Point, and Cowleds Landing were within 10% of the same amount and these differences are not considered significant for this assessment.

The cost differential for sites situated on the east coast of the Gulf and also Ceduna, Elliston and Capy Hardy were noted to be significant and are anticipated to make these sites financially unviable.

ES-5. Summary and Recommendations

The outcomes of the two separate assessment processes were considered broadly consistent in indicating a subset of feasible sites. A shortlist of sites has been selected in consideration of the results of the assessments and the following:

- Sites where the cost differential exceeds $1 billion above the 'baseline' option have been excluded on the basis that they would not be financially viable
- Sites where the assessments indicate there is a high likelihood of poor source water quality or issues associated with achieving the require diffusion and hence potential discharge impacts have been excluded.

On this basis, the sites considered most feasible and suitable to take forward for further evaluation to support the supply of water to the Gawler Craton area include:

- Port Bonython
- Crag Point
- Cowleds Landing

One of the key outcomes of this report has been to identify that there are a range of feasible sites, but to also identify that there is currently an unequal level of data available on each of these sites. There is therefore currently an unequal level of understanding of the potential risks that may arise as further investigation and project development is undertaken.

Port Bonython is one site that has a greater volume of data, as it has been subject to more investigation historically in past projects.

This assessment has been based on desktop level review of information readily available from publicly available databases. Further work on any of the sites may identify flaws or issues that have yet to be uncovered. It is prudent to move forward with several sites as a shortlist and then undertake site specific investigations to develop the understanding of each site to an equal level. This then would enable a robust assessment and selection of a preferred site for the purposes of detailed assessment within an EIS.

For the three sites identified to be taken forward, it is recommended that the following initial investigations be made to determine whether they enable any further differentiation between the three shortlisted sites:

- SARDI be engaged to undertake high level modelling of plume dispersion and recirculation.
- Liaison with Defence be undertaken regarding the Crag Point site to see what options or limitations exist for provision of an access right of way and pipeline easement to the site location, and to the acquisition of additional area for the site from the Defence Training Area.

Following assessment of these investigations, there are further site-specific investigations recommended as prudent to undertake. These investigations are intended to levelise the amount of information available across the shortlist of sites to better support a final site selection process. At a minimum it is recommended these include:

- A range of physical terrain, morphology and geotechnical investigations, land ownership and zoning
- Environmental and cultural heritage assessment of the terrestrial and aquatic environments.

Further assessment of the anticipated water demand from customers and the timeframe over which this demand would develop is also recommended.

There is also the need for further assessment of the timeframe to deliver these additional investigations so that they can be allowed for the overall delivery program for the project.

1. Introduction

The purpose of this assessment has been to undertake a brief desktop review of a range of potential desalination plant sites that could support the supply of water to the Gawler Craton area of the far north of South Australia. Potential off takers include BHP's Olympic Dam and OZ Minerals' Carrapateena mines.

This assessment draws on publicly available information including BHP's 2009 Environmental Impact Statement (EIS) for their proposal to site a desalination plant at Port Bonython. It also assimilates information provided by ISA from BHP's 2006 siting studies. This report provides a high-level comparison of sites including Port Bonython and several further locations recently identified by Infrastructure South Australia (ISA).

In the Northern Water Supply (NWS) Technical Assessment Report (Jacobs and GHD, August 2021), several plant capacity options were considered, in response to different potential demand scenarios. These are summarised as:

- **Option A** – Mining demand only – 100 ML/d capacity
- **Option B** – Medium mining demand and SA Water Option 1 Peak Day Demand (PDD) – 250 ML/d capacity
- **Option C** – Medium mining demand and SA Water Option 3A PDD – 350 ML/d capacity
- **Option D** – Partial mining demand and SA Water – 150 ML/d capacity

These capacities are derived from a range of assumptions around future demand from several different off takers including BHP, OZ Minerals, and SA Water, and when in time their demand requirement would be triggered.

For the purposes of this site assessment study, a plant capacity of 150 ML/d has been assumed, to provide consistency in the assessment when considering the impacts from the likely site extent required, and the overall option configuration (intake/outlet power supply and delivery system configuration).

Of note with respect to the Port Bonython site is the fact that Department of Treasury and Finance are currently leading planning for development of a significant mining, energy, and related industrial development in the vicinity of the site. This review has not considered altering the desalination plant to provide additional capacity specifically for this development as system demands are still being assessed by ISA.

Noting Treasury's current planning, a brief assessment has been undertaken as an appendix to this report (Appendix D) to provide additional clarity on the site location and the site area required for a 'large' desalination plant such as one sized to meet the highest demand scenario considered in the NWS. This is to provide some basis for understanding the site requirements for a 'larger' plant that may eventually include demand from the energy hub development. Consideration has been given to staging development of the plant, and how this may impact the plant layout and the overall site area required. Consideration has also been given to how the plant may fit within the existing landform, and whether this impacts the associated intake/outfall alignments and location.

Noting the above points about Port Bonython, this report investigates a range of sites for feasibility, assumes the Port Bonython site as a baseline site for certain comparative purposes, however, does not reach a conclusion as to the most appropriate site given the preliminary nature of these investigations.

2. Site Selection – Key Considerations

In the development of a seawater desalination project, site selection is perhaps the most critical aspect. Selection of a site that is not well suited due to oceanic conditions, environmental, heritage and social values and its proximity to inputs and outputs can alter a projects feasibility. Selection of the site may also be open to question during subsequent environmental and community assessment if the selection process has not been broad enough or sufficiently robust. As such a review of potential site alternatives to Port Bonython has been undertaken, and their attributes compared, to assess whether selection of Port Bonython as the preferential site remains justified.

Whilst at this level of investigation all sites still have many unknowns, it is valuable to understand what features could constrain the project such that what is known can be applied to the site selection process.

The following section summarises the key considerations for siting a seawater reverse osmosis desalination plant, including:

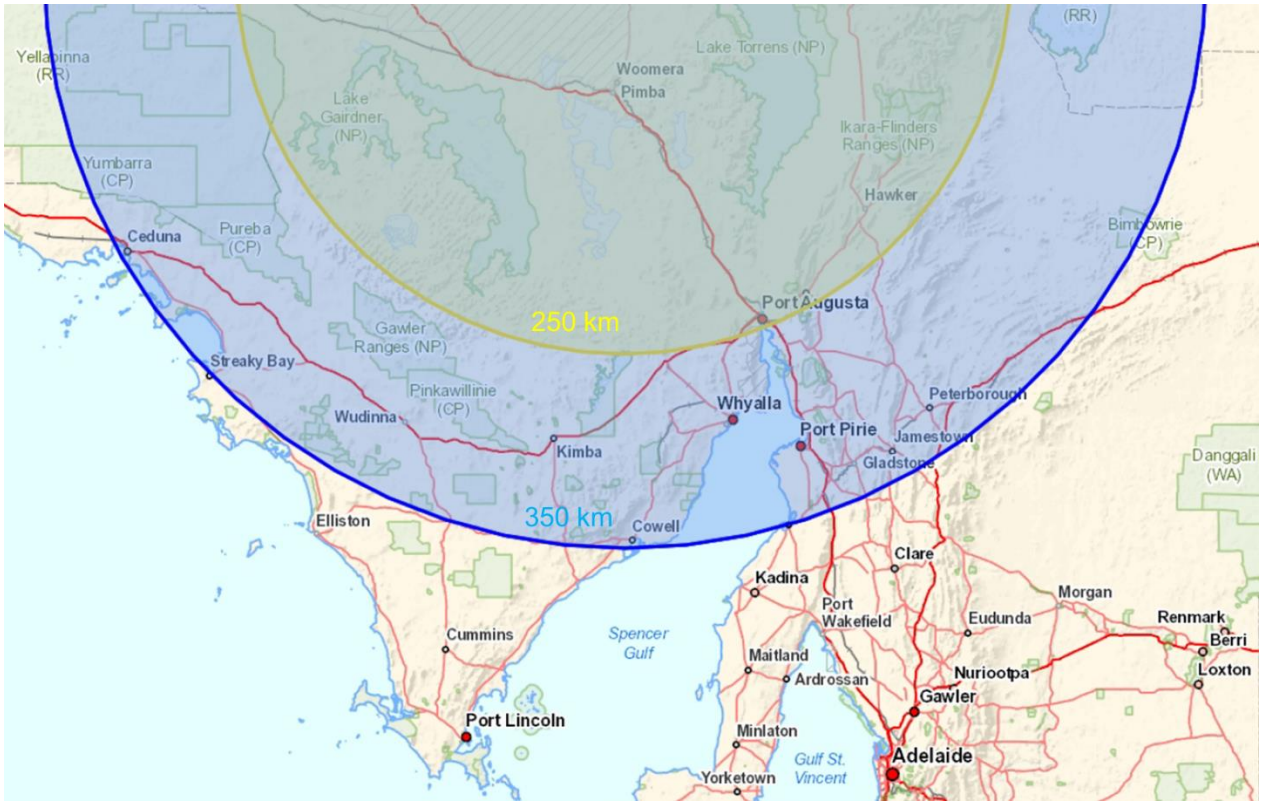
- Proximity to the ocean for the seawater intake and concentrate outlet.
- Oceanic features that provide required intake water quality and where the return concentrate can be rapidly diluted and dispersed
- Accessibility and constructability of a water supply pipeline and proximity to treated water storage
- Proximity to a power supply, roads, and telecommunications infrastructure
- Land features
- Community concerns
- Terrestrial and marine environmental impact

Many of the site selection issues/considerations noted herein can be addressed through engineering approaches, however these will increase costs. This section shows that the 'ideal' site is vacant, industrial-zoned land, next to deep open ocean water and relatively close to key water supply assets that can accept the water. This concept provides useful background when considering site selection.

2.1 Proximity to ocean

The desalination process operates at around 40% recovery. This means that more than twice the volume of the required product water must be pumped from the ocean and slightly more than the product flow must be returned to the ocean. As a result, the piping and pumping costs for the inlet pipeline and seawater concentrate return pipeline are much higher per kilometre than for the delivery pipeline carrying the final desalinated water.

It is therefore typically more economic to site the plant as close as possible to the ocean water source. For this project, sites located near to Spencer Gulf have been considered, as well as the Great Australian Bight. These water bodies were chosen as they provide access to seawater at approximately the same overall distance from the point of delivery, noting that this is between 250 - 350 km away from the major points of water demand, shown in **Figure 1**, being Olympic Dam and Carrapateena.



Source: SA Nature Maps, 2021

Figure 1 Project focus area

2.2 Intake and outfall

Drawing from seawater in open ocean water which is unaffected by inflows from the land leads to more consistent salinity and lower suspended solids in the feedwater. This reduces the extent of pre-treatment required reducing plant costs and operational and commercial risks. However, a key downside of construction in the open ocean is that large swells and weather condition may present construction difficulties.

In general, water quality for intakes and management of environmental issues is usually more easily achieved in the open ocean versus bays. Drawing from seawater in the open ocean water generally results in better quality raw seawater. Bays are also more 'unique' compared to open ocean and therefore tend to have more unique and potentially sensitive ecology, and may therefore have a higher risk of difficulty in getting approvals and may need more specific investigations and time to assess.

To maintain reasonable inlet water quality, it is preferable to have the inlet located in deeper water. This avoids sediments that are stirred up by wind and wave action in more shallow waters. It is also preferred to keep the inlet deep enough to avoid any interaction with boats and shipping. Further, constructing the connecting pipes or tunnels to the inlet is costly and a significant project risk, therefore minimising this length is beneficial.

This means that sites where deeper water is relatively close to shore are preferred. If available depths of more than 20 m are preferred if available.

Concentrate from the RO membranes contain elevated concentrations of salts naturally found in seawater. The concentrate is discharged via a pipeline similar to the intake pipeline. The concentrate can be dispersed effectively using diffusers on the outlet pipeline.

Significant local currents and/or a highly active ocean environment (e.g., in open ocean) also assist mixing and reduce the need for extensive diffuser approaches. A high turnover of water is also desirable as it is less likely to result in environmental and social concerns regarding build-up of salinity.

This discharge arrangement requires a minimum depth of water which again means sites near deeper water are preferred (>20 m if possible).

Figure 2 and **Figure 3** show the depth profiles in Upper Spencer Gulf and Lower Spencer Gulf respectively.

Depths of greater than 20 m are readily available in the southern region of Spencer Gulf, however there is limited suitable depth within Upper Spencer Gulf. There is also a deep channel that runs through Spencer Gulf in a snaking pattern that results in deeper water in areas along the west coast. This mapping indicates that sites in the vicinity of Crag Point, Point Lowly, Cowleds Landing, Cape Driver and Cape Hardy on the west coast of the Gulf would be appropriate to consider further, as they are all in close proximity to water depths of 20m. The mapping indicates there are less site opportunities on the east coast of the Gulf in close proximity to the preferred water depth, with Myponie Point being one of the few locations where water depths of 20m are nearest the shoreline.

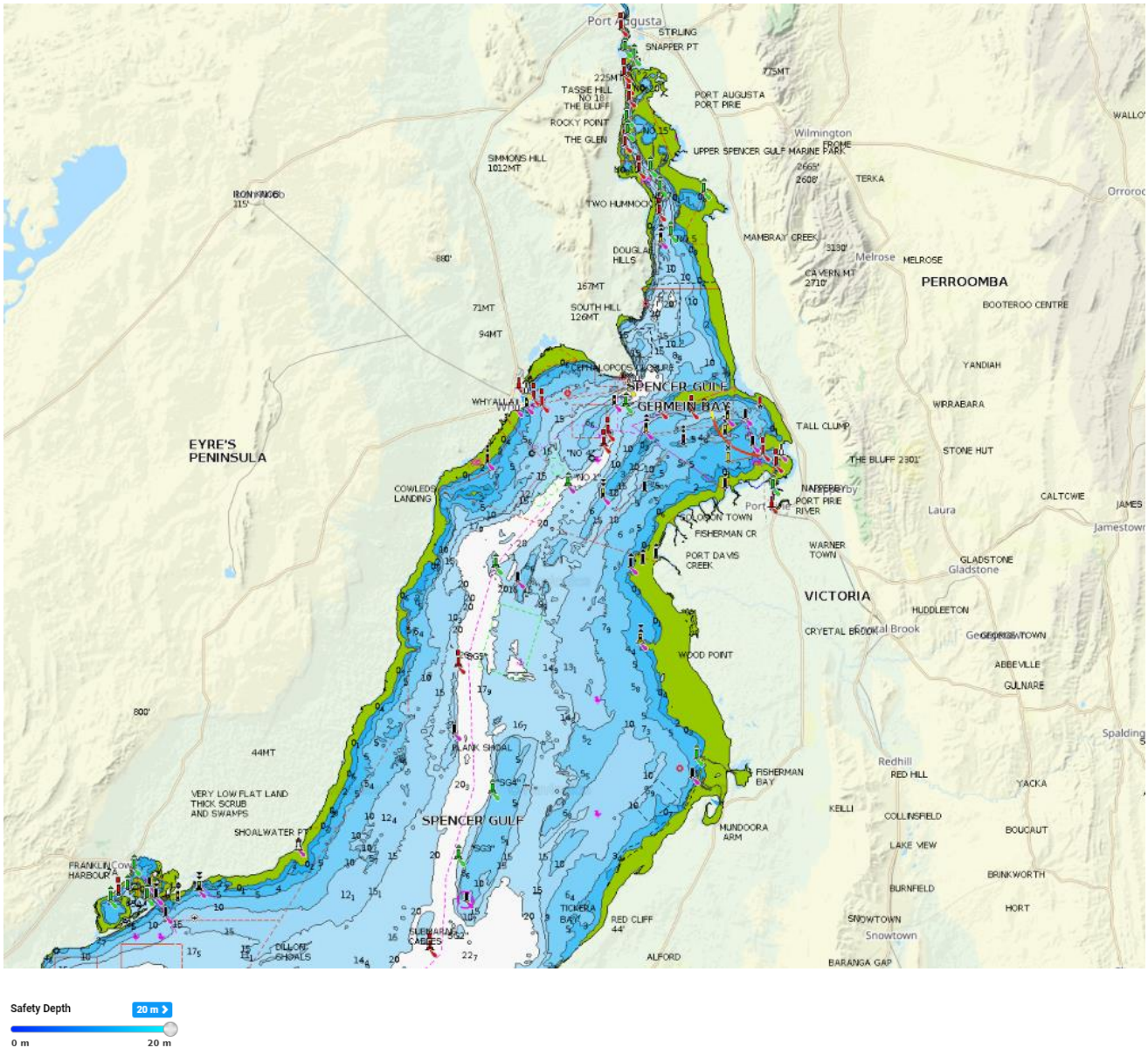


Figure 2 Upper Spencer Gulf digital elevation model

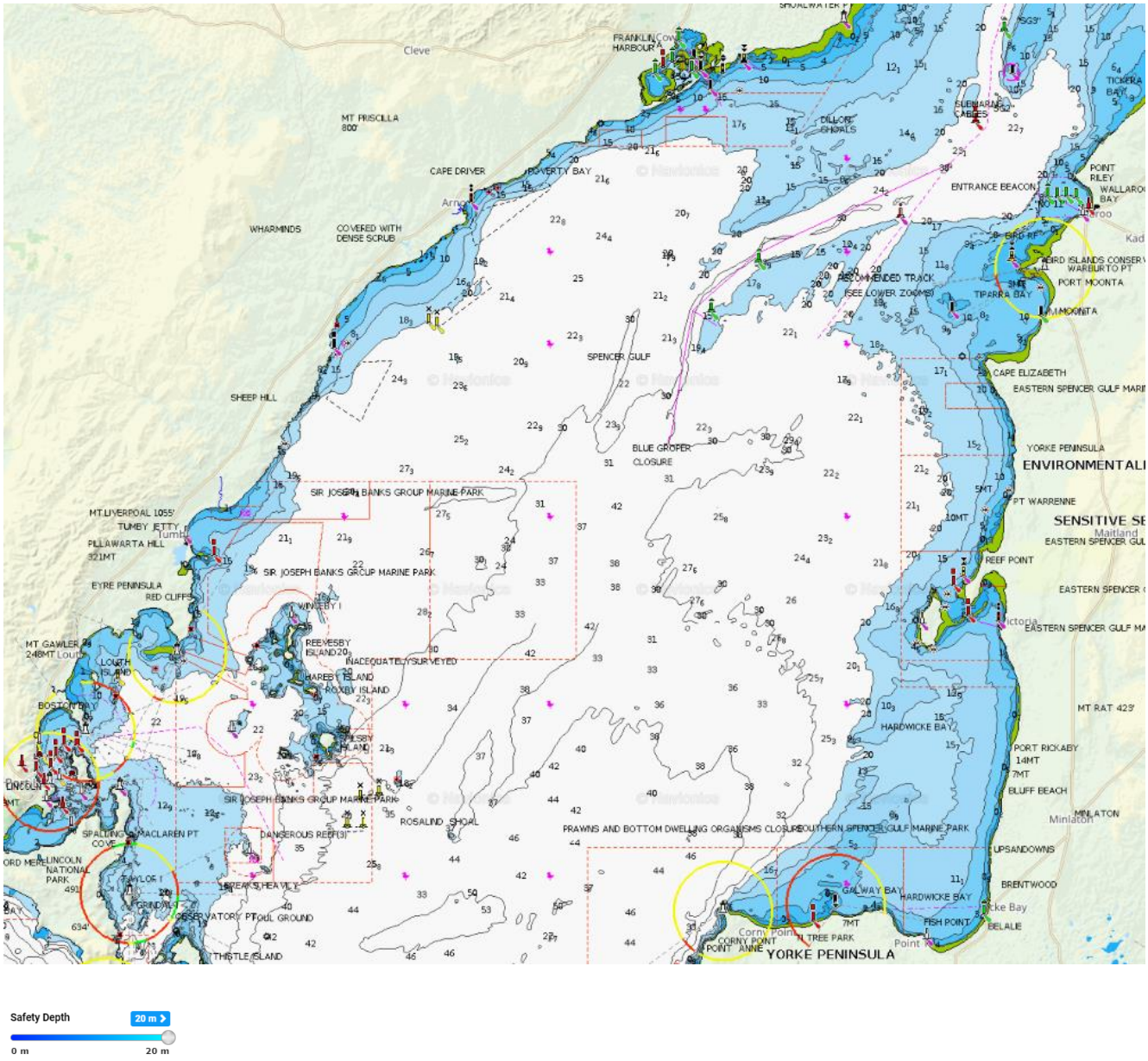


Figure 3 Lower Spencer Gulf digital elevation model

2.3 Proximity to water demand

Proximity to treated water storage and the ease of construction of a water supply pipeline is an important consideration. A significant treated water connection must be provided and on this basis sites near large demands are typically preferred.

For this project the key points for water delivery are Lincoln Gap Reservoir, Olympic Dam and OZ Minerals at Carrapateena. The existing trunk water distribution system is shown in **Figure 4** for context. On the basis that the major water demand centres are well north of Port Augusta, sites around Port Augusta would be favoured as it is closer to the demand than sites around the Gulf, or on the open ocean coastline.



Figure 4 SA Water Existing System Schematic

2.4 Proximity to power infrastructure

A significant power supply must be provided for the plant. On this basis sites near major power infrastructure assets are preferred. However, this preference must be weighed up against other factors as the cost is typically less than other project components. Exceptions exist for sites located at a large distance from a power supply of sufficient capacity, where the transmission line cost per km and mobilisation costs have a greater influence on the overall project cost. Older or low rated transmission assets also need to be considered. An example of this is along the west coast of South Australia.

The power supply required for a 150 ML/d plant is estimated to have a maximum demand of 44 MVA. The required electrical current favours transmission level 132 kV or 275 kV assets that are owned and operated by ElectraNet, however this should not completely rule out the opportunity for SA Power Networks to potentially supply at a distribution voltage of 66 kV. The concern for a supply at 66 kV is the energy losses due to the higher current required at that voltage level, larger line current capacity, and line support structures are still required to be of sufficient height for road crossings. Schedule 5.8(h) in the National Electricity Rules (NER) requires distribution network service provider (DNSP) and transmission network service provider (TNSP) to perform joint planning including for large load connections such as this.

Information is publicly available on the Australian Energy Market Operator (AEMO) website for electricity network constraints, forecasts and planned works. For example, there is an existing ElectraNet project called 'Eyre Peninsula Link' to install a new double circuit 132 kV overhead line from Cultana to Port Lincoln, and if required for new higher loads it could be converted to 275 kV.

The following are key considerations for the power supply connection:

- Large scale desalination plants require significant energy, and greenhouse gas emissions from traditional power generation methods are one of the key environmental issues associated with such projects. It can be anticipated a large-scale plant will need to be powered from carbon neutral sources.
- Early negotiations are required to ensure that sufficient time is given for the connection application process, inclusion into the electricity network provider's capital works program, arranging easements for new power lines, planning, construction, commissioning, and final connection to the network.
- Initially information is readily obtainable from the web sites of AEMO, ElectraNet and SA Power Networks, followed by consultation with AEMO in regard to the project intent. Network constraints and existing network upgrades need to be considered. Discussion needs to occur before any formal application.
- Contact the transmission network service provider (TNSP) with intentions to connect. Connection enquiry forms are available on the ElectraNet website and must be submitted in accordance with clause 5.3.2 of the NER (National Electricity Rules). A response is given within an agreed timeframe of usually less than four weeks.
- Based on the TNSP response an application to connect is submitted in addition to a preliminary works agreement which is required for the TNSP to commit time and resources to processing this application. This stage requires network assessment including system modelling of the connection impact on the network.
- The TNSP then provides a final offer to connect.
- Allow approximately 18 months depending on the advice provided in the initial stages of enquiry. The TNSP will need to plan for capital budget and resources for the following financial year. Consideration needs to be given to any requirement for 'up-rating' of existing lines in order to supply the required load from the connection point substation.
- Construction may be completed within a 12 month period. This will include the upgrade of the existing connection point substation performed by the TNSP, the transmission line construction to the site location, and the construction of the site substation.

From these considerations, and also noting the fact the 'Eyre Peninsula Link' project is currently underway, the following points are noted with respect to power supply to a desalination plant

- Sites located along the 'Eyre Peninsula Link' corridor (west Gulf coast) would potentially benefit from easier access to existing grid infrastructure of a suitable scale.
- Sufficient time needs to be allowed for in the project development and procurement program to achieve a suitably scaled power supply from the grid.

2.5 Land features

The following are key features of a site that make the land suitable to support a desalination plant:

- Sufficient area for the infrastructure and construction lay down. Additional area can have benefits such as the management of visual impacts, noise, and light.
- Sites of least environmental, heritage and social values are preferred.
- Sites that are not subject to inundation, have soils suited for simple foundations and excavations and have flat grades for infrastructure siting are preferred.
- Appropriate existing land use zoning, such as industrial or strategic employment. Land currently zoned 'Conservation' or 'Rural' would have higher community value and is therefore less desirable.

Identification of the current land zoning and current listed environmental constraints at each of the proposed sites has been undertaken from public registers. This information is graphically presented in the following figures contained within the appendices to this study:

Appendix A : Land Zoning Maps
Appendix B : Environmental Constraint Maps

2.6 Community concerns

Whilst not solely a site selection issue, community concerns will be a feature of developing a seawater desalination project. Experience on desalination and other major water projects elsewhere suggests the following issues are likely to be of concern to the community:

- While not an issue specific to any particular site, energy use is typically an area of concern.
- Impacts on marine environments and the local fishing industry from concentrate discharge, intake, and general presence of infrastructure.
- Visual impacts near the coast. As populations increase near the coast, the concern to maintain a sense of the visual landscape is increasing.
- Noise, odour, dust, light, vibrations. Local communities have an understandable concern about these impacts, but in practice they are not major issues for desalination plants.
- Traffic, employment, economic and other impacts from construction.

It is premature at this point to engage in any consultation to assess what community concerns may arise. This assessment has given preliminary consideration to the issues above based on previous project experiences. However it is noted that there may be other issues that are important to local communities beyond those noted here, which may come to light during a consultation process.

2.7 Terrestrial and Marine Environmental Impact

Any construction project, irrespective of the location, size, or nature of the development, will have environmental consequences. This is particularly true when working on the coast or at sea given the often sensitive nature of the environment and the importance of this area for human activities. However, good management and construction processes can avoid or minimise impacts.

The following issues are likely to be of concern:

- Approval pathway
- Level/amount of clearing of native vegetation required
- Extent of endangered or listed sensitive flora and fauna impacted

- Potential for impacts on Aboriginal values
- Potential for European Heritage impacts
- Impact on marine environment from intake
- Impact on marine environment from discharge

This assessment has not included any site inspection or field work to gather site specific data. The level of assessment conducted has relied upon readily available data sources. The extent to which these issues are assessed is therefore limited by this. Further work including field work will provide opportunity to gather more information and increase the level of understanding of each potential site.

3. Ocean Environments

A fundamental requirement for a seawater desalination project is access to the ocean for the intake of seawater and disposal of concentrate. The regions under consideration involve taking water from - and returning concentrate to - three major water bodies, namely the Spencer Gulf, Upper Spencer Gulf and Great Australian Bight. The discussion in this section distils key features of these water bodies that impact on the feasibility of a desalination plant site.

In general, water quality for intakes and management of environmental issues is usually more easily achieved in the open ocean versus bays. As summarised in the previous sections, drawing from seawater in open ocean water generally results in better quality raw seawater. Bays are also more 'unique' compared to open ocean and therefore tend to have more unique and potentially sensitive ecology.

For this project sites located in Great Australian Bight are representative of open ocean, while sites in Spencer Gulf are representative of bays.

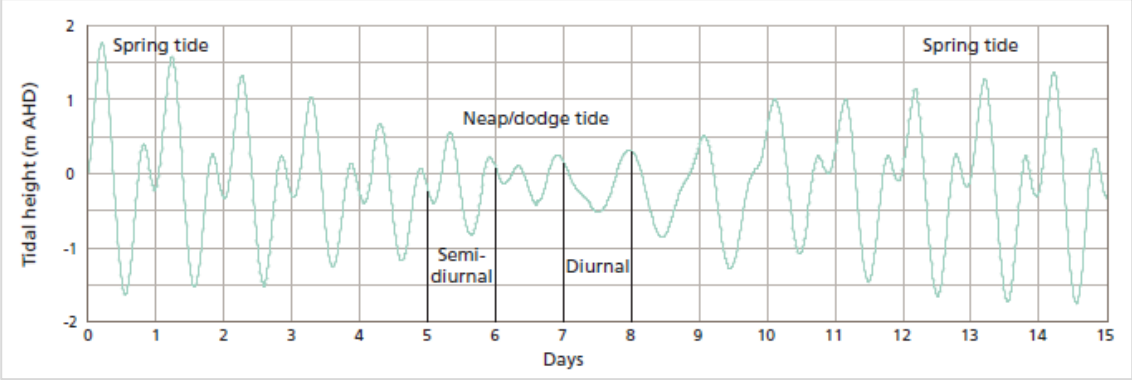
3.1 Spencer Gulf tidal patterns

Upper Spencer Gulf is the only location in southern Australia where the shape and depth profiles of the gulf result in significantly greater than expected tides, with ranges of more than 4 m occurring at Port Augusta and 3 m at Point Lowly (compared with less than 2 m at the mouth of the gulf at Port Lincoln) (Noye, 1984).

The tidal patterns in Upper Spencer Gulf are uncommon; Spencer Gulf and Gulf St Vincent are two of the few coastal areas in the world where there are regular periods of minimal tidal movement. Tides are governed by the interaction of four main constituents related to astronomical forcing, principally by the gravitational effects of the sun and the moon. Two of the main constituents are semi-diurnal (i.e. consecutive high tides are approximately 12 hours apart), and two are diurnal (i.e. consecutive high tides are approximately 24 hours apart).

In South Australia, and a few other coastal locations in the world, the similar strength but slightly different period of the semi-diurnal constituents produces an approximately fortnightly cycle in which the semi-diurnal contributions add constructively during spring tides, then almost completely cancel one another out during neap tides (known locally as 'dodge' tides), leaving (primarily) the diurnal contributions, producing only one tide per day. This is highlighted in **Figure 5**, where the dodge tides result in minimal tidal height variation, while spring tides result in large tidal height variations.

Extreme dodge tides occur every 6 months when both the semi-diurnal and diurnal constituents cancel one another simultaneously. In Upper Spencer Gulf, this phenomenon occurs in late May and November, and results in tidal ranges of less than 0.5 m. The combination of small tidal ranges and longer duration of the diurnal tide during dodge tides results in limited water movement for a period of up to two days.

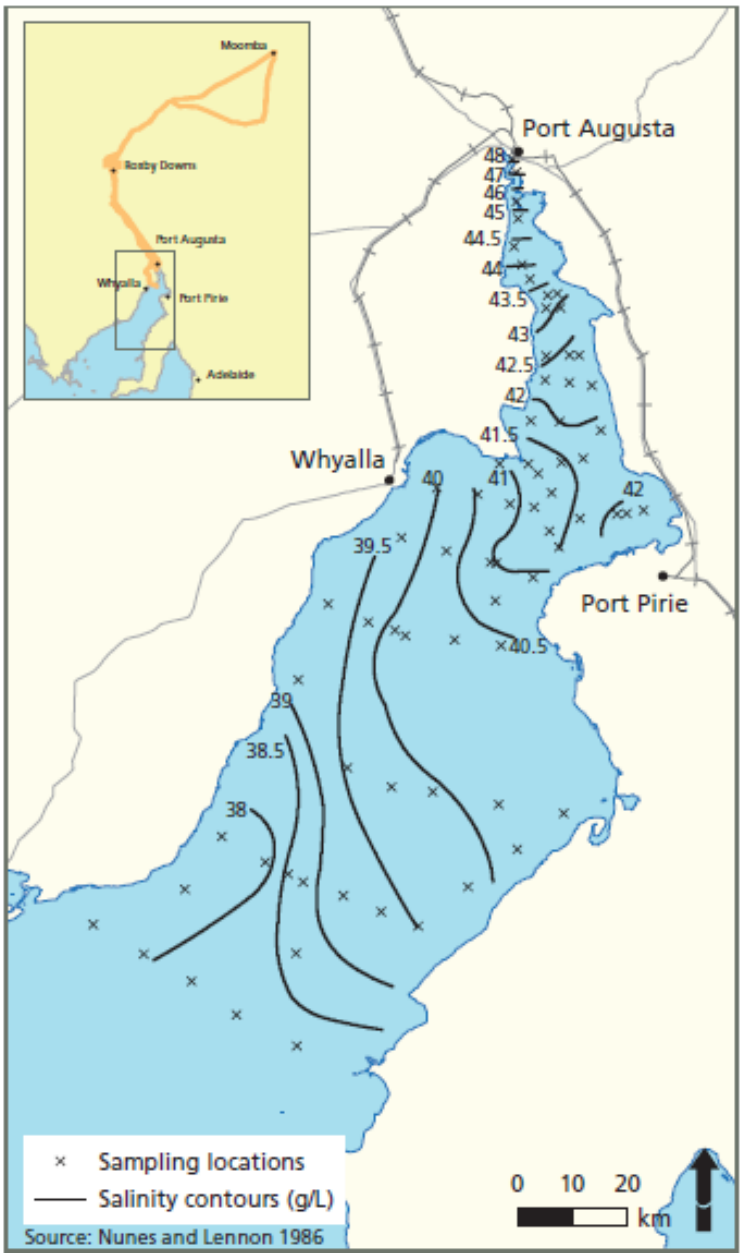


Source: Olympic Dam Expansion Draft Environmental Impacts Statement, BHP Billiton, 2009

Figure 5 Dodge and spring tides in Upper Spencer Gulf

Circulation of water within the Upper Spencer Gulf (particularly north of Point Lowly) is understood to be limited. The principal mechanisms for water exchange within the gulf are a combination of tidal, wind driven and thermohaline (density driven) currents (Harbison and Wilshire 1993). It is estimated that 78% of the water north of point Lowly is exchanged with water south of that point each year.

There is a distinct north-south salinity and temperature gradient in Spencer Gulf, shown in **Figure 6** with salinities at Port Augusta exceeding 48 g/L in summer. Higher levels are reached on shallow tidal flats. This gradient, in combination with the Earth's rotation and Coriolis effect, produced unique circulation patterns in the gulf. A large gulf-scale gyre is formed, whereby hypersaline water exits on the gulf along the eastern shore and fresher ocean water enters on the western shore (Nunes and Lennon 1986). Combined with tidal currents, this creates a local clockwise eddy (circular movement of seawater) to the south of Point Lowly and other unusual circulation patterns near banks and shoals (SEA 1981). This effect is considered to favour plant sites located on the western shore of the Gulf as the fresher, lower salinity seawater circulating northward along that coastline is anticipated to be of better quality.



Source: Olympic Dam Expansion Draft Environmental Impacts Statement, BHP Billiton, 2009

Figure 6 Example of salinity gradients within Spencer Gulf (early autumn)

The unusual combination of relatively warm water, high salinity, and sheltered conditions in the Northern reaches of Upper Spencer Gulf has led to the presence of communities with tropical and subtropical affinities. The hypersaline conditions (i.e. with a level of salinity much higher than that of seawater) within the area are further elevated by the input of brine from saltpans in the Pirie-Torrens basin. These factors result in the gulf behaving as an inverse estuary, where the more landward sections of the estuary are more saline.

3.2 Upper Spencer Gulf Marine Park

Upper Spencer Gulf supports a highly productive marine ecosystem, that is defined by several major habitats, including tidal flats and mangrove woodlands, extensive seagrass meadows in the shallow subtidal zone, intermittent rocky reefs on the west coast and deep channels further offshore. These habitats support an abundance of marine organisms, some of which are commercially or recreationally important.

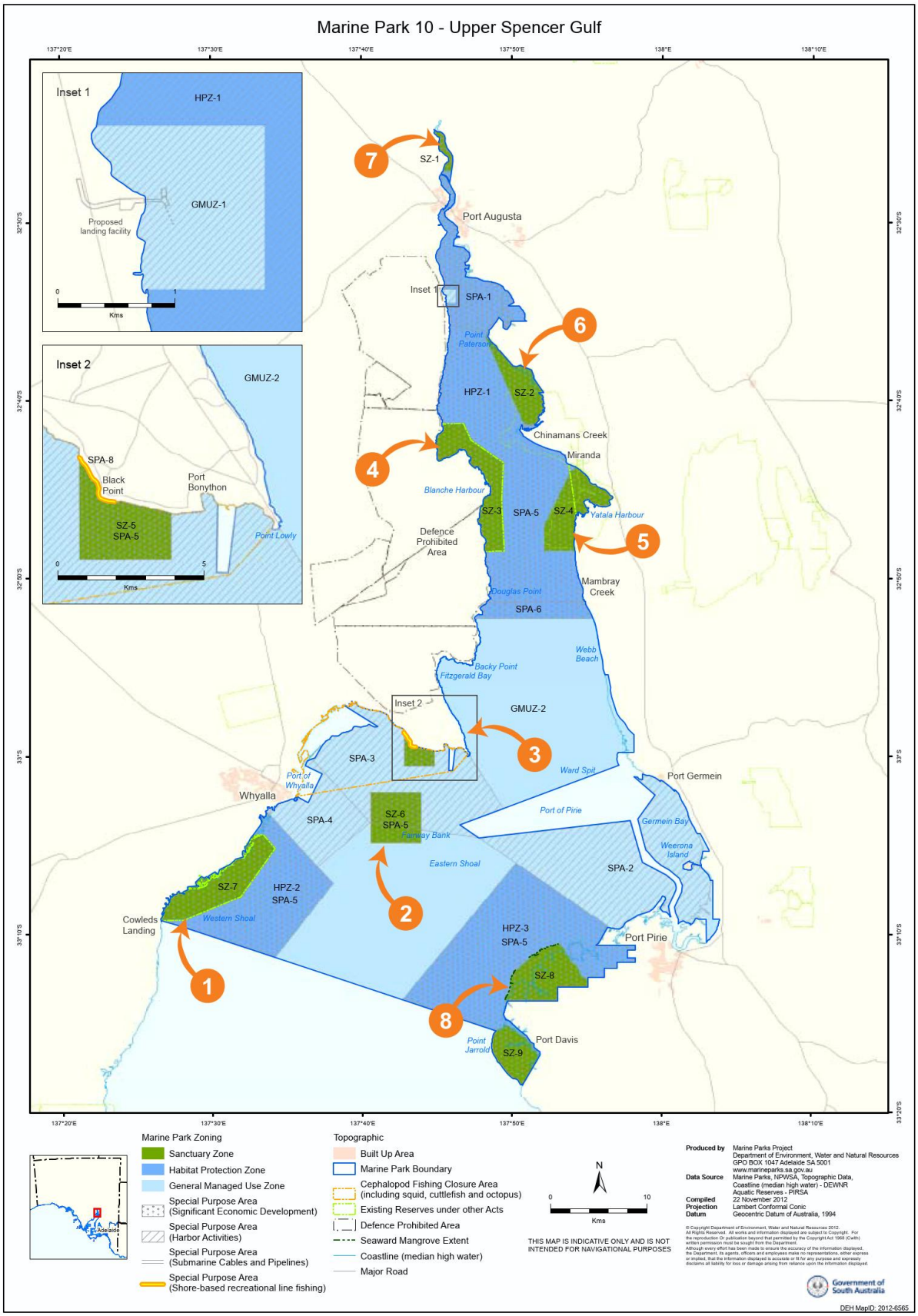
The Upper Spencer Gulf Marine Park spans the waters of the upper reaches of the gulf north of the southern end of Cowleds Landing and Jarrold Point, as shown in **Figure 7**. The Marine Parks Act 2007 provides the legislative basis for marine parks. The indentured areas of Whyalla and Port Bonython, and the port of Port Pirie are excluded from the marine park.

Marine parks in South Australia have been zoned for multiple uses, providing for varying levels of conservation, recreational and commercial use. The types of zoning and uses include:

- General Managed Use Zones (GMUZ) enable areas to be managed to provide protection for habitats and biodiversity, while allowing ecologically sustainable development and use.
- Habitat Protection Zones (HPZ) enable areas to be managed to provide protection for habitats and biodiversity, while allowing for activities and uses that do not harm habitats or the functioning of ecosystems.
- Sanctuary Zones (SZ) enable areas to be managed to provide protection and conservation for habitats and biodiversity, especially by prohibiting the removal or harm of plants, animals or marine products.
- Restricted Access Zones (RAZ) enable areas to be managed by limiting access to them.
- Special Purposes Area designates an area in which specified activities, that would otherwise be prohibited or restricted as a consequence of the zoning of the area, will be permitted under the terms of the management plan. For example, harbour activities as defined by activities undertaken by or on behalf of the Minister responsible for the administration of the Harbours and Navigation Act 1993, or a port operator, for the purposes of maintaining or improving a harbour or port are permitted.

Discharge, extraction and disposal of waters for a desalination plant are only permitted within GMUZ and HPZ. Therefore, providing plant intakes and outfalls are located in GMUZ or HPZ areas of Upper Spencer Gulf, this would not preclude a location from being feasible to site a desalination plant. However, it is expected that significant community and stakeholder engagement would be required to progress a project in such instances.

In summary, siting a desalination plant in the gulf will have a number of significant challenges due to its oceanographic features and range of sensitive ecology. even in relation to potentially high inlet salinities, which go to making the approvals process more complex than for a site on the open ocean. However it is noted that the Gulf is a highly commercialised region, with the SANTOS export facility at Port Bonython, Whyalla and Port Augusta all being major shipping hubs, together with a large scale commercial fishing industry operating I the Gulf. In comparison, the Adelaide Desalination Plant is located within the St Vincent Gulf, which has several similar oceanographic and environmental features in common with Spencer Gulf. That plant has received environmental approval and its impacts are understood and managed.



Source: Upper Spencer Gulf Marine Park Management Plan Summary, Department of Environment, Water and Natural Resources, SA Government, 2012.

Figure 7 Upper Spencer Gulf Marine Park

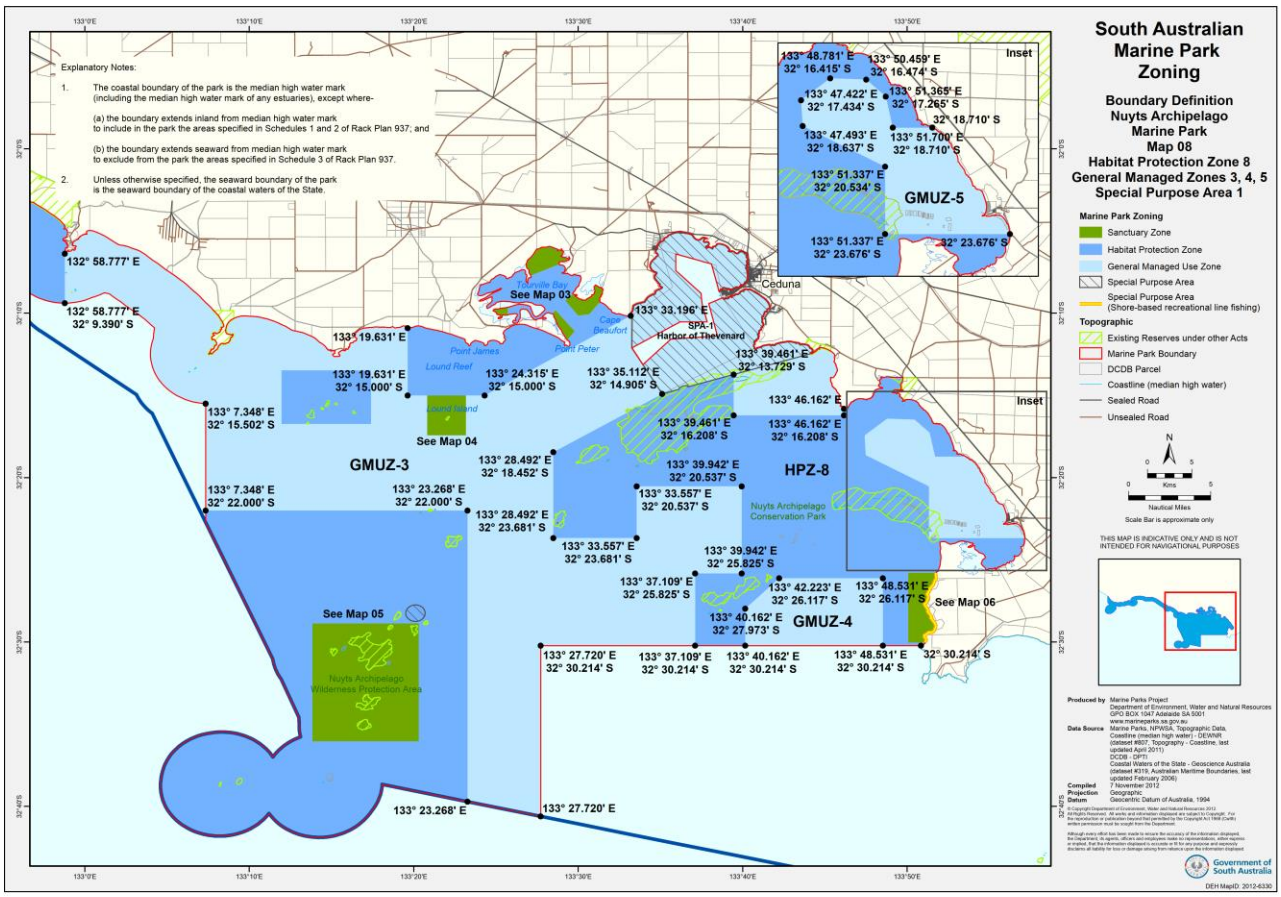
3.3 Great Australian Bight and Nuyts Archipelago Marine Park

The Nuyts Archipelago Marine Park spans waters from Nuyts Reef to Point Brown. It includes the Nuyts Reef complex, Fowlers Bay, islands of the Nuyts Archipelago and adjacent coastal bays. The marine park overlays all or part of a number of other protected areas including the Nuyts Archipelago Wilderness Protection Area, Fowlers Bay Conservation Park, Isles of St Francis Conservation Park, Sinclair Island Conservation Park, Nuyts Archipelago Conservation Park, Nuyts Reef Conservation Park, Wittelbee Conservation Park, Laura Bay Conservation Park, Chadinga Conservation Park and Point Bell Conservation Park (DENR 2010).

High wave energy is responsible for shaping the region's exposed cliffs and rocky reef platforms, while in other areas low wave energy has resulted in extensive seagrass meadows and mangrove forests.

The most eastern section surrounding Ceduna is shown in **Figure 8**. The port of Thevenard is excluded from the marine park.

As for Upper Spencer Gulf Marine Park, discharge, extraction, and disposal for a desalination plant are only permitted within GMUZ and HPZ.



Source: Nuyts Archipelago Marine Park Management Plan, Department of Environment, Water and Natural Resources, SA Government, 2012.

Figure 8 Nuyts Archipelago Marine Park

4. Potential Site Alternatives Review

4.1 Overview

The following section provides a description of the assessment undertaken on the key considerations at each of the potential sites.

The sites assessed in this report have been identified by inspection of desktop data, consideration of the key site selection criteria, and consultation with ISA. A number of sites have been selected because they were assessed previously by BHP in their 2009 EIS for Olympic Dam. These sites have been incorporated and re-reviewed in this study to check whether any newly available information would alter the outcomes indicated in the BHP EIS. This desktop review has drawn on the information presented in the EIS. A full satellite data based investigation is a possible approach for a next stage of investigation if further assessment is required to ensure no advantageous sites have been omitted.

Given BHP received environmental approval for development of a large scale (280ML/d) desalination plant on the Port Bonython site in their 2009 EIS, it has been used as a baseline option for comparison with other options in certain instances.

The review of each region includes high level commentary on:

- Land Features: Does there appear to be developable land for a project? What are the key constraints on land?
- Marine Features: How far offshore would intakes and outlets need to extend to reach a suitable water depth? Are there expected water quality issues? What are the key constraints in the water body?
- Water Delivery: Where would the treated water likely connect into the network? Does it seem possible to identify a feasible alignment?
- Power Supply: Where in the grid would power be sourced from? Does it seem possible to identify a feasible alignment?
- Environmental Impact: How does the desalination plant affect the environment? Which site presents the lowest impact to the terrestrial and marine environment?

Each of the above categories are provided with qualitative assessments of:

- Feasibility uncertainty
- Capital cost relative to the proposed Port Bonython site

The specific issues in each region are discussed in each section.

For the purposes of this assessment, a plant capacity of 150 ML/d has been assumed to provide for some consistency in option configuration across each of the site locations.

Feasibility uncertainty

This qualitative assessment attempts to assign a risk against the potential for any of the identified features or issues to result in the region being unsuitable for a seawater desalination project.

- **Low Risk:** Based on the high-level desktop assessment either no material risks have been identified or there appear to be plausible mitigations for the risks that have been identified.
- **Medium Risk:** Based on the high-level desktop assessment some material risks have been identified. It is uncertain if mitigations to these risks are available or if they will be effective.

- **High Risk:** Based on the high-level desktop assessment some material risks have been identified. It seems unlikely that mitigations will be available or effective.

Note that it is likely that further detailed work will identify additional risks or alter the understanding of risks in each location that could alter this assessment.

Capital cost relative to Port Bonython

A comparative assessment of the anticipated capital cost for development of a desalination plant and the associated infrastructure at each site option has been undertaken.

This assessment considers cost against each of the key siting considerations (site features, marine morphology, delivery system configuration and power supply), based on a qualitative view of the scale of infrastructure required. These are compared in relative terms to the expected capital costs of a baseline option for a plant located at Port Bonython. This assessment aims to highlight key points of difference between each site option and Port Bonython. This relative cost assessment categorises the magnitude of likely cost as either lower, equivalent, higher, or significantly higher than that anticipated for a plant located at Port Bonython. This is intended as a screening level assessment to provide an initial understanding of how an option may compare with the Port Bonython option.

An assessment of the order of magnitude cost differential has then also been undertaken for the option configuration (intakes, outlets, power supply delivery system) for each potential site. This cost differential assessment considers the areas of difference in the infrastructure required when each option configuration is compared with the configuration required for a plant at Port Bonython.

Potential Site Locations Considered

Based on assessment of the key site selection considerations and a review of the land and marine environment data presented, the following site options were identified for discussion and comparison with Port Bonython.

- Whyalla
- Port Bonython
- Crag Point – north of Point Lowly
- Port Augusta (ex Northern Power Station site)
- Cowleds Landing – vicinity (south of Whyalla)
- Myponie Point (south of Port Pirie)
- Weeroona (ex. SAMAG site north of Port Pirie)
- Ceduna Region (Point Brown)
- Elliston
- Cape Hardy ('Iron Road' project port site)

The relative locations of the alternative site locations considered are illustrated in **Figure 9**.

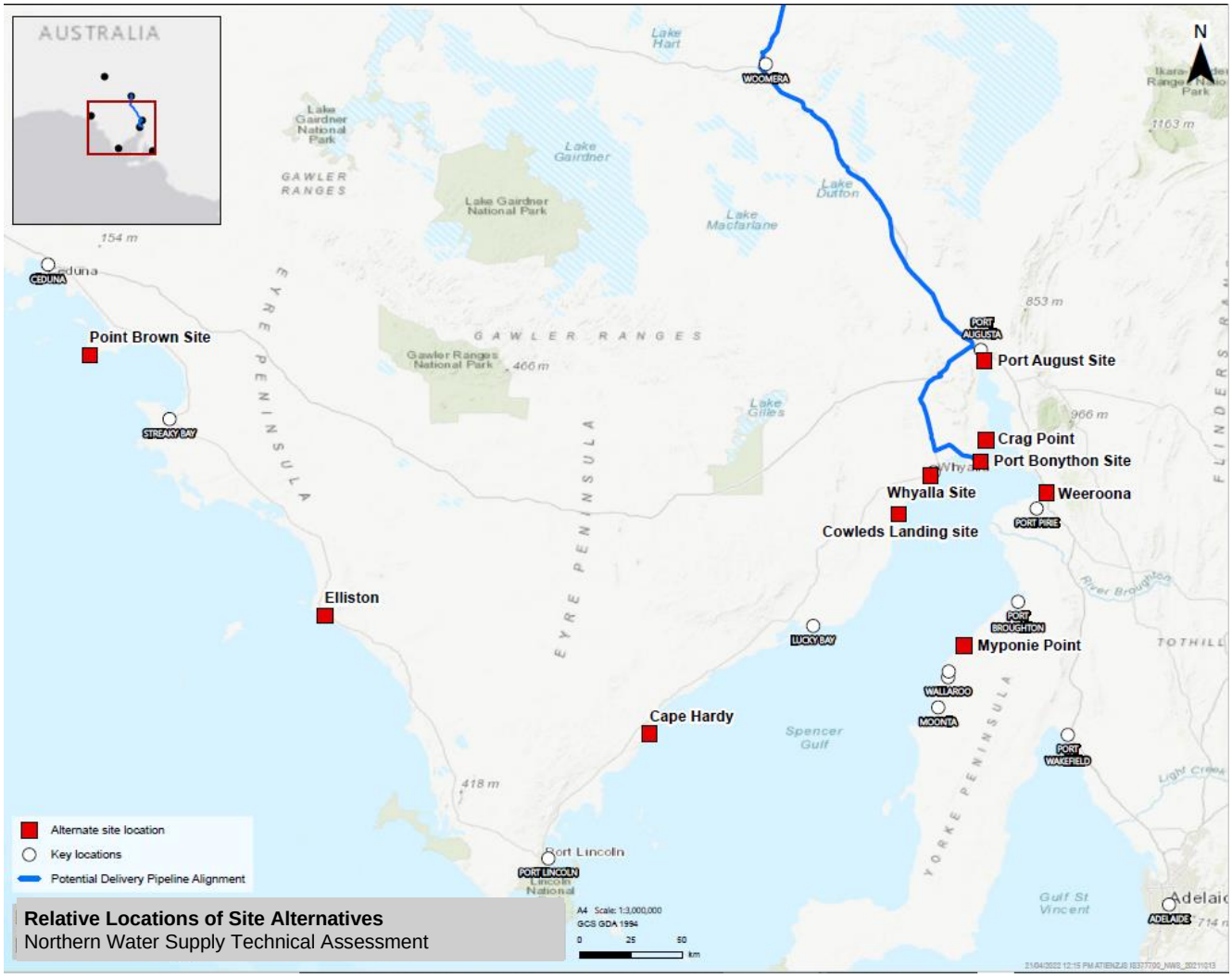


Figure 9 Relative Locations of Potential Site Alternatives

Identification of the current land zoning and current listed environmental constraints at each of the proposed sites has been undertaken from public registers. This information is graphically presented in the following figures contained within the appendices to this study:

Appendix A : Land Zoning Maps
Appendix B : Environmental Constraint Maps

Each of the ten sites is discussed in Sections 4.2 to 4.11, with the comparative anticipated capital costs presented in Section 4.12

4.2 Whyalla

Land features and geology

This area is focused on a site located at Whyalla. The township of Whyalla has a population of approximately 22,000, according to the 2016 census.

Whyalla's major industries include steel, crude oil and LPG, industrial fabrication; national contractors to heavy engineering industries; commercial salt production and tourism. Whyalla is serviced by major roads, an airport, port and railway line.

There are potential sites available to the north of Whyalla in an industrial precinct that is zoned as infrastructure, as shown in Land Zoning Maps. This location is bound to the south by residential housing in the township of Whyalla and to the north by the Whyalla salt pans.

The 1:250,000 scale published geological map for the area suggests that the surface and near-surface strata comprise Holocene age fluviatile sands and gravels associated with modern drainage channels. At depth, Proterozoic age bedrock in the form of the Pandurra Formation (medium grained and gritty red sandstone) underlies the area. However, the bedrock is only shown as outcropping at the ground surface several kilometres further inland (to the west) of the Lincoln Highway. Borehole log information available from the WaterConnect online GIS indicates that near and seaward of the Lincoln Highway, rock is unlikely to be present within at least 20 m depth below the ground surface, and that below the surficial soils the sub-surface strata typically comprise gravelly and sandy clays.

The surficial ground conditions should allow conventional footings to be adopted for desalination plant buildings. Excavations of circa 15 m depth for tunnel launch chambers are unlikely to encounter rock strength materials. It also appears that the vertical alignments of marine intake and outfall pipelines may be mostly, if not wholly, within the depths of soil strength materials. Therefore, predominantly "soft ground" (i.e. soil strength) tunnelling conditions in mainly clayey soils would be anticipated for tunnel boring machines that form the tunnels for the intake and outfall pipelines.

Marine features

For a plant site located in Whyalla, the seawater intake and concentrate outlet would be located in Upper Spencer Gulf.

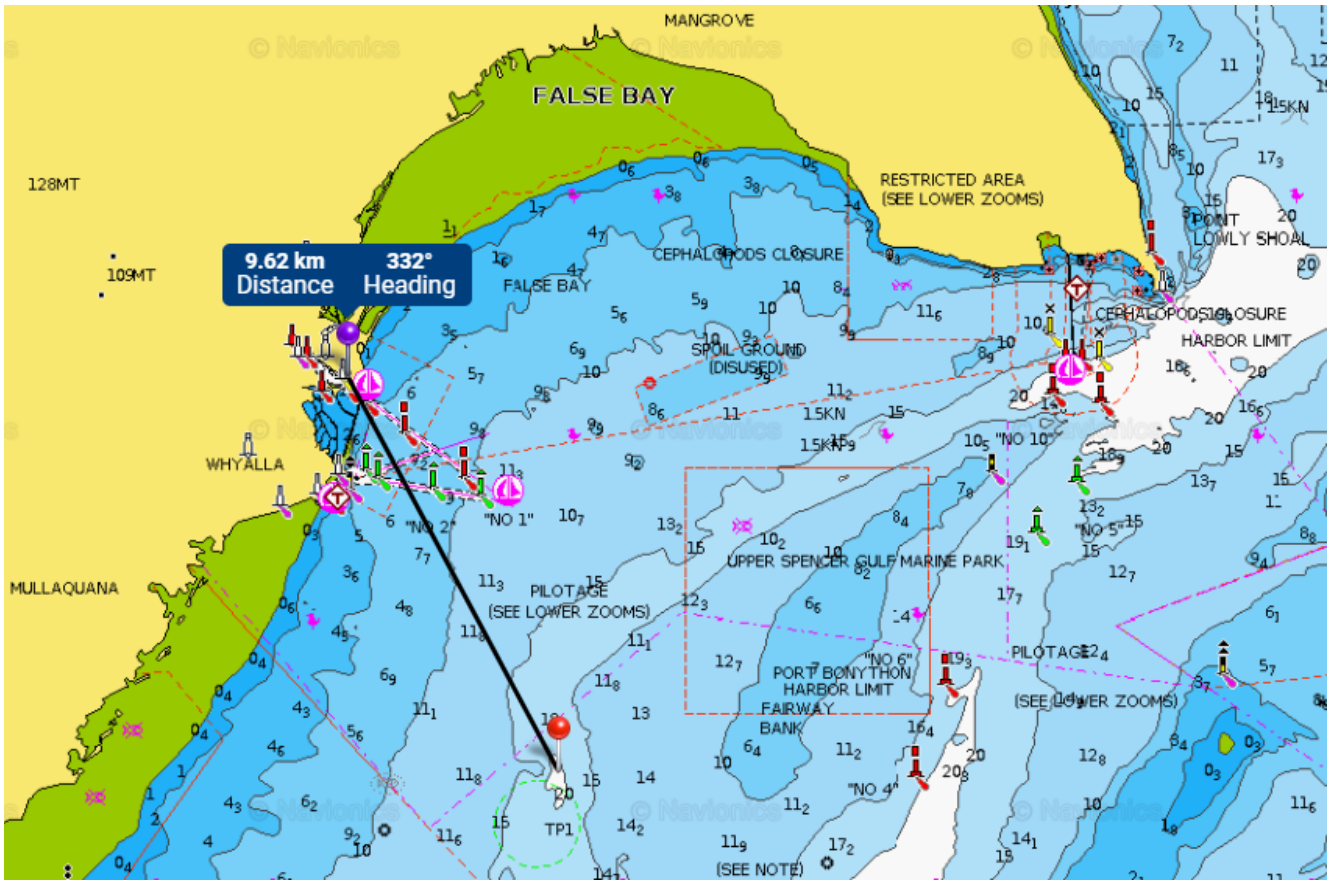
There is a known local clockwise eddy in the embayment off-shore of Whyalla. This has implications for the location of the outfall compared to the inlet, and careful consideration would be required to avoid short-circuiting.

Modelling undertaken as part of the BHP EIS (2009) showed that brine discharge at two specific locations within the gulf off the coast of Whyalla, would not achieve the required dilution requirements within a suitable distance (1:85 dilution contour exceeded 6 km).

As Spencer Gulf becomes progressively narrower, the depth becomes shallower, and the water becomes more saline. This is highlighted in **Figure 6** where the salinity in Whyalla is expected to be 1-2 g/L lower than Port Bonython.

The intake and outfall would need to be located in the GPUZ or HPZ areas of the marine park and is constrained by SZ6 and SZ7 as detailed in **Figure 7**. SZ6 is recognised as an offshore seagrass habitat, which important for many fish species, including pipefish and sea horse, while SZ7 consists of mangrove and tidal creeks that provide habitat for internationally important shorebirds and is the feeding ground for blue crabs.

Figure 10 indicates an approximate alignment of the intake tunnel required to reach the preferred depth of 20 m of water offshore. Bathymetry indicates the intake and outlet tunnels would be in the order of 9-10 km long from the shore, which is significantly greater than the 1 -2 km length required at Port Bonython.



Source: chartviewer, www.navionics.com

Figure 10 Whyalla Harbour Bathymetry

Water delivery

The water delivery infrastructure required for a plant sited in Whyalla is relatively similar to that required for the Port Bonython site. The delivery pipeline would head north from Whyalla to Lincoln Gap, via the Lincoln Highway picking up the route proposed from Port Bonython.

Power supply

Provision of a power supply to a plant site around Whyalla is feasible as supplies at 132 kV or 33 kV are available within close proximity to the city. Multiple 132 kV transmission lines exist from the Cultana transmission substation to the Whyalla Central substation, however the asset condition and line capacity ratings need to be considered for the level of load required. Within the boundary of the steelworks is a 132 kV supplied 33 kV substation Whyalla Terminal, with dedicated 33 kV supplies to the steelworks. It is highly likely that the Whyalla Central substation will require augmentation to supply the required load and connect a single double circuit 132 kV line. Depending on the actual proposed location of the site, solutions will be needed to determine a 132 kV transmission line route across the highway and around existing steelworks infrastructure.

Considering that Cultana substation is supplied at 275 kV from the Davenport substation near Port Augusta, connections further west from this location have an increased possibility of connection difficulties and higher costs to connect.

Summary

Whyalla

Region: This area is focused on a site located at Whyalla.

Description	Feasibility uncertainty	Capital cost relative to Port Bonython
Land Features		
Potential sites appear available through the acquisition of industrial land in the north of town (Whyalla steelworks site). Acquisition potentially complex as owner has ongoing operations at the site. Acquisition may impact existing economic activity and jobs in the region. Potential for contaminated sediments on the site and immediately offshore. (Potential to rerate to medium with further work)	High	Equivalent
Marine Features		
The site provides access to Upper Spencer Gulf. Reasonably high-quality water is expected with lower salinity than northern regions of Upper Spencer Gulf, however the brine dispersion may be problematic. Water depth of 20 m (as preferred for intake and outlet) can be reached around 9 km offshore. Specific constraints include fauna habitat (seagrass, internationally important shorebirds, feeding ground for blue crab) and marine national park. Achieving suitable mixing will be challenging.	Medium	Higher
Water Delivery		
Connection from the plant site to the demand centres is relatively similar to that required from Port Bonython, with the majority of the pipeline following the same route via Whyalla North and Lincoln Gap reservoirs.	Low	Equivalent
Power Supply		
Provision of a power supply to a site around Whyalla is feasible	Low	Equivalent

Key Risks	Opportunities
Distance to a water depth of 20 m Achieving suitable return water mixing	Close to power supply and water delivery points

4.3 Point Lowly/Port Bonython

Land features and geology

This area is focused on a site located at Port Bonython, which has a population of 14 people according to the 2016 census. It is also characterised by numerous recent larger residential home developments that make use of the coastline views, a commercial aquaculture business a commercial fishing port, and further from the site itself the Point Lowly light house. Land use zonings in the vicinity include infrastructure, rural land with a conservation zone along the coastline.

The immediate area around the site is occupied by large scale industrial facilities, including a bulk petroleum product storage facility and a gas import/export facility which has pipeline connections to oil and gas produced in the Cooper Basin. A large area inland from Port Bonython is zoned for Commonwealth facilities and is the location of the Cultana Training Area, a declared Defence Practice Area.

The potential for this site to situate a desalination plant was identified at Port Bonython as part of the BHP Billiton Olympic Dam Expansion EIS in 2009. The land of the site and also adjacent is vacant Crown Land. The SANTOS gas import/export facility is located to the south, and a diesel fuel storage facility to the west. Associated with the SANTOS gas facility opposite the site are certain exclusion distances. Siting of the plant would have to consider the risks associated the gas facility and the explosion hazard zone.

The topography of the proposed site is generally clear and gently sloping upward away from the roadway. The site is generally clear of vegetation.

The 1:250,000 scale published geological map for the area suggests that Proterozoic age bedrock in the form of the Tent Hill Formation (equivalent to ABC Range Quartzite) is present at or near the ground surface. Hence, in general, any overlying soil profile is likely to be not more than a couple of metres deep. However, north of Point Lowly the geological map shows a thin coastal strip where Quaternary Pooraka Formation soil (clays, clayey sands, sands and gravels) outcrops. The Pooraka Formation is typically underlain by Pleistocene Hindmarsh Clay (clay with sandy and gravelly interbeds).

The results of previous geotechnical investigations for the Port Bonython Jetty, and more recent investigations, are consistent with the published geological information. The Tent Hill Formation is described as blocky sandstone and quartzite of medium to high strength and is present close to the ground surface on-shore at Port Bonython, where it is overlain by a thin profile of residual or colluvial sands and clays. However, along the line of the Port Bonython Jetty, the top of the bedrock falls seaward at a relatively constant grade of about 1V:40H and is overlain by a profile of soil strata that progressively thickens with distance seaward. The soil strata comprise loose over dense sands and clayey sands, over very stiff to hard Hindmarsh Clay. A gravel/cobble zone was noted below the sandy strata, closer to shore.

The surficial ground conditions should allow conventional footings to be adopted for desalination plant buildings. Excavations of circa 15 m depth for tunnel launch chambers are likely to encounter rock strength materials for most of the excavation depth, which may require blasting to achieve satisfactory excavation productivity. Near and landward of the coastline, the vertical alignments of marine intake and outfall pipelines would be within the Tent Hill Formation. Therefore, for this part of a tunnel drive, “hard ground” (i.e. rock strength) tunnelling conditions would be anticipated for tunnel boring machines that form the tunnels for the intake and outfall pipelines. Seaward of the coastline, mixed face conditions would be expected, and then the gravel/cobble layer and Hindmarsh Clay, which represent “soft ground” (i.e. soil strength) tunnelling conditions. The likely variation in tunnelling conditions from “hard” to “soft” with increasing distance seaward, and the presence of mixed face conditions over a transition zone, will make the tunnelling more difficult compared to if consistent tunnelling conditions within a single geological unit were present along the full lengths of the tunnels.

Marine features

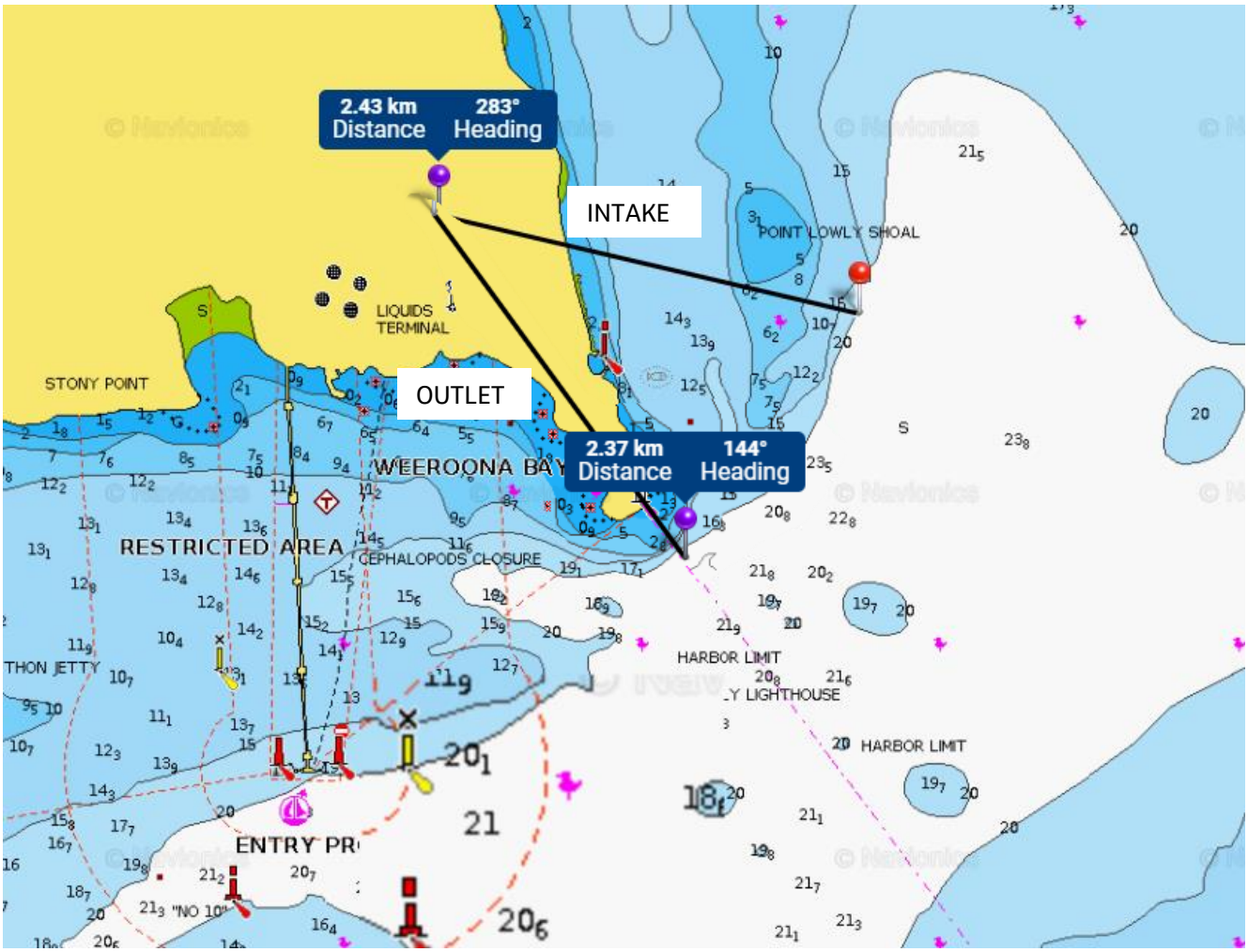


Figure 11 Port Bonython Bathymetry

For a plant site located in Port Bonython the seawater intake and concentrate outlet would be located in Upper Spencer Gulf. This location, in particular Port Bonython, was previously identified as the most suitable location to site a coastal desalination plant for the BHP Olympic Dam Expansion project.

A narrowing of the gulf between Point Lowly and Ward Spit results in very strong currents in the vicinity of Point Lowly. In the main channels off Point Lowly and near Fairway Bank, current velocities of 1 m/s are common (Baker 2004). Current velocities in the vicinity of Point Lowly can reach 2 m/s, and rarely fall below 0.05 m/s, except during dodge tides when limited water movement occurs. This suggests that good mixing would be obtained for the discharge of return water in this area. However, the Gulf also has a regime of fortnightly 'dodge' tides where there are periods of one to two days of very low tidal currents which would need specific consideration in design of the outlet diffusers.

Generally, the Gulf is characterised by sandbanks and seagrass and therefore water may contain significant sediment load even at depth. The strong currents off Point Lowly result in relatively high turbidity levels in some areas, particularly the deep channels. Background turbidity levels have been measured off Point Lowly in the range of 2-12 NTU during calm conditions, and up to 20 NTU during strong southerly winds when waves re-suspend sediment in the nearshore zone. This is a risk for intake water quality and would require a good understanding of seasonal seawater quality borne out by a long-term water quality monitoring program, and suitable pre-treatment. The risk otherwise is that conservative decisions on water quality will lead to significantly increased cost in construction of the plant.

The annual salinity range at Point Lowly is 40-43 g/L with the peak in late autumn. The salinity of oceanic seawater is about 35-36 g/L. The annual variability of salinity at Point Lowly is 3 g/L, which is significant when compared to open ocean waters. Daily and depth related variability can also exceed 1 g/L. Annual temperature ranges at Point Lowly are 11 ◦C to 24 ◦C.

A water depth of 20 m is available within 1 km of Point Lowly, as shown in **Figure 11**. Intake and outlet tunnel lengths would range from 1km if tunnelled from the foreshore, or up to 2.5 km if tunnelled all the way from the site. The intake and outfall would be located to the east of the exclusion zone but west of Lowly Point with the outfall either directly off Lowly Point or to the east at the southern extremity of Fitzgerald Bay.

The intake and outfall would need to be located in the GPUZ or HPZ areas of the marine park and is constrained by SZ5 as detailed in **Figure 7**. SZ5 is recognised internationally as an area of major significance for breeding of the Giant Australian cuttlefish.

Water delivery

The water delivery infrastructure required for a plant sited in Port Bonython would head along Port Bonython Rd, to the Lincoln Highway, to Lincoln Gap via Whyalla North Reservoir (SA Water integration), and then continue via the Lincoln Highway to Port Augusta, and then along the Stuart Highway to Woomera and Olympic Dam. The total length is approximately 345 km.

Power supply

Power to the site at Port Bonython would be provided from the Cultana transmission substation. For a large scale desalination plant (150 ML/d capacity) provision of new transformers at the substation and dual 132 kV feeders, approximately 25 km in length, along Port Bonython Rd to the plant site would be required. Given that Cultana is supplied via dual 275 kV lines via Port Augusta (Davenport Substation) line capacity and availability for substation expansion has high feasibility certainty, and there is an existing 132 kV transmission line corridor between Cultana and Port Bonython giving this proposal overall high feasibility certainty of power supply. Ease of future expansions for increased load is also favourable for this option.

Road access for heavy substation plant such as transformers is convenient using the Port Augusta to Whyalla highway and depending on the actual site location the land slope is to be considered for planning transportation and set down areas. Existing overhead 132 kV transmission line crossing the road to Point Lowly will need to be considered for any high loads.

Summary

Point Lowly / Port Bonython **Region:** This area is focused on a site located at Port Bonython.		
Description	**Feasibility uncertainty**	**Capital cost relative to Port Bonython**
Land Features		
Potential site available at Port Bonython as identified in 2009 BHP EIS. Surrounding land uses include other industrial activity.	Low	Equivalent

Marine Features		
The site provides access to Upper Spencer Gulf. Good dispersion of brine due to strong currents, however relatively high turbidity levels. Water depth of 20 m (as preferred for intake and outlet) can be reached around 1 km offshore. Specific constraints include fauna habitat (Giant Australian cuttlefish) and marine national park. Each of these constraints are expected to be manageable by the location of seawater intake and brine discharge.	Medium	Equivalent
Water Delivery		
Connection from the plant site to the demand centres follows existing roadways via the Lincoln Gap reservoir, and Port Augusta, for a total length of approximately 345km.	Low	Equivalent
Power Supply		
Upgrading of the Cultana STS and new feeders approximately 25km in length are required	Low	Equivalent

Key Risks	Opportunities
Proximity to cuttlefish breeding grounds	Clear available site in industrial zoning
Intake water quality	Close to power supply and water delivery points
Possible impact on nearby aquaculture industry	Shorter intake and outlet conduits
	Possibility of having intake and outlet on opposite sides of point preventing short circuiting
	Strong currents promote dispersion

4.4 Crag Point - north of Point Lowly

Land features and geology

Crag Point lies approximately 12 km north of Point Lowly and north-east of Fitzgerald Bay. The coastal fringe, as shown in Land Zoning Maps is zoned as conservation land and is mainly utilised by public for recreation. The site extent is constrained by the terrain which slopes steeply to the foreshore and is traversed by ravines, and bounded by Defence land immediately to the west. A four-wheel drive track provides access along the coastline for recreational users, and given the Conservation zoning of the land it is considered to have a higher community value.

Access to the plant site would need to be improved by development of an all-weather road coming off Port Bonython Rd, skirting the perimeter of the Defence Training area.

The 1:250,000 scale published geological map for the area suggests that Proterozoic age bedrock in the form of the Moonabie Formation is present at or near the ground surface and forms the coastal cliff line. This geological unit consists of indurated dark grey quartzite with scattered rhyolite pebbles, and is commonly a granular greywacke. Hence, in general, any overlying soil profile is likely to be not more than a couple of metres deep. The bedrock may be overlain by Quaternary Pooraka Formation soil (clays, clayey sands, sands and gravels), with a limited thickness of Pleistocene Hindmarsh Clay (clay with sandy and gravelly interbeds) possibly also present below the Pooraka Formation.

The surficial ground conditions should allow conventional footings to be adopted for desalination plant buildings. Excavations of circa 15 m depth for tunnel launch chambers are likely to encounter rock strength materials for most of the excavation depth, which may require blasting to achieve satisfactory excavation productivity. Near and landward of the coastline, the vertical alignments of marine intake and outfall pipelines would be within the Moonabie Formation. Therefore, for this part of a tunnel drive, “hard ground” (i.e. rock strength) tunnelling conditions would be anticipated for tunnel boring machines that form the tunnels for the intake and outfall pipelines. Seaward of the coastline, it is possible that mixed face conditions may be encountered, and then “soft ground” (i.e. soil strength) tunnelling conditions. However, this depends on the levels of the tunnels below the seabed and on whether the surface of the bedrock falls with increasing distance seaward, such that a profile of overlying soil strata progressively thickens with distance seaward. Any variation in tunnelling conditions from “hard” to “soft” with increasing distance seaward, and the presence of mixed face conditions over any transition zone, will make the tunnelling more difficult compared to if consistent tunnelling conditions within a single geological unit were present along the full lengths of the tunnels.

Marine features

For a site located in Crag point, the seawater intake and concentrate outlet would be located in Upper Spencer Gulf.

The Port Bonython and Crag Point site locations are close to each other; therefore, they are very similar in their site conditions in terms of salinity and access to high quality seawater. The current climate is anticipated to be similar but not as significant as at Port Bonython due to the open coastline morphology.

Figure 12 indicates an approximate alignment of the intake tunnel required to reach the preferred depth of 20 m offshore. Bathymetry indicates the intake and outlet tunnels would be of the order of 1.5 km long, similar in length required for the intake and outlet at Port Bonython.

Figure 12 also indicates the proximity of the intake and outlet locations to designated marine aquaculture farms to the north and east of the intake location. Aquaculture farming can result in significant increases in nutrient levels within the water which would compromise the water quality with respect to a desalination plant.

The intake and outfall would be located within the GMUZ-2 zone of the marine park, clear of designated habitat protection zones indicated in **Figure 7.**

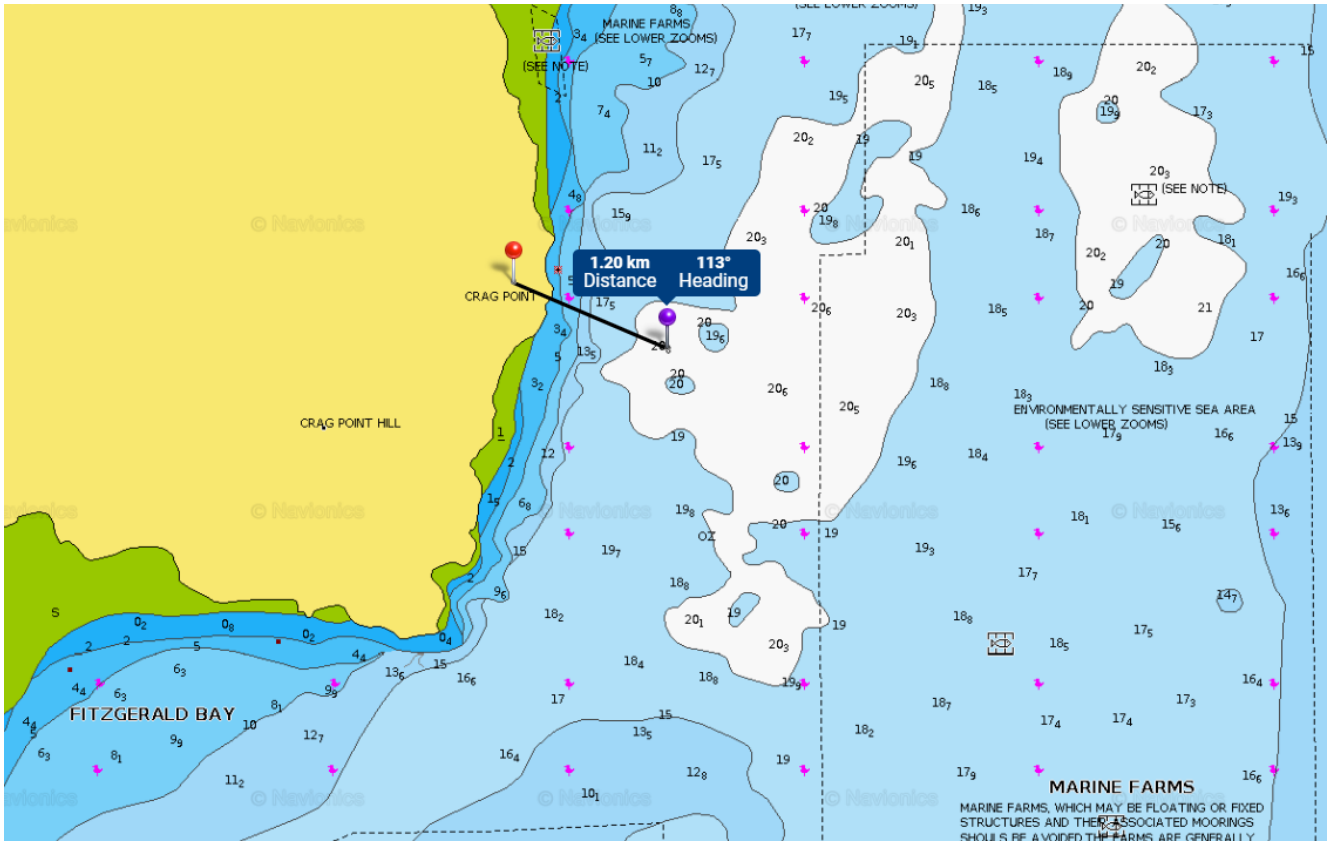


Figure 12 Crag Point Bathymetry

Water delivery

The water delivery infrastructure required for a plant sited in Crag Point is relatively similar to that required for the Port Bonython site. There is an additional 15 km of pipeline required from the plant site to reach the alignment currently proposed along Port Bonython Road, that would skirt the perimeter of the Defence Training Area, shown in **Figure 13**. The delivery pipeline would then head along Port Bonython Rd, to the Lincoln Highway, to Lincoln Gap, and then continue via the Lincoln Highway to Port Augusta, and then along the Stuart Highway to Woomera and Olympic Dam.

Power supply

Power to the site at Crag Point would be provided from an existing 132 kV transmission line from Cultana to Yadnarie that covers a large distance towards the west coast. For a large-scale desalination plant (150 ML/d capacity) provision of new transformers at a 132 kV tee-off and dual 132 kV feeders, approximately 25 km in length, to the plant site would be required. Given that Cultana is supplied via dual 275 kV lines via Port Augusta (Davenport Substation) and there is an ElectraNet project underway for a new 132 kV dual transmission line from Cultana to Port Lincoln, then this location has medium feasibility certainty.

The complexity of a new supply will depend on whether spare capacity is available from the new transmission line. It would then need to be extended via a 132 kV transmission line tee-off at Ungarra, and over the Port Lincoln highway, totalling up to 25 km to the plant site on the coast.

Power is supplied into the ElectraNet 132 kV zone substation Yadnarie, from existing grid infrastructure centred around the Gulf. Yadnarie is located halfway between Cleve and Rudall. Yadnarie 132 kV transmission lines that

are directed South-West, supply Port Lincoln. If a 132 kV connection tee-off South-West of Yadnarie, at Ungarra, is not feasible then an expected high cost is anticipated for the upgrade of Yadnarie substation and / or the construction of an additional 132 kV line supply from Cultana.

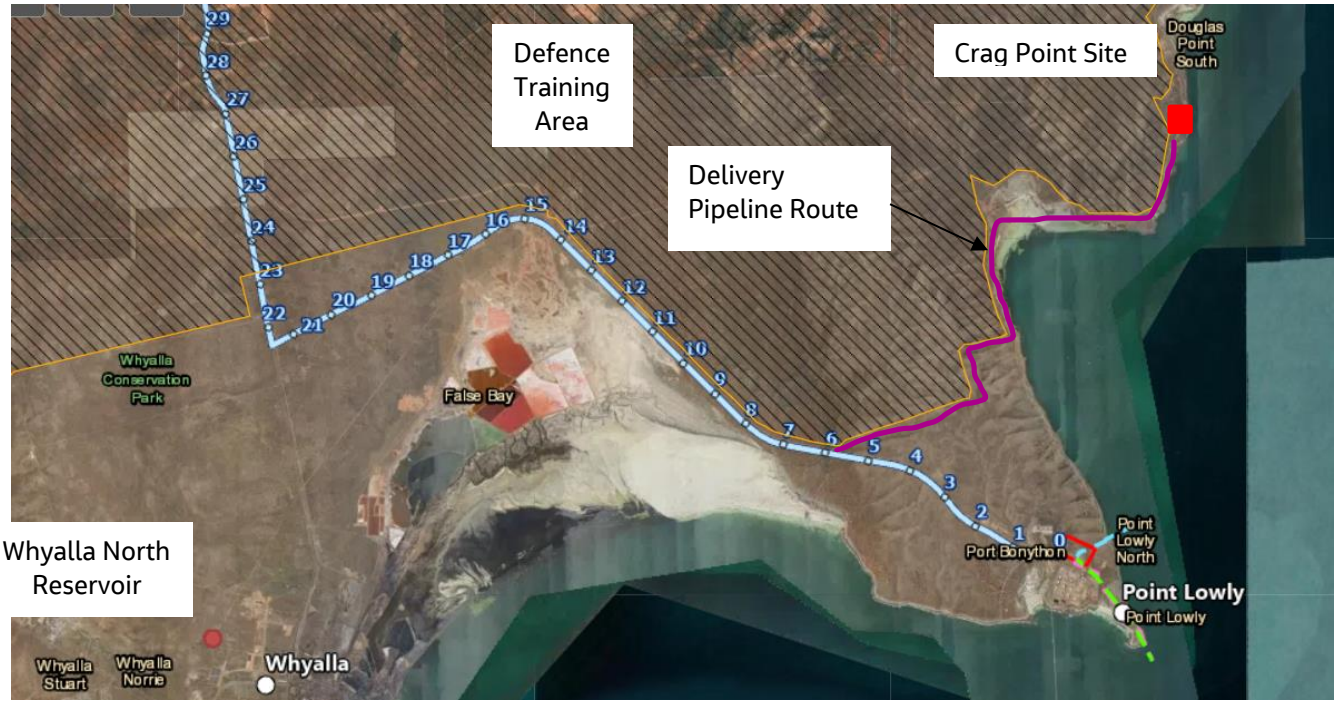


Figure 13 Crag Point Delivery Line

According to published planning reports from ElectraNet and SA Power Networks, and details on the AEMO website, there are various existing network capacity limits west of the Cultana substation and it is unclear which network upgrade projects may proceed and when. However, the June 2016 South Australian Transmission Annual Planning Report lists the Eyre Peninsula 132 kV line replacement from Cultana via Yadnarie to Port Lincoln, as a 2020 ElectraNet project and potential for a future 275 kV line to the Eyre Peninsula. ElectraNet has since published web-site information for the 2021 commencement of the 'Eyre Peninsula Link' project, with construction of a new double circuit 132 kV line from Cultana to Port Lincoln. Further enquiries are required with the TNSP to determine the status of existing network upgrades and commitments to planned network upgrade projects. A new connection planned together with a network upgrade could have benefits of reduce network augmentation costs.

Road access for heavy substation plant such as transformers is convenient using the Port Augusta to Whyalla highway, and Whyalla to Port Lincoln highways. Depending on the actual site location the land slope is to be considered for planning transportation and set down areas. Note that the direct line route to Crag Point is approximately the same as the Point Lowly site however higher costs are anticipated due to the locality being a greater distance from Adelaide for transportation and 132 kV augmentation influencing zone substations back to Cultana.

Summary

Crag Point - north of Point Lowly

Region: This area is focused on a site located near Crag Point.

Description	Feasibility uncertainty	Capital cost relative to Port Bonython
Land Features		
Coastal fringe conservation zoned land, significantly constrained by terrain and Defence Training Area (negotiation needed for access road). Potential high community value. New site access required	High	Equivalent
Marine Features		
Similar intake and outlet conditions as for Port Bonython. Potential for impacts from aquaculture leases on seawater quality. Aquatic environment less understood.	Medium	Equivalent
Water Delivery		
Constrained by location of site and adjacent Defence lands.	Medium	Higher
Power Supply		
Similar to Port Bonython however requires an additional 10 km of transmission line.	Low	Higher

Key Risks	Opportunities
Potentially less mixing capacity available from tides and currents.	Outside Habitat Protection Zone.
Potential for cultural heritage impacts.	Shortest intake and outlet conduits
Requires construction of an access road (15km)	
Site area significantly constrained by terrain and Defence land	

4.5 Port Augusta

Land features and geology

This area is focused on a site located near Port Augusta, which has a population of approximately 13,500 people according to the 2016 census. Port Augusta is located on the major transport crossroad for both road and rail and has been the hub of commercial, railroad and government services for the far north of the State.

Tourism and related services are seen as significant components of the economy of Port Augusta given its location, and the mix of tourist attractions, with its proximity to the Flinders Ranges and the outback.

A potential site is available at Port Paterson, where there is a section of infrastructure zoned land, as shown on Land Zoning Maps. It is bounded by conservation and suburban neighbourhood to the northwest, rural living to the north-east and rural to the south-east.

In 2006 BHP also considered co-locating the plant with the Northern Power Station and drawing source water from the outlet channel for the desalination plant. This is because the operating power station provided a large volume of screened seawater to draw from, and a significant flow volume in which to discharge and mix the brine back into before being discharged back into the Gulf. This option is no longer considered viable as the Power Station was demolished in 2016, and water is no longer circulated through the Power Station intake and outlet channels.

The 1:250,000 scale published geological map for the area suggests that at the former power station site, the surface and near-surface strata comprise Holocene age estuarine deposits in the form of the St Kilda Formation, which consists of sands, shelly silts and clays of littoral lagoons and mangrove swamps. In areas of past land reclamation, these soft, loose, and compressible sediments are overlain by fill that is very likely to be non-engineered in general. Based on the results of historical and recent borehole drilling that was undertaken for the Joy Baluch Bridge and its duplication over Spencer Gulf in Port Augusta, the estuarine St Kilda Formation sediments are expected to be around 5 m thick. The St Kilda Formation is then underlain by around 20-25 m thickness of Hindmarsh Clay comprising interbedded clay, clayey sand and sand layers. At 25-30 m depth, Proterozoic age quartzite and sandstone bedrock in the form of the Tent Hill Formation (equivalent to ABC Range Quartzite) is present.

The surficial ground conditions may not allow conventional footings to be adopted for desalination plant buildings, given the expected presence of existing non-engineered fill overlying weak natural sediments with large settlement potential. Therefore, the use of pile footings founded at depth in the Hindmarsh Clay would be expected to be generally required, rather than shallow spread footings. Excavations of circa 15 m depth for tunnel launch chambers are unlikely to encounter rock strength materials. It also appears that the vertical alignments of marine intake and outfall pipelines may be mostly, if not wholly, within the depths of soil strength materials. Therefore, predominantly “soft ground” (i.e. soil strength) tunnelling conditions in a mixture of very stiff to hard clayey soils and dense to very dense sandy soils would be anticipated for tunnel boring machines that form the tunnels for the intake and outfall pipelines.

Marine features

For a plant site located in Port Augusta the seawater intake and concentrate outlet would be located in the most northern section of Upper Spencer Gulf.

As shown in **Figure 14** bathymetry in the northern section Upper Spencer Gulf indicates water depths are very shallow -6 to 8 m. Reaching a depth of 20 m is not achievable within this section of the gulf. The width of the Gulf is narrow at this location. These aspects suggest that achieving suitable mixing and locating reliable intake water quality will be challenging.

The salinity in this area is the highest in the gulf and is expected to be 6-7 g/L higher than Port Bonython (as shown in **Figure 6**).

The location of marine structures is constrained by SZ1, which is the home to mangrove forests of state-wide importance that are important fish breeding grounds and bird habitats.

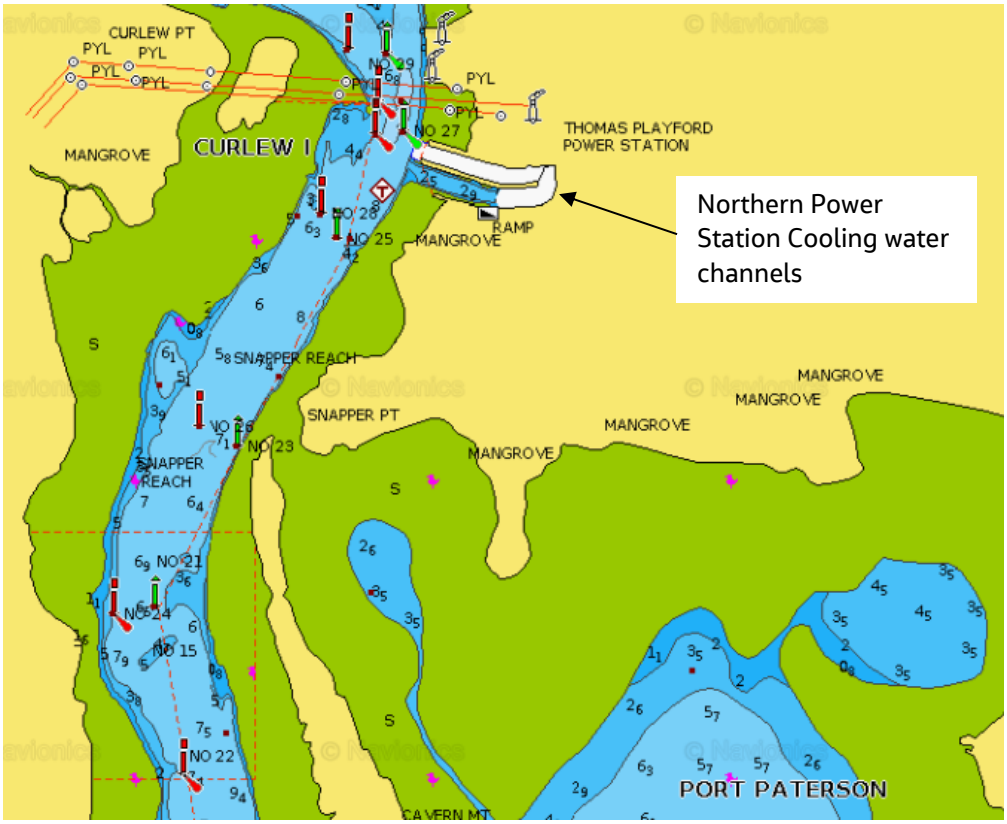


Figure 14 Port Augusta Bathymetry

Water delivery

The water delivery infrastructure required for a plant sited in Port Augusta is somewhat similar to that required for the Port Bonython site. To enable supply to SA Water customers a main would have to be run back along the Eyre Highway to Lincoln Gap, a distance of approximately 32 km, and then potentially as far back as the Whyalla North Reservoir to integrate with SA Waters distribution network similar to the scheme proposed to date for the Port Bonython concept.

From Port Augusta the pipeline route would mirror that proposed already for the Port Bonython option.

Power supply

Provision of a power supply to a plant site near Port Augusta is feasible as supplies at 132 kV are available from the Davenport substation, which is within 5 km of potential site areas. Davenport substation is supplied at 275 kV and appears to be favourable for augmentation to supply the required load at 132 kV either directly from the substation or via a tee-off from an existing 132 kV line which would still require a 132 kV/11 kV tie-in substation to be built. This option is relatively comparable to the power supply for the Port Bonython site.

Summary

Port Augusta

Region: This area is focused on a site located near Port Augusta (Port Paterson).

Description	Feasibility uncertainty	Capital cost relative to Port Bonython
Land Features		
Potential site available at Port Paterson through the acquisition of industrial land.	Low	Equivalent
Marine Features		
The site is in the most northern section of Upper Spencer Gulf. Relatively shallow depths and very high salinity. Water depth of 20 m is not achievable. Water depths of ~15 m are only reached ~15 km further south in the Gulf channel (noting 20 m is preferred for intake and outlet). Constrained by access to suitable water depth and achieving mixing.	High	Higher
Water Delivery		
Connection from the plant site to the demand centres would effectively mirror that required for the Port Bonython option, to provide equivalent supply for SA Water demands.	Low	Equivalent
Power Supply		
Provision of a power supply to a site around Port Augusta is feasible	Low	Lower

Key Risks	Opportunities
Accessing water of a suitable depth (20 m)	
Achieving suitable return water mixing	Close to power supply and water delivery points
Inside Habitat Protection zone	
Seawater quality	

4.6 Cowleds Landing - South of Whyalla

Land features and geology

Cowleds Landing is approximately 50 km south by the Lincoln Highway from Whyalla. The area consists of a strip of land along the coast of an unnamed bay and contains a settlement consisting of a street of low-rise dwellings. Most of the locality is zoned for conservation purposes with the view of providing limited built development intended principally for recreational and tourism uses. The coastline lies approximately 15 km to the east of the Lincoln Highway. A new access road with be required to the site from the highway.

This region is bound by Whyalla to the North and Lucky Bay to the south. As shown in Land Zoning Maps this area is largely zoned as rural with the coastline and small pockets as conservation zones. The Munyaroo Conservation Park in this area consists of three separate areas close to each other. They provide an important habitat link between the coastal vegetation and inland mallee of the peninsula. Given the rural/ conservation zoning of the land, it is considered to have a higher community value than land zoned industrial or as strategic employment. As such the relative cost to acquire the land has been considered higher than vacant industrial land such as that at Port Bonython.

There is little development in this area, with minimal roads and other infrastructure. State suburbs in this area include Murninnie Beach, Midgee and Mitchellville with a combined population of 82 people according to the 2016 Census.

The 1:250,000 scale published geological map suggests that the geology of the near-coastal area between Whyalla and Lucky Bay differs between the northern half and the southern half. For the northern half, the geological map indicates a sub-surface profile consisting of around 5 m thickness of Quaternary sediments comprising a thin soil veneer over locally exposed Pooraka Formation (alluvial sandy clays). The Pooraka Formation is underlain by a Tertiary age sequence of not less than 20-25 m thickness, in the form of the Gibbon Beds (clayey sand, clay and conglomerate) over fossiliferous limestone (equivalent to Melton Limestone). For the southern half, the geological map indicates a sub-surface profile consisting of Holocene age aeolian soil in the form of the Moornaba Sand that comprises white quartz sand of inland seif dunes grading to yellow sand with carbonate pipes. This may be underlain by Pooraka Formation, with the total thickness of the Quaternary strata being around 10 m. Not less than around 60 m thickness of Tertiary age Gibbon Beds underlies the Quaternary sediments.

The surficial ground conditions should allow conventional footings to be adopted for desalination plant buildings, although the potentially collapsing nature of the aeolian Moornaba Sand must be considered by designing for large potential ground movements and by paying particular attention to site drainage so as to prevent wetting up of the foundation soils. Excavations of circa 15 m depth for tunnel launch chambers are unlikely to encounter rock strength materials within the first 5-10 m depth of the excavation. However, at greater depths the excavation is likely to encounter rock strength materials in the form of Gibbon Beds conglomerate. In addition, for the northern half of the area fossiliferous limestone may also underlie the Gibbons Beds at or near the base of the excavation. The rock strength strata may require blasting to achieve satisfactory excavation productivity.

It appears that the vertical alignments of marine intake and outfall pipelines would be in Tertiary age strata that are mostly materials of rock strength. Therefore, for most of the total length of a tunnel drive, “hard ground” (i.e. rock strength) tunnelling conditions would be anticipated for tunnel boring machines that form the tunnels for the intake and outfall pipelines. However, the Gibbons Beds also include materials that represent “soft ground” (i.e soil strength) tunnelling conditions. Therefore, there may be a variation in tunnelling conditions between “hard” to “soft”, and/or the presence of mixed face conditions over a transition zone. The presence of either of these ground conditions will make the tunnelling more difficult compared to if consistent tunnelling conditions within a single geological unit were present along the full lengths of the tunnels.

Marine features

Cowleds Landing forms the southern border of the Whyalla-Cowleds Landing Aquatic Reserve. The area south of Cowleds Landing is a zone of coastline where the 20 m contour comes closer to land. In this region, water depths of 20 m can be reached approximately 5 km off shore, shown in **Figure 15**.

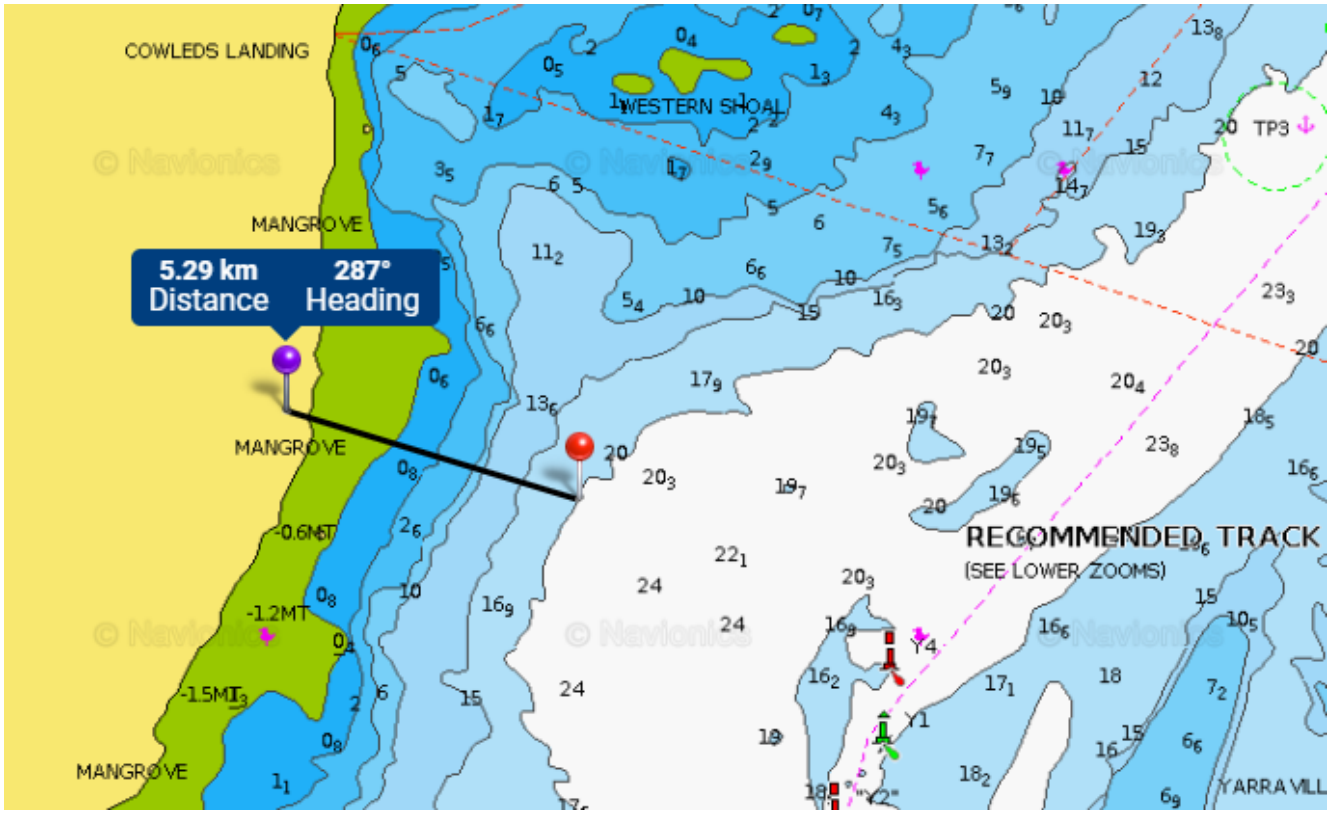


Figure 15 Bathymetry off shore from Cowleds Landing area

The coastal shoreline is mangrove.

Cowleds Landing is further south in the Gulf than Point Lowly and the salinity gradient as indicated in **Figure 6** is approximately 3 g/L lower that for Point Bonython. The current climate and water quality is anticipated to be similar to Port Bonython, but with lower currents due to the open coastline morphology.

The intake and outfall would be located outside the Upper Spencer Gulf Marine Park and north of the habitat protection zone off the coast of the Munyaroo conservation park, clear of designated habitat protection zones.

Water delivery

Water delivery infrastructure required for a plant sited in Cowleds Landing would be similar to that required for a Whyalla site, however would require extension by approximately 52 km in DN 1600 main capable of delivering up to 150 ML/d from the plant site to Whyalla. It is anticipated it would connect into the Wyhalla North Reservoir to enable integration into the SA Water network. The delivery pipeline would then head north from Whyalla to Lincoln Gap, via the Lincoln Highway picking up the route proposed from Port Bonython.

Power supply

Provision of a power supply to a plant site in the region south of Whyalla is feasible, depending on where the site is finally located. An existing 132 kV transmission line from Cultana to Yadnarie covers a large distance towards the west coast. The complexity of a new supply will depend on whether spare capacity is available from this

transmission line. At this stage it is proposed that the connection is made from the existing 132 kV transmission line and would then need to be extended up to 20 km to the plant site on the coast.

This initially appears to be a feasible option however has a higher number of unknowns compared to other options. Those unknowns include existing network proposed load and generation connections, existing and proposed 132 kV line ratings, and existing network upgrade projects for this area of the network. For a plant of large capacity, a new transmission line may be required from the Whyalla Central sub-station, which is approximately 25 km away, depending on the final plant site location. This will increase the cost of this option and those costs can only be assessed in conjunction with ElectraNet. According to published planning reports from ElectraNet and SA Power Networks, and details on the AEMO web site, there are various existing network capacity limits west of the Cultana substation and it is unclear which network upgrade projects may proceed and when. A new connection planned together with a network upgrade could have benefits of reduce network augmentation costs.

Summary

Cowleds Landing - South of Whyalla

Region: This region is adjacent Cowleds Landing.

Description	Feasibility uncertainty	Capital cost relative to Port Bonython
Land Features		
Largely undeveloped rural land with a coastal conservation zone along the entire coastline. Numerous potential sites available through the acquisition of rural/coastal land. Potential for sites with large buffer distances, however minimal roads and infrastructure are available.	Low	Higher
Marine Features		
The site provides access to Spencer Gulf. Reasonably high-quality water is expected with lower salinity than Upper Spencer Gulf. Water depth of 20 m (as preferred for intake and outlet) can be reached around 5 km offshore. Aquatic environment less understood. Potential for local impacts on commercial fishing (prawn) operations Achieving suitable mixing is anticipated to be feasible.	Medium	Higher
Water Delivery		
Connection from the plant site to the demand centres would require a pipeline approximately 50km longer than that for a Whyalla option. The majority of the pipeline would then follow the same route via the Lincoln Gap reservoir.	Low	Higher

Power Supply		
Upgrading of supply from Whyalla may be feasible, however requires 25km extension, and has more uncertainty at this stage of project development.	Medium	Higher

Key Risks	Opportunities
Distance to a water depth of 20 m	
Potential for cultural heritage and community use impacts.	Outside Marine Habitat Zone
Site located in Coastal Conservation Zone	Good potential for high quality water

4.7 Myponie Point - South of Port Pirie

Land features and geology

Myponie Point, adjacent to coast town of Tickera, is a geographical feature in the locality of Wallaroo Plain, 10 km north of Wallaroo in South Australia, 100 km south of Port Pirie. The area is dominated by sloping bedrock and its shoreline mounts 10 to 20 m high bluffs and steep gullies. Adjacent properties have been cleared for agricultural use. Several coastal shacks are present, and the area is used by rock and boat-based fishers.

The closes point where there is reasonable access to deep water is located in the area between Myponie Point and Point Reily.

The region is zoned General Farming and is currently used for general cropping and grazing. The coastline is zoned for conservation, while inland is zoned for rural areas.

Road access is available for some sections of the coastline including Tickera, and the southern area of this region, while limited road access is available in the northern area.

The 1:250,000 scale published geological map suggests that the geology south of Port Broughton a sub-surface profile that consists of Moornaba Sand and/or fluviatile gravel, sand and clay of modern drainage channels. These Quaternary sediments are again underlain by the Tertiary strata described above, except that near North Beach the total thickness of the Tertiary sequence decreases rapidly, the sequence changes to Melton Limestone over sandstone, and is underlain by Tickera Granite that is exposed on the coastal cliff line.

The surficial ground conditions should allow conventional footings to be adopted for desalination plant buildings, although the soft and compressible nature of the St Kilda Formation, and the potentially collapsing nature of the aeolian Moornaba Sand, must be considered by designing for large potential ground movements and, for the Moornaba Sand, by paying particular attention to site drainage so as to prevent wetting up of the foundation soils. Excavations of circa 15 m depth for tunnel launch chambers are unlikely to encounter rock strength materials within the first 5-10 m depth of the excavation. However, at greater depths the excavation is likely to encounter rock strength materials for the southern half of the area. The rock strength strata may require blasting to achieve satisfactory excavation productivity.

It appears that the vertical alignments of marine intake and outfall pipelines would be in Tertiary age strata that are mostly materials of rock strength. Therefore, for most or all of the total length of a tunnel drive, “hard ground” (i.e. rock strength) tunnelling conditions would be expected.

Marine features

For a plant site located in the Myponie Point region, water depths of 20 m for the seawater intake and concentrate outlet can be reached approximately 4 km offshore, shown in **Figure 16**.

Myponie Point is located on the eastern side of the Gulf further south from Cowleds landing, opposite Franklin Harbour. The salinity gradient in this region is indicated to be similar to that at Cowleds Landing by **Figure 6** and approximately 3 g/L lower that for Point Bonython. The site is subject to the effects of the clockwise eddy (circular movement of seawater) within the Gulf south of Point Lowly, with hypersaline water exiting the gulf along the eastern shore

The intake and outfall would be located outside the Upper Spencer Gulf Marine Park clear of designated habitat protection zones.

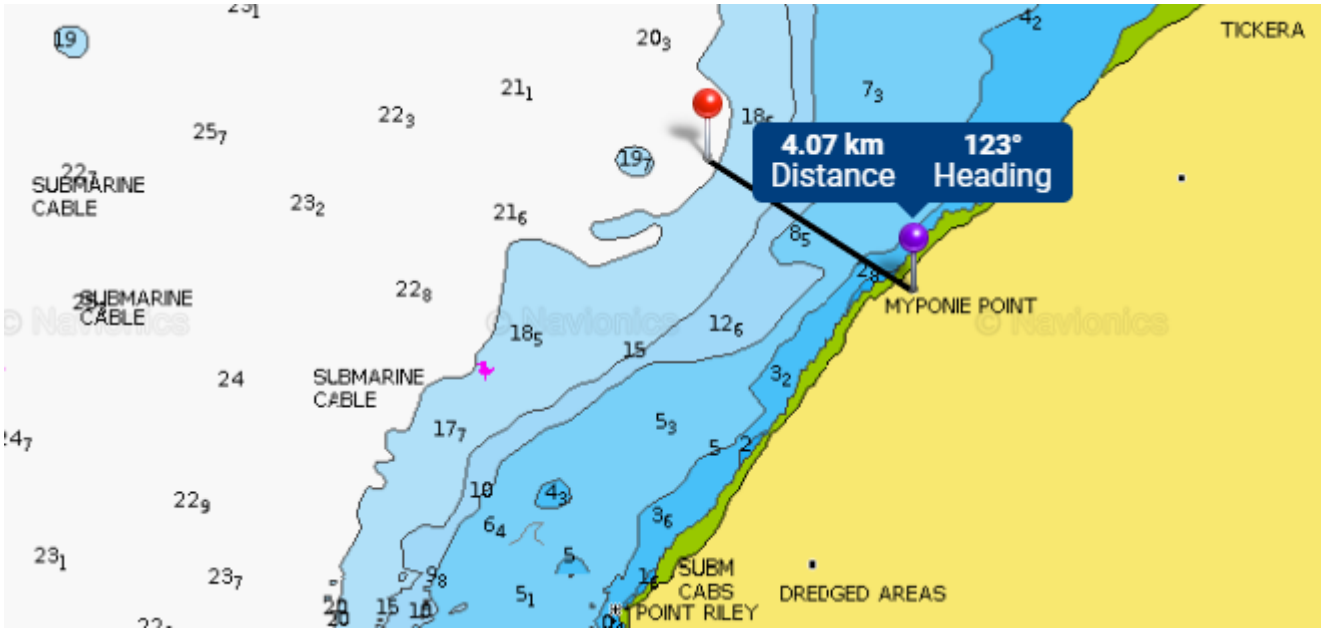


Figure 16 Bathymetry off shore from Myponie Point area

Water delivery

Water delivery infrastructure required for a plant sited in a region south of Port Pirie would firstly have to reach Port Augusta, via the Spencer, Augusta and Princes Highways, a distance of approximately 190 km. To enable supply to SA Water customers a main would have to be run back along the Eyre Highway to Lincoln Gap, and then potentially as far back as Whyalla to provide equivalent supply to the scheme proposed to date for the Port Bonython plant concept.

From Port Augusta the pipeline route would mirror that proposed already for the Port Bonython option.

Power supply

Provision of a power supply to a plant site in the region south of Port Pirie is feasible, and likely easier than for sites in the region south and west of Whyalla. Supplies could be provided from either of the two 132 kV transmission lines running north-south, or the Bungama sub-station at the northern end of the region, Redhill 132 kV line, or potentially from towards Kadina at the southern end. Several Windfarms exist in the region and are connected at 132 kV south of Pt Pirie. It would depend on TNSP assessment as to whether existing 132 kV transmission lines have spare capacity and would give consideration for when windfarms are not generating power. For a plant of large capacity, it is anticipated a new transmission line would be required to connect to an existing 132 kV line. Within the Redhill area and south of Port Pirie new transmission lines would be in the order of 20 -50 km depending on the final plant site location.

Summary

Myponie Point - South of Port Pirie

Region: This region is located in the Myponie Point area, adjacent to coast town of Tickera.

Description	Feasibility uncertainty	Capital cost relative to Port Bonython
Land Features		
The region is zoned General Farming and used for cropping and grazing. Potential medium community value, with a coastal conservation zone.	Low	Higher
Marine Features		
The site provides access to Spencer Gulf. Water depth of 20 m (as preferred for intake and outlet) is provided approximately 4 km offshore. At this location lower salinity than Upper Spencer Gulf. Aquatic environment less understood Potential water quality impacts from the Gulf eddy current	Medium	Higher
Water Delivery		
Connection from the plant site to the demand centres would require a pipeline potentially 150 km longer than that for the Port Bonython option.	Medium	Higher
Power Supply		
Provision of a power supply to a site south of Port Pirie is feasible, new transmission lines would be in the order of 20-50 km .	Medium	Higher

Key Risks	Opportunities
Land Acquisition Additional distance of approximately 150 km water delivery pipeline Potential water quality impacts from the Gulf eddy current	Outside Marine habitat zones

4.8 Weeroona Area

Land features and geology

The site location at Weeroona is on the eastern side of Spencer Gulf, on Germain Bay. The site was previously earmarked for industrial infrastructure development. It was the site for the proposed SAMAG magnesium ore processing and export rail/ship loading interface. An EIS was approved for the development, however it did not proceed. Currently the area is zoned as Rural.

The site is bounded on the eastern side by the Augusta highway and on the west by the north-south railway line, and is east of the entrance to Port Pirie.

The 1:250,000 scale published geological map suggests that the geology of the area on the mainland consists of Quaternary low angle slope deposits, comprising a deep, hard, gradational sandy loam possibly underlain by red clay. Weeroona Island is formed by an outcrop of Proterozoic quartzite and sandstone rock of the Tent Hill Formation. However, there are no stratigraphic logs or other borehole information in the area to indicate the depth to the Tent Hill Formation below the Quaternary soils on the mainland.

The surficial ground conditions should allow conventional footings to be adopted for desalination plant buildings. Excavations of circa 15 m depth for tunnel launch chambers are unlikely to encounter rock strength materials within the first 5 m depth of the excavation. However, at greater depths the excavation may encounter rock strength materials in the form of the Tent Hill Formation. Where encountered, the rock strength strata may require blasting to achieve satisfactory excavation productivity. There is uncertainty as to whether the vertical alignments of marine intake and outfall pipelines would be in materials of rock strength, or soil strength. Based on the very limited geological information for the area, it is likely that most of the total length of a tunnel drive would be in the Tent Hill Formation, and so “hard ground” (i.e. rock strength) tunnelling conditions would be generally expected for tunnel boring machines that form the tunnels for the intake and outfall pipelines. However, the landward parts of the tunnel drives may be within soil strength materials, and so “soft ground” (i.e. soil strength) tunnelling conditions may be present for the landward parts. The presence of mixed face conditions over any transition zone between soil and rock strength materials will make the tunnelling more difficult compared to if consistent tunnelling conditions within a single geological unit were present along the full lengths of the tunnels.

Marine features

The site is located on the eastern side of the Gulf at Germain Bay, and the shoreline is characterised by shallow sloping beds with water depths of only 3-4 m for some distance offshore. The entrance to Port Pirie is via a dredged channel that runs north-south off the shoreline of the site. The significant embayment that is Germain Bay is anticipated to influence tidal currents, which are lower than on the western side of the gulf.

The coastal area is extremely sensitive environmentally, mainly consisting of intertidal flats and mangroves. Bathymetry offshore (**Figure 17**) indicates the distance from the site to reach the preferred depth of water for the intake and outlet would be over 20 km.

The site and intake and outlet are located within the Upper Spencer Gulf Marine Park. Germain Bay is zoned as special purpose use for harbour activities. The potential locations for the intake and outlet are however in a HPZ habitat protection zone and adjacent to a Sanctuary Zone. Hence placement of the intake and outlet will require particular consideration of the local environment.

Figure 6 indicates the expected salinity levels in the intake location would be similar to that expected at Port Bonython.

Access to good quality feed water and locating the outlet to provide for acceptable brine dispersion appear to have specific challenges.

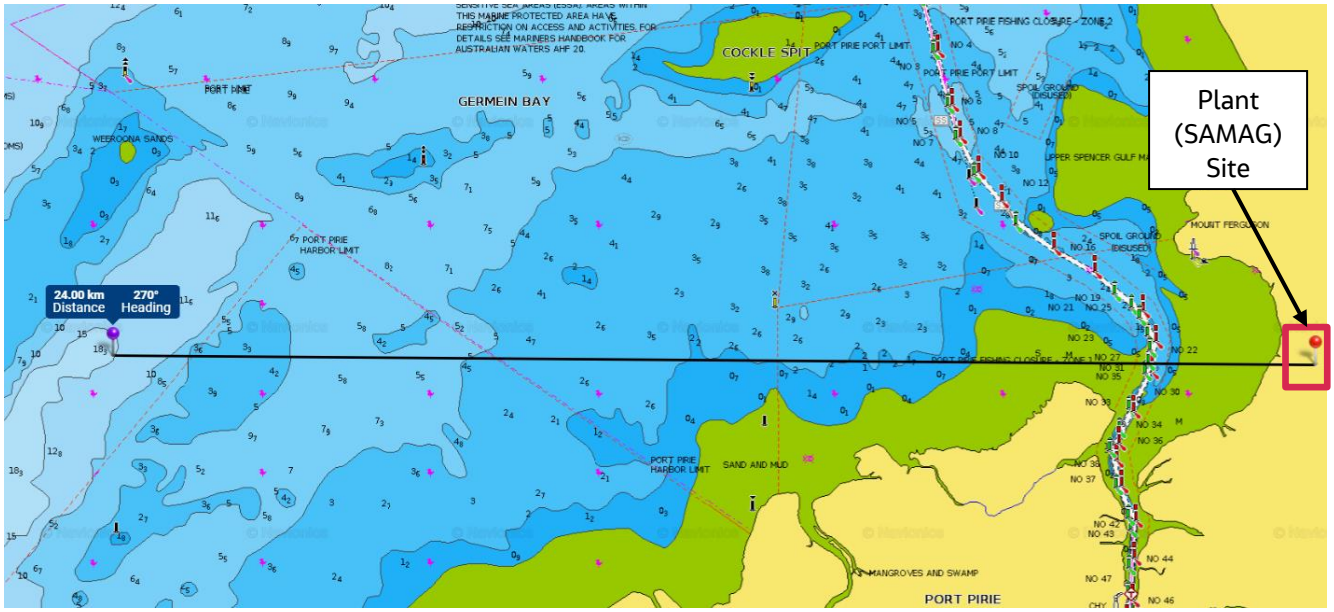


Figure 17 Bathymetry off shore from Weeroona

Water delivery

Water delivery infrastructure required for a plant sited in Weeroona area would be similar to but shorter in length for a Myponie based site. The delivery pipeline would be aligned along the Augusta Highway up to Port Augusta, a distance of approximately 85 km.

From Port Augusta the pipeline route would mirror that proposed already for the Port Bonython option. To enable supply to SA Water customers a main would have to be run back along the Eyre Highway to Lincoln Gap, and then potentially as far back as Whyalla to provide equivalent supply to the scheme proposed to date for the Port Bonython plant concept.

Power Supply

Provision of a power supply to a plant site in the region north of Port Pirie is feasible, and likely easier than for sites in the region south and west of Whyalla. Supplies could be provided from the 132 kV Bungama substation. For a plant of large capacity, it is anticipated a new transmission line would be required over an approximate distance of 15 km depending on site location. Consideration to be given for line crossings through any tidal areas and determining a suitable site for the plant substation.

According to published planning reports from ElectraNet and SA Power Networks, and details on the AEMO web site, there are various existing network capacity limits west of the Cultana substation and it is unclear which network upgrade projects may proceed and when. The June 2016 South Australian Transmission Annual Planning Report lists the Eyre Peninsula 132 kV line replacement from Cultana via Yadnarie to Port Lincoln, as a 2020 ElectraNet project and potential for a future 275 kV line to the Eyre Peninsula. Further enquiries are required with the TNSP to determine the status of existing network upgrades and commitments to planned network upgrade projects. A new connection planned together with a network upgrade could have benefits of reduce network augmentation costs.

Summary

Weeroona

Region: This area is focused on a site located at Weeroona area – ex SAMAG site.

Description	Feasibility uncertainty	Capital cost relative to Port Bonython
Land Features		
Land use within the locality consists of residential use and conservation, zoned as Rural. EIS approval for an industrial site was obtained (over 10 years ago) indicating industrial developments may be permitted.	Low	Higher
Marine Features		
The site is located on the eastern side of the Gulf that has shallow slope beds and tidal currents are lower than on the western side of the gulf. Therefore, access to good quality feed water and acceptable brine dispersion appear challenging. Aquatic environment less understood.	High	Higher
Water Delivery		
Connection from the plant site to the demand centres would require a pipeline potentially 85 km longer than that for the Port Bonython option.	Medium	Higher
Power Supply		
New transmission line would be required over an approximate distance of 15 km.	Medium	Higher

Key Risks	Opportunities
Significant intake outlet conduit lengths required to access deep water	
Low tidal currents, poor water quality in the vicinity of the site	Site previously approved for industrial development
Intake/outlet located within habitat protection zones	Site supported by existing nearby logistical infrastructure.

4.9 Ceduna - Point Brown

Ceduna was considered as a potential site as it provides a number of key advantages with respect to development of a seawater desalination plant. The primary advantage compared with the Spencer Gulf site locations is that it offers an open ocean intake site, rather than a location drawing water from the more enclosed Gulf, with deep water accessible relatively close to the coastline. Ceduna is also the closest population centre located outside the Spencer Gulf to the points of water demand for the project. Ceduna was considered as a potential site by BHP in their 2009 EIS for their Olympic Dam expansion. In this project however BHP were considering a delivery pipeline that would run straight from Ceduna on the coast inland to Olympic Dam. The length of the delivery system would then be similar to that required if the plant were located at Port Bonython on the Gulf. The proposed alignment by BHP from Ceduna however does not readily extend to allow integration with the SA Water system on the Gulf, without significant cost to include an interconnecting line.

As noted, drawing seawater from open ocean water, which is unaffected by inflows from the land, or by the currents seen within the Gulf, leads to more consistent salinity and lower suspended solids. This reduces the extent of pre-treatment required reducing plant costs and operational and commercial risks.

Ceduna also has an established local community that could provide support to the construction and ongoing operation of the plant. It has a large-scale commercial port, which is important as a significant proportion of materials and all specialised equipment will have to be imported to the site for construction of the plant. Ceduna is also connected by a rail link which would aid in this also.

Whilst these points are noted, the site identified for the purposes of this study is approximately 50 km south of Ceduna on the promontory near Point Brown. This site is selected for the reasons outlined below in the discussion of marine features as it is one of the few areas local to Ceduna that have ocean water depths of 20 m within 2 km of the site.

Land features and geology

Point Brown is located approximately 50 km south of Ceduna on the promontory south of Smoky Bay. As shown in Land Zoning Maps the coastline of the promontory is a conservation zone, while inland is zoned for rural use.

There is limited access to roads and infrastructure in this area with one unsealed road leading into and out of Point Brown. This road is accessed from Flinders Highway.

The nearest township is located at Smoky Bay, with a population of approximately 200 people, located 25 km away.

The 1:250,000 scale published geological map suggests that the geology of the area consists of the Pleistocene age Bridgewater Formation that comprises aeolian calcarenite, the interbeds of which may vary from hard sheet calcrete to silt. The Bridgewater Formation may be overlain by a veneer of Holocene age Semaphore Sand (quartz and shelly sand). Volcanic rocks, mainly granite gneiss and porphyritic granite, outcrop on the coastal cliff line and hence are likely to underlie the Quaternary strata.

The surficial ground conditions should allow conventional footings to be adopted for desalination plant buildings, although the potentially collapsing nature of the aeolian Semaphore Sand, and any loose silt and sandy layers of the Bridgewater Formation, must be considered by designing for large potential ground movements and by paying particular attention to site drainage so as to prevent wetting up of the foundation soils. Excavations of circa 15 m depth for tunnel launch chambers are likely to encounter rock strength materials both in the form of sheet calcrete layers in the Bridgewater Formation closer to the surface, and volcanic rock deeper down. The rock strength strata may require blasting to achieve satisfactory excavation productivity. It appears that the vertical alignments of marine intake and outfall pipelines would be in materials of rock strength, and so “hard ground” (i.e. rock strength) tunnelling conditions would be generally expected for tunnel boring machines that form the tunnels for the intake and outfall pipelines. However, the landward parts of the

tunnel drives may be partly within soil strength materials, and so "soft ground" (i.e. soil strength) tunnelling conditions may be present for the landward parts. The presence of mixed face conditions, including over any transition zone between soil and rock strength materials, will make the tunnelling more difficult compared to if consistent tunnelling conditions within a single geological unit were present along the full lengths of the tunnels.

Marine features

At Point Brown water depths of 20 m are available within 2 km of the shore (**Figure 18**), compared with Ceduna, where water depths of 20 m are approximately 20 km from shore. This area is outside of the Nuyts Archipelago Marine Park and is not constrained by other marine features. A habitat protection zone is located north of Point Dillon, however this is 3 km to the north of the likely intake and outlet locations.

The marine environment around Ceduna and Smoky Bay is known for clean water where Smoky Bay and Denial Bay oysters are grown.

Point Brown is an historic whaling site, with various fishing and swimming locations, however no formal access to the location is available.

The high wave environment of the open ocean is expected to assist with the mixing and dilution requirements for brine discharge. Salinity levels of intake water are anticipated to be consistent with open ocean, and so expected to be 5-6 g/L lower than at Port Bonython.

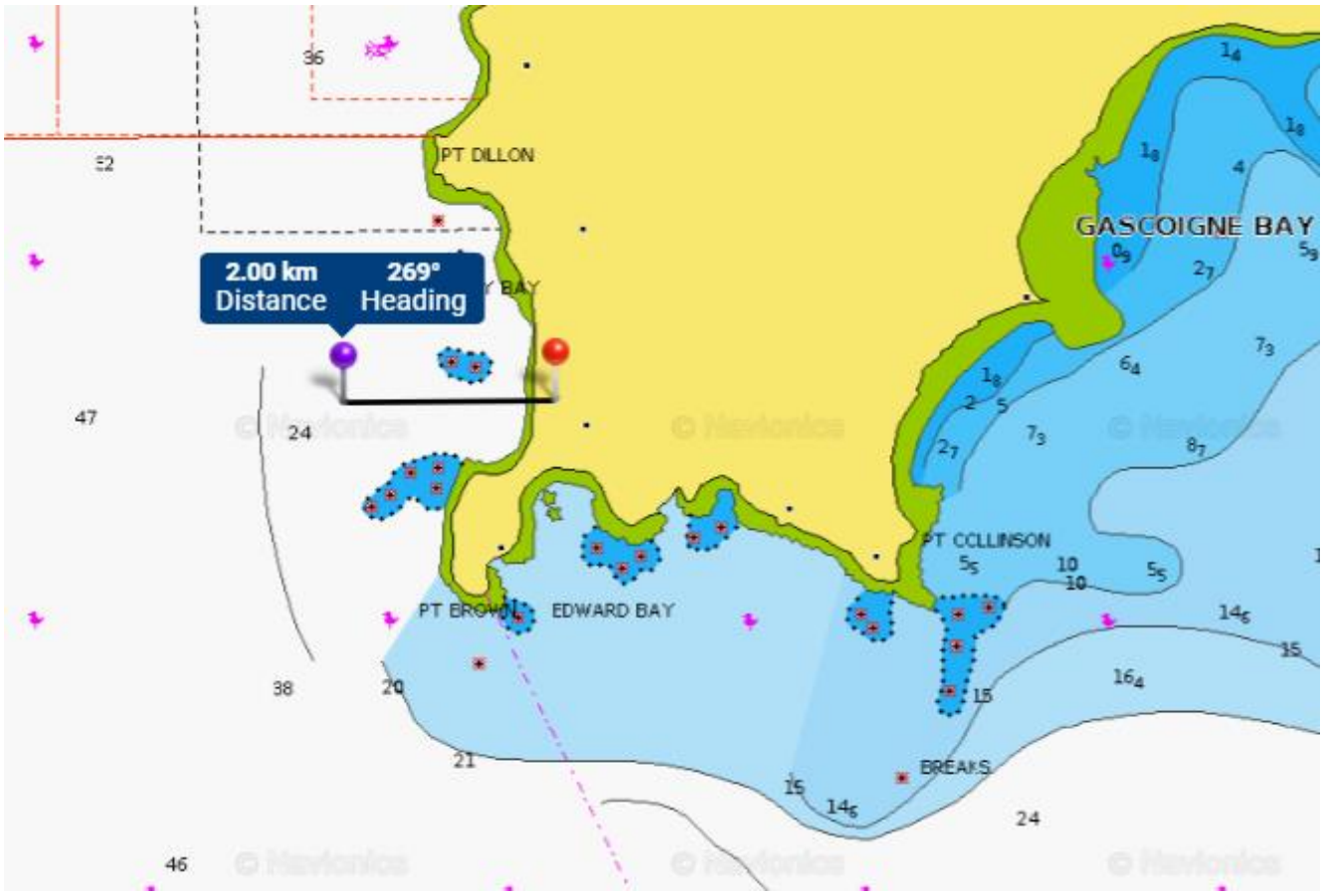


Figure 18 Point Brown Bathymetry

Water delivery

Point Brown is significantly disadvantaged compared to the other site options as it is the furthest from the points of water demand in the SA Water network by a significant margin. The distance from the site to Port Augusta is approximately 440 km via the Eyre highway. The delivery pipe would then have to extend a further 320 km to reach BHP's Olympic Dam site.

By direct line, the proposed site is 370 km from Olympic Dam, and such an alignment would traverse though Lake Gairdner National Park. Deviating to route the line through Pimba, and then continue to Olympic Dam would add an additional 20 km. The direct alignment however does not enable SA Water demands to be served off the same pipeline. An additional delivery main would be required to bring water east, possibly by extending a pipeline back from Pimba south to Lincoln Gap – a distance of 185 km.

Power supply

Power is supplied into Ceduna from existing grid infrastructure centred around the Gulf. A 132 kV transmission line from Cultana, via Yadnarie, to Wudinna exists however due to existing loads and distances a connection at 132 kV from Wudinna substation is uncertain. If feasible there will be high costs for transmission line construction over 200 km and high mobilisation costs. An existing 66 kV line runs to the Ceduna substation from Wudinna however it is unlikely to support the required loads for a large desalination plant in Ceduna. If a 132 kV connection from Wudinna is not feasible then an expected high cost is anticipated for the upgrade of Yadnarie substation and / or the construction of an additional 132 kV line supply from Cultana.

According to published planning reports from ElectraNet and SA Power Networks, and details on the AEMO web site, there are various existing network capacity limits west of the Cultana substation and it is unclear which network upgrade projects may proceed and when. The June 2016 South Australian Transmission Annual Planning Report lists the Eyre Peninsula 132 kV line replacement from Cultana via Yadnarie to Port Lincoln, as a 2020 ElectraNet project and potential for a future 275 kV line to the Eyre Peninsula. ElectraNet has since published web-site information for the 2021 commencement of the 'Eyre Peninsula Link' project, with construction of a new double circuit 132 kV line from Cultana to Port Lincoln. Further enquiries are required with the TNSP to determine the status of existing network upgrades and commitments to planned network upgrade projects. A new connection planned together with a network upgrade could have benefits of reduce network augmentation costs.

Summary

Ceduna

Region: This area is focused on a site located at Point Brown near Ceduna.

Description	Feasibility uncertainty	Capital cost relative to Port Bonython
Land Features		
Conservation/rural zoned land, largely undeveloped with potential sites available through the acquisition of conservation zoned or rural land in the middle of the promontory. Potential for sites with large buffer distances, however minimal existing roads and infrastructure are available to support.	Low	Higher
Marine Features		
Access to deep ocean in Great Australian Bight. Good dispersion of brine due to high wave energy. Water depth of 20 m (as preferred for intake and outlet) can be reached within 2 km of shore. High energy coastline introduces risks for marine construction activities.	Low	Equivalent
Water Delivery		
Significant length of water delivery pipeline required to reach the points of supply at Whyalla, Lincoln's Gap and the mining sites at Olympic Dam and Carrapateena. Distance is approximately twice that of other site location options	High	Significantly Higher
Power Supply		
If feasible there will be high costs for transmission line construction over 200km.	High	Significantly Higher

Key Risks	Opportunities
The significant scope of the power supply and water delivery infrastructure required introduces risk to the project	Open ocean water intake, provides potentially higher quality water source
Potential marine construction risks from high energy coastline	Good dispersion currents reduce potential for plume impacts.
Remote site location within conservation zone	

4.10 Elliston

Land Features and geology

Elliston is a small coastal town in the Australian state of South Australia on the west coast of Eyre Peninsula. The township is located on Waterloo Bay. At the 2006 census, Elliston had a population of 377. Economic activity in the area comprises agriculture, fishing, and a small tourism sector.

Elliston was considered as a potential site as it provides a number of key advantages when compared to Ceduna (Point Brown) location. It provides access to open ocean, is outside existing marine parks and is much closer to Whyalla. Connection from the plant site to the demand centres would require approximately 320 km of additional pipeline (following existing road routes) from the plant site to reach Whyalla. from where it would continue in a configuration as proposed for other options to Lincoln's Gap and the mining sites at Olympic Dam and Carrapateena.

The site location is within a coastline area zoned as conservation, and is anticipated to have a high community value given its proximity to the township of Elliston. The coastline in the vicinity of the proposed site is generally characterised by high cliff faces interspersed with small beaches. Inland the terrain is mostly flat rural land.

The 1:250,000 scale published geological map suggests that the geology of the area consists of the Pleistocene age Bridgewater Formation that comprises aeolian calcarenite, the interbeds of which may vary from hard sheet calcrete to silt. The Bridgewater Formation may be overlain by a veneer of Holocene age Semaphore Sand (quartz and shelly sand). The Bridgewater Formation is indicated to be in the order of 100 m thick in the Elliston area, and thus is expected to form all of the coastal cliff face area. However, over parts of nearby offshore islands, Proterozoic age Calca Granite outcrops. This granite is described as massive and coarse grained.

The surficial ground conditions should allow conventional footings to be adopted for desalination plant buildings, although the potentially collapsing nature of any aeolian Semaphore Sand that is present, and any loose silt and sandy layers of the Bridgewater Formation, must be considered by designing for large potential ground movements and by paying particular attention to site drainage so as to prevent wetting up of the foundation soils. Excavations of circa 15 m depth for tunnel launch chambers are likely to encounter rock strength materials in the form of sheet calcrete layers in the Bridgewater Formation. Where the rock strength layers are stronger, thicker or more frequent, they may require blasting to achieve satisfactory excavation productivity. It appears that the vertical alignments of marine intake and outfall pipelines would be in Bridgewater Formation. Due to the variability of layer types and strengths for this geological unit, variable tunnelling conditions are expected. Thus, face conditions may vary from "hard ground" (i.e. rock strength) to "soft ground" (i.e. soil strength) tunnelling conditions with differences in chainage, or even within the tunnel face at any given chainage. The presence of mixed face conditions will make the tunnelling more difficult compared to if consistent tunnelling conditions within a single layer type were present along the full lengths of the tunnels. Should the tunnels encounter granite, the hard and abrasive nature of the rock is likely to result in greater face wear and slower tunnelling productivity.

Marine features

A site located near Elliston on the ocean cliff coastline, provides access to an open coastline on the Great Australian Bight.

Water depths of 20 m are available within 1 km of the shore, shown in **Figure 19**. This area is to the north-west of and outside the Investigator Marine Park and is not constrained by other marine features. A habitat protection zone within the Investigator Marine Park is located 4 km further south-east of the potential intake / outlet locations.

As with Point Brown, the high wave environment of the open ocean is expected to assist with mixing and dilution requirements for brine discharge. Salinity levels of intake water are anticipated to be consistent with open ocean, and so expected to be 5-6 g/L lower than at Port Bonython.



Figure 19 Elliston Coastline Bathymetry

Water Delivery

The distance from the proposed Elliston site to Whyalla is approximately 320 km via the Birdseye and Lincoln highways. The delivery pipe would then have to extend a further 320 km to reach BHP's Olympic Dam site.

Power Supply

Power is supplied into Elliston from existing grid infrastructure centred around the Gulf, however existing power to Elliston is at distribution voltages and local council documentation describes the existing power supply as inadequate to support additional industrial connections. A 132 kV transmission supply is required from either Wudinna or a line tee-off south of Wudinna. The 132 kV line distance from this locality to the Elliston site is approximately 85 km. A 132 kV transmission line from Cultana, via Yadnarie, to Wudinna exists however due to existing loads and distances a connection at 132 kV from Wudinna substation is uncertain. If feasible there will be high costs for transmission line construction over 200 km and high mobilisation costs. Existing 66 kV lines run from Wudinna to the north and south, however it is unlikely to support the required loads for a large desalination plant at Elliston. If a 132 kV connection from Wudinna is not feasible then an expected high cost is anticipated for the upgrade of Yadnarie substation and / or the construction of an additional 132 kV line supply from Cultana.

According to published planning reports from ElectraNet and SA Power Networks, and details on the AEMO web site, there are various existing network capacity limits west of the Cultana substation and it is unclear which network upgrade projects may proceed and when. The June 2016 South Australian Transmission Annual

Planning Report lists the Eyre Peninsula 132 kV line replacement from Cultana via Yadnarie to Port Lincoln, as a 2020 ElectraNet project and potential for a future 275 kV line to the Eyre Peninsula. ElectraNet has since published web-site information for the 2021 commencement of the 'Eyre Peninsula Link' project, with construction of a new double circuit 132 kV line from Cultana to Port Lincoln. Further enquiries are required with the TNSP to determine the status of existing network upgrades and commitments to planned network upgrade projects. A new connection planned together with a network upgrade could have benefits of reduce network augmentation costs.

Summary

Elliston

Region: This area is focused on a site located near Elliston.

Description	Feasibility uncertainty	Capital cost relative to Port Bonython
Land Features		
Site located outside Elliston on an ocean cliff coastline. Conservation zoned land. Potential for land to have a high community value.	Low	Higher
Marine Features		
Access to deep ocean in Great Australian Bight. Good dispersion of brine due to high wave energy. Water depth of 20 m (as preferred for intake and outlet) can be reached around 1 km offshore.	Low	Equivalent
Water Delivery		
Significant length of water delivery pipeline required approximately 320km of pipeline to reach Whyalla, and then a further 320km via Lincoln's Gap to the mining sites at Olympic Dam and Carrapateena.	High	Significantly Higher
Power Supply		
Similar as for Ceduna. Limited infrastructure and logistics available from local township of Elliston. Location is remote from major supply hub.	High	Significantly Higher

Key Risks	Opportunities
Significant issues with power supply and water delivery infrastructure	Open ocean water intake, provides potentially higher quality water source.
Potential marine construction risks from high energy coastline	Good dispersion currents reduce potential for plume impacts.
Site location within conservation zone on high cliff face. Anticipated to have high community value.	

4.11 Cape Hardy

Land Features and geology

The proposed site location is associated with the headland of Cape Hardy, which is on the western side of the Gulf, approximately 10 km south of Port Neil. The site and surrounding land is owned by the proponents of the proposed Iron Road Port Development. The port is planned to serve the export interests of mining company Iron Road and the development of the Central Eyre Iron Project. In November 2015, Iron Road announced that an Environmental Impact Statement and Mining Lease application had been lodged with the South Australian Department of Planning, Transport and Infrastructure, which includes the port proposal. Project Approval is understood to have been achieved. Iron Road are also understood to have a, indigenous land use agreement in place. Development of the site is still yet to commence.

The coastline currently is zoned as conservation, with the area behind the coastal dune zone being rural zoning. Access to the area is currently limited to the Cape Hardy track, and no infrastructure exists within the area. The coastline lies approximately 7 km to the east of the Lincoln Highway. A new access road with be required to the site from the highway.

The 1:250,000 scale published geological map suggests that the geology of the area consists of Proterozoic volcanic rocks comprising undifferentiated intrusives and orthogneisses of the Donington Suite. The volcanic rocks are likely to be veneered by Quaterary age soils comprising either quartz seif dunes and sand spreads, or thin colluvial loamy sand and gravelly clay with nodules of calcrete.

The surficial ground conditions should allow conventional footings to be adopted for desalination plant buildings, although the potentially collapsing nature of any aeolian sands that are present must be considered by designing for large potential ground movements and by paying particular attention to site drainage so as to prevent wetting up of the foundation soils. Excavations of circa 15 m depth for tunnel launch chambers are very likely to encounter rock strength materials in the form of Donington Suite volcanic rock. Therefore, these excavations are expected to require blasting to achieve satisfactory excavation productivity. Since the vertical alignments of marine intake and outfall pipelines would be in the Donington Suite volcanic rock, “hard ground” (i.e. rock strength) tunnelling conditions are expected. The expected hard and abrasive nature of the rock is likely to result in greater face wear and slower tunnelling productivity.

Marine features

For a plant located in Cape Hardy, the seawater intake and concentrate outlet would be located in the southern region of Spencer Gulf.

A water depth of 20 m in proximity to the site location is available at a distance of approximately 1.3 km offshore (**Figure 20**), which is a similar distance for Port Bonython.

The southern region of Spencer Gulf has low salinity compared to the northern regions. The salinity gradient as indicated in **Figure 6** is approximately 3 g/L lower that for Point Bonython. The current climate and water quality is anticipated to be similar to Port Bonython, but with potentially lower average currents due to the open coastline morphology.

Two areas are currently designated for aquaculture purposes in the vicinity of the Cape. The intake and outlet locations will have to take these into account in selection of a final location to avoid water quality impacts from elevated nutrient levels associated with the aquaculture pens.

The site location is approximately 12 km north of the Sir Joseph Banks Group Marine Park. Operation of the intake and outlet are not anticipated to impact this area.

Mixing and dilution of the brine discharge is expected to be aided by the open nature of the coastline in this location.

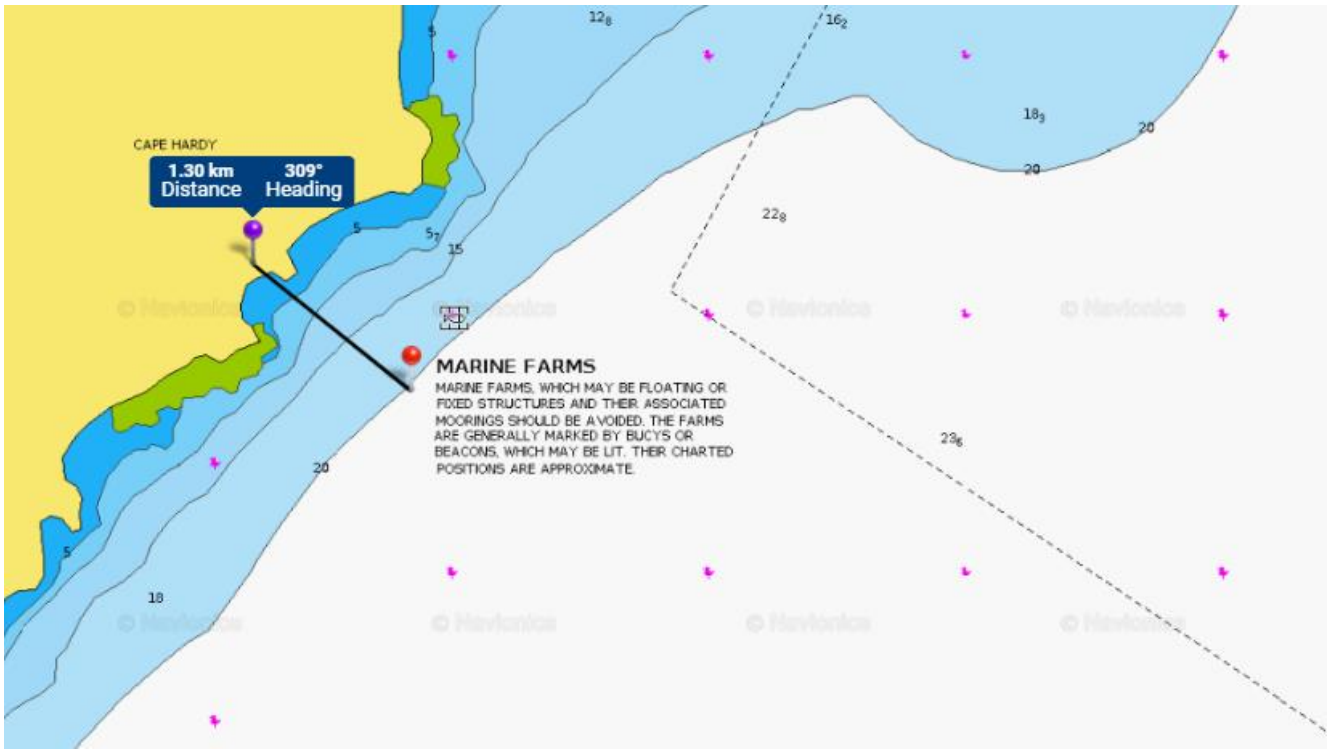


Figure 20 Cape Hardy area bathymetry

Water Delivery

The distance from Cape Hardy site to Whyalla is approximately 200 km via the Lincoln highway. The delivery pipe would then have to extend a further 320 km in the configuration proposed for the Port Bonython site option to reach the mining sites at Olympic Dam and Carrapateena.

Power Supply

Power to the site at Cape Hardy would be provided from an existing 132 kV transmission line from Cultana to Yadnarie that covers a large distance towards the west coast. For a large-scale desalination plant (150 ML/d capacity) provision of new transformers at a 132 kV tee-off and dual 132 kV feeders, approximately 25 km in length, to the plant site would be required. Given that Cultana is supplied via dual 275 kV lines via Port Augusta (Davenport Substation) and there is an ElectraNet project underway for a new 132 kV dual transmission line from Cultana to Port Lincoln, then this location has medium feasibility certainty.

The complexity of a new supply will depend on whether spare capacity is available from the new transmission line in its originally proposed 132 kV form or if initiation of projects drives the change to 275 kV conversion from Cultana to Port Lincoln. The line would need to be extended via a 132 kV transmission line tee-off in the Ungarra area, and over the Port Lincoln highway, totalling approximately 25 km to the plant site on the coast. Noting that the new 132 kV lines from Cultana are planned to be located on the northern side of the existing line.

Power is supplied into the ElectraNet 132 kV zone substation Yadnarie, from existing grid infrastructure centred around the Gulf. Yadnarie is located halfway between Cleve and Rudall. Yadnarie 132 kV transmission lines that are directed south-west, supply Port Lincoln and surrounding areas. If a 132 kV connection tee-off South-West of Yadnarie, at Ungarra, is not feasible then an expected high cost is anticipated for the upgrade of Yadnarie substation and / or the construction of an additional 132 kV line supply from Cultana. This appears to be unlikely given the information available from the AEMO and ElectraNet websites.

According to published planning reports from ElectraNet and SA Power Networks, and details on the AEMO web site, there are various existing network capacity limits west of the Cultana substation and it is unclear which network upgrade projects may proceed and when. However, the June 2016 South Australian Transmission Annual Planning Report lists the Eyre Peninsula 132 kV line replacement from Cultana via Yadnarie to Port Lincoln, as a 2020 ElectraNet project and potential for a future conversion to a 275kV line to the Eyre Peninsula. ElectraNet has since published web-site information for the 2021 commencement of the 'Eyre Peninsula Link' project, with construction of a new double circuit 132 kV line from Cultana to Port Lincoln. Further enquiries are required with the TNSP to determine the status of existing network upgrades and commitments to planned network upgrade projects. A new connection planned together with a network upgrade could have benefits of reduce network augmentation costs.

This level of detail gives the Cape Hardy location potential for a high confidence rating for power supply however due to a number of dependencies such as project timing and negotiations required, this option is assessed as being medium confidence for the power supply.

Summary

Cape Hardy

Region: The site is located behind the headland north of Cape Hardy.

Description	Feasibility uncertainty	Capital cost relative to Port Bonython
Land Features		
The site is located within the site proposed for the Iron Rd development, Iron Rd already have an indigenous land use agreement. The coastline of the promontory is zoned as conservation/rural area.	Low	Higher
Marine Features		
The site provides access to Southern part of Spencer Gulf. Reasonably high-quality water is expected with lower salinity than northern regions of Spencer Gulf. Water depths of 20 m can be reached within 1.3 km from shore. Moderate water depth and wave energy is anticipated to be available to promote mixing and dilution of brine.	Low	Equivalent
Water Delivery		
Significant length of additional water delivery pipeline required approximately 200 km of pipeline to reach a point of connection to SA Water system at Whyalla, which then extends on as for other options to connect the mining sites at Olympic Dam and Carrapateena.	High	Significantly Higher

Power Supply		
ElectraNet have published information on their website for the 2021 commencement of the 'Eyre Peninsula Link' project, with construction of a new double circuit 132 kV line from Cultana to Port Lincoln. This is to replace the existing aging 132 kV link, so is not "new" capacity. ElectraNet project is about 50% complete.	Medium	Higher

Key Risks	Opportunities
Scale of water delivery infrastructure required introduces project risk – additional 200km of pipeline required	Access to good quality water
Perceived impacts on nearby aquaculture industry	Good dispersion currents reduce potential for plume impacts.
	Outside Marine Park zones
	Iron Rd development has an existing EIS and ILUA

4.12 Option Cost Difference

The purpose of these estimates is to illustrate the comparative difference in capital cost between each desalination plant and delivery system option configuration associated with each potential site location. For this assessment, the Port Bonython option has been used as a baseline from which the cost difference is compared, presented in **Table 1**.

The same 150 ML/d capacity desalination plant has been assumed for all cases. The primary differences between the baseline case and other potential site alternatives are the intake/outlet structures, the length of the delivery system and the power supply requirements. These infrastructure components vary from site to site due to their proximity to the ocean and the points of power supply as well as water delivery.

Cost estimates for this study have been developed using the same approach adopted for the Northern Water Supply (NWS) Technical Assessment Report (Jacobs and GHD, August 2021) study for consistency. The estimate is built up from unit rate estimating of contractor's direct costs and percentage-based estimates for indirect costs, client costs and contingency. The percentage of the project cost used for the various indirect costs are those adopted for use in the Technical Assessment Report.

Table 1 Summary of Option Cost Differential

Option Differential Cost		**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**	**Option 6**	**Option 7**	**Option 8**	**Option 9**	**Option 10**
Description		**Whyalla - Steel Works 150 ML/d desal plant**	**Point Lowly - Port Bonython 150 ML/d desal plant**	**Crag Point - South of Port Augusta 150 ML/d desal plant**	**Port Augusta - ex. Northern Power Station 150 ML/d desal plant**	**Cowleds Landing - South of Whyalla 150 ML/d desal plant**	**Myponie Point - South of Port Pirie 150 ML/d desal plant**	**Weeroona Area 150 ML/d desal plant**	**Ceduna (Point Brown) 150 ML/d desal plant**	**Elliston 150 ML/d desal plant**	**Cape Hardy 150 ML/d desal plant**
CONTRACT DIRECTS											
Desalination Plant		equal	equal	equal	equal	equal	equal	equal	equal	equal	equal
Power upgrade		$17,000,000	$25,000,000	$28,600,000	$17,000,000	$22,500,000	$23,200,000	$21,400,000	$99,500,000	$58,100,000	$29,000,000
Intake / Outlet Tunnels		$360,500,000	$90,100,000	$54,100,000	$360,500,000	$180,300,000	$162,200,000	$721,000,000	$72,100,000	$36,100,000	$46,900,000
Delivery System		$0	$0	$32,600,000	$159,400,000	$237,200,000	$872,900,000	$520,000,000	$1,724,200,000	$1,284,000,000	$820,900,000
Contractor's Direct Cost	**[A]**	**$377,500,000**	**$115,100,000**	**$115,200,000**	**$536,900,000**	**$440,000,000**	**$1,058,400,000**	**$1,262,400,000**	**$1,895,800,000**	**$1,378,100,000**	**$896,800,000**
CONTRACT INDIRECTS	**% of [A]**										
Contractor's Indirect Cost	**[B]**	**$158,200,000**	**$48,200,000**	**$48,300,000**	**$225,000,000**	**$184,400,000**	**$443,500,000**	**$528,900,000**	**$794,300,000**	**$577,400,000**	**$375,700,000**
CONSTRUCTION COST	**[A]+[B]**										
Construction Cost	**[C]**	**$535,700,000**	**$163,400,000**	**$163,500,000**	**$761,900,000**	**$624,300,000**	**$1,501,800,000**	**$1,791,400,000**	**$2,690,100,000**	**$1,955,500,000**	**$1,272,500,000**
CLIENT COSTS	**% of [C]**										
Client Costs	**[D]**	**$50,900,000**	**$21,100,000**	**$21,100,000**	**$69,000,000**	**$57,900,000**	**$128,100,000**	**$151,300,000**	**$223,200,000**	**$164,400,000**	**$109,800,000**
SUB-TOTAL OPTION COSTS	**[C]+[D]**										
Sub-Total Option Costs	**[E]**	**$586,500,000**	**$184,400,000**	**$184,600,000**	**$830,900,000**	**$682,300,000**	**$1,630,000,000**	**$1,942,700,000**	**$2,913,300,000**	**$2,120,000,000**	**$1,382,300,000**
CONTINGENCY	**% of [C]**										
Contingency	**[F]**	**$160,700,000**	**$49,000,000**	**$49,100,000**	**$228,600,000**	**$187,300,000**	**$450,500,000**	**$537,400,000**	**$807,000,000**	**$586,700,000**	**$381,700,000**
OPTION ESTIMATE DIFFERENTIAL COST	**[E] + [F]**										
Option Estimate Differential (excl. SA Water cost components	**[G]**	**$747,200,000**	**$233,400,000**	**$233,600,000**	**$1,059,400,000**	**$869,600,000**	**$2,080,500,000**	**$2,480,100,000**	**$3,720,400,000**	**$2,706,600,000**	**$1,764,000,000**
Shared Components (priced by SA Water)		**$606,000,000**	**$743,000,000**	**$743,000,000**	**$573,000,000**	**$573,000,000**	**$573,000,000**	**$573,000,000**	**$573,000,000**	**$573,000,000**	**$573,000,000**
SA Water Infrastructure Requirements		**$588,600,000**	**$611,600,000**	**$611,600,000**	**$569,600,000**	**$602,456,522**	**$569,600,000**	**$569,600,000**	**$569,600,000**	**$569,600,000**	**$602,456,522**
Nett difference in cost against Option 4 (Port Bonython)		**$353,800,000**	**$0**	**$200,000**	**$614,000,000**	**$457,000,000**	**$1,635,100,000**	**$2,034,700,000**	**$3,275,000,000**	**$2,261,200,000**	**$1,351,500,000**
Nett difference in cost, percentage		**9%**	**0%**	**0%**	**16%**	**12%**	**43%**	**54%**	**86%**	**60%**	**36%**

The costs stated in **Table 1** do not represent an estimate of the total capital cost of each option. They only represent an order of magnitude assessment of the difference in cost between a Port Bonython option and any other option.

5. Site Review Outcomes

Potential sites at a range of locations around the Spencer Gulf and southern ocean coastline were reviewed based on high level information readily available in the public domain to assess their feasibility for siting a desalination plant that could serve as a supply of water to the Gawler Craton.

A comparative assessment of the sites identified has also been undertaken against the Port Bonython site. The feasibility of Port Bonython as a site has been reviewed within this study and also assessed against the other potential sites. Port Bonython has been assessed in this manner as it has previously been considered as a preferred site in another similar desalination project – the BHP Olympic Dam expansion. There is interest to ascertain whether it still ranks as feasible at this point in time in comparison to other potential sites, and in response to the key siting considerations identified in this study.

The site locations assessed are:

- Whyalla (steelworks site)
- Point Lowly (Port Bonython)
- Crag Point - north of Point Lowly
- Port Augusta (ex Northern Power Station site)
- Cowleds Landing - South of Whyalla
- Myponie Point - South of Port Pirie
- Weeroona (ex. SAMAG magnesium processing and export terminal site)
- Ceduna – Point Brown
- Elliston
- Cape Hardy (Iron Road ore export terminal site)

The relative locations of the potential site locations considered are illustrated in **Figure 9**. These sites have included several sites previously assessed by BHP in their 2009 EIS for the Olympic Dam expansion project, as well as a number of additional sites identified by ISA through more recent studies.

Assessment of each potential site has been undertaken employing two individual and distinct processes. The different assessment processes have been used as a form of independent cross check on the outcome to see if there are any common themes. The results of each process are discussed and then summarised in the Outcomes of the report. The assessment processes undertaken were:

- An initial qualitative assessment of the feasibility uncertainty of each site against the potential for any of the identified features or issues to result in the region being unsuitable for a seawater desalination project. A qualitative risk rating (Low, Medium, High) was assigned against each siting assessment criteria for each site.
- A multi-criteria risk assessment, undertaken within a workshop environment held with ISA and their environmental consultant, JBS&G, to assess the features and issues associated with each site, and the option configuration that would be required to be able to service the Gawler Craton.

A high-level assessment has then been undertaken of the cost differential between each site option relative to the configuration required for a plant at Port Bonython. This cost differential assessment considers the areas of difference in the infrastructure required (intakes, outlets, power supply delivery system) when each option configuration is compared with that required for a plant at Port Bonython.

The outcomes from each of these assessment phases are summarised in the following discussion.

5.1 Feasibility Uncertainty Assessment Outcomes

Feasibility uncertainty for each site option as assessed and presented within Section 4 of this study. The findings from this review against the key siting considerations are summarised together in **Table 2**.

Table 2 Site Feasibility Uncertainty Assessment Summary

Feasibility uncertainty	Whyalla	Point Lowly (Port Bonython)	Crag Point - north of Point Lowly	Port Augusta	Cowleds Landing - South of Whyalla	Myponie Point -South of Port Pirie	Weeroona area	Ceduna	Elliston	Cape Hardy
Land Features	*High*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
	Occupied commercially productive Industrial land	Vacant State land	Highly constrained site	Industrial land	Rural land	Rural land	Rural land.	Rural land	Rural land	Co-located with new development
Marine Features	*Medium*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Low*	*Low*	*Low*
	Low circulation and mixing	Perceived marine fauna impacts	Lower potential for aquatic impacts	Shallow. High potential for poor water quality	Aquatic environment less understood	Aquatic environment less understood	Shallow water. Significant intake infrastructure	Deep, clean water	Deep, clean water	Good potential for high water quality
Water Delivery	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Medium*	*High*	*High*	*High*
	Equivalent delivery pipeline	Equivalent delivery pipeline	Constrained by Defence land.	Equivalent delivery pipeline	Longer delivery pipeline	Longer delivery pipeline	Longer delivery pipeline	Extremely long delivery pipeline	Long delivery pipeline	Additional works required with more uncertain
Power Supply	*Low*	*Low*	*Low*	*Low*	*Medium*	*Medium*	*Medium*	*High*	*High*	*Medium*
	Available close by	Available close by	Available close by	Available close by	Upgrade scope greater, and more uncertain	Upgrade scope greater, and more uncertain	Upgrade scope greater, and more uncertain	Significant works required and more uncertain	Significant works required and more uncertain	Significant upgrade scope but potential to benefit from current project

From this assessment, the following points are noted in respect of the feasibility of the various sites assessed:

- A Port Augusta site is considered to provide significant challenges with respect to the raw water quality available at the site, and also the ability to effectively mix and diffuse the brine discharge and manage its impacts.
- The bathymetry of Spencer Gulf around Port Augusta, Myponie Point and Weeroona is shallow, meaning the length of intakes and outfalls required to reach locations and depths of water that would provide for good quality seawater feed to the plant are very significant compared to the other site options. This aspect is considered to impact the feasibility of these site options.
- Ceduna and Elliston requires long delivery pipelines and significant works to enable a suitable power connection to be provided. They are also in locations that are generally remote from the logistical support necessary for operation of a desalination plant. This includes access to skilled operators, maintenance staff, chemicals, and consumables supplies. Truck transport for water treatment chemical deliveries and waste product removal required for a plant of this scale will be frequent activities, potentially weekly. The transport distances involved will impact operating cost.
- The Whyalla site is constrained by current ongoing industrial metal processing, and acquisition of this land has yet to be tested with the current owner. Local eddy currents within the Whyalla embayment and the potential for contaminated sediments present challenges that are not present at other site locations.
- The Crag Point site area is significantly constrained as it is bounded by the shoreline to the east and the Defence Training area to the west. The terrain is anticipated to have significant slopes to the shoreline and is traversed by a major gully, which affect the useable area of the site. More detailed site inspection may show these constraints can be managed. Ability to access or acquire of a portion of defence land to expand the site area has not yet been tested.

Based on this assessment, the sites with the lower levels of uncertainty, which are therefore considered more likely to provide feasible potential sites, include:

- Port Bonython
- Cowleds Landing
- Crag Point

5.2 Multi-Criteria Risk Assessment Workshop Outcomes

On 11th of March 2022 Jacobs/GHD held a workshop with ISA and their environmental assessment advisers, JBS&G, to undertake assessment of the risk to completion of the project. The assessment utilised criteria based on the key siting consideration factors and assessed the information on each site gathered to date. The assessment considered three levels of potential risk to project completion – High, Medium, and Low.

The risk workshop process gave separate consideration to the terrestrial and aquatic environmental impacts associated with each potential site, which was not done in the feasibility uncertainty assessment.

The results of the workshop evaluation are presented in **Table 3** in the form of a heat map for ease of interpretation. The relative risk levels are represented by the traffic light colours – Red, Amber, and Green. A more comprehensive summary of the risk assessment outcomes incorporating commentary on the risk ratings assigned is tabulated in **Appendix C**.

The outcomes noted from this assessment included:

- The risk workshop outcomes were considered generally consistent with the initial feasibility assessment screening
- Sites with the overall lower risk levels included Port Bonython following by Cowleds Landing and then Cape Hardy.
- Sites with intake / outlet structures located toward the centre or in open areas of the Gulf (Cowleds Landing, Myponie, Weeroona, and potentially Cape Hardy) were noted to potentially have localised impacts on commercial prawn fishing. The fishing operations involve trawl nets that are pulled along the seafloor right across the Gulf south of Point Lowly. Navigation exclusion zones would have to be set up around the structures, which would impact trawling activities.
- The Crag Point site was rated as having a high potential for cultural heritage impact as it is located on the foreshore as foreshore areas around the Gulf were noted to commonly have high cultural heritage value. Further evaluation of the site may enable this rating to be revised. The Port Bonython site by comparison is located inland from the foreshore and it may be possible to avoid impacts by tunnelling under sensitive areas.
- The water delivery complexity category doesn't have any other site with a lower risk rating than Port Bonython
- The assessed terrestrial environmental impact at Cowleds Landing was rated as high, however this was noted to have potential to be reduced with further investigation work.
- Water delivery complexity for the Point Brown, Elliston and Cape Hardy sites was rated as high on the basis that the significant length of pipeline infrastructure required would translate to a higher project risk profile. Additional work to optimise the infrastructure required and refine the route, particularly in the case of Cape Hardy (lesser amount of infrastructure, and more direct route to Whyalla) may enable a lower risk rating.
- The cost differential for sites situated on the east coast of the Gulf and also Ceduna, Elliston and Capy Hardy were noted to be significant and are anticipated to make these sites financially unviable.

Table 3 Site Assessment Risk Identification Heatmap

			Criteria							
	FINANCIAL		TECHNICAL						ENVIRONMENTAL	
	Relative Cost Differential		**Water Quality/ Diffusion Mixing**	**Water Delivery Complexity**	**Proximity to Support infrastructure**	**Power Supply Complexity**	**Site Acquisition & Compatibility**		**Terrestrial Environmental Impacts**	**Marine Environmental Impacts**
	Design, construction and client costs; intake and outlet; delivery system; power supply		Potential for access to Good Water Quality; Potential for access to area of high energy to promote diffusion mixing	Accessibility and constructability of a water supply pipeline. Existing road access. Additiona length increase risk of delay in completion. (Cost is treated separatly)	Proximity to roads and telecommunications infrastructure, and logistical and population centres to support construction and ongoing operation.	Assessment of existing power supply or possibility for installation of power supply infrastructure.	Current compatible land use. Ability to acquire the land. Sufficient area for the infrastructure and construction lay down		- Approval pathway - Level/amount of clearing of native vegetation required - Extent of endangered or listed sensitive flora and fauna impacted - Potential for impacts on Aboriginal values - Potential for European Heritage impacts	- Impact on marine environment from intake - Impact on marine environment from discharge (Assumes tunnelled intake and outlet)
Potential Site	% Increase	$m	Risk : Low Medium High	Risk : Low Medium High	Risk : Low Medium High	Risk : Low Medium High	Risk : Low Medium High		Risk : Low Medium High	Risk : Low Medium High
Whyalla	9%	$354								
Point Lowly - Port Bonython	0%	$0								
Crag Point	0%	$0.2								
Port Augusta	16%	$614								
Cowleds Landing - South	12%	$457								
Myponie Point - South of Port Pirie	43%	$1,635								
Weeroona (ex. SAMAG site)	54%	$2,035								
Ceduna (Point Brown)	86%	$3,275								
Eliston (South Coast)	60%	$2,261								
Cape Hardy	36%	$1,352								

5.3 Cost Differential Assessment

The anticipated cost differential between the desalination plant and delivery system option configuration associated with each potential site location has been assessed to further inform the site assessment process. This cost assessment only focusses on the primary differences in infrastructure between each option configuration.

The Port Bonython option has been used as a base case only to enable this comparison. The cost differential for each option has been included in the heat map in **Table 3**.

The cost differences are primarily driven by the cost for the delivery system infrastructure, and the length of intake and outlet tunnels required from the plant site to reach the preferred depth of water. It is noted that these estimates of cost have been developed from high level concepts which have not been optimised, and so further work may influence the result indicated in this assessment.

Port Bonython was seen to have the lowest relative cost, however Whyalla, Crag Point, and Cowleds Landing are within 10% of the same amount and these differences are not considered significant for this assessment.

6. Summary

A high-level assessment has been undertaken on a range of potential sites for a desalination plant to service the Gawler Craton. The assessments evaluated the sites based on the range of criteria including financial, technical, environmental and social aspects.

Two separate forms of assessment were undertaken:

- An initial qualitative assessment of the feasibility uncertainty of each site against a range of criteria that influence the viability of development of a desalination project in a given area or site.
- A multi-criteria risk assessment, to assess technical risks and anticipated environmental impacts associated with each site.

The cost differential between each option and a 'baseline' option of a plant sited at Port Bonython was also assessed.

The outcomes of each of these assessments were considered broadly consistent in indicating a sub-set of feasible sites. A shortlist of sites has been selected in consideration of the results of the assessments and the following:

- Sites where the cost differential exceeds $1 billion above the 'baseline' option have been excluded on the basis that they would not be financially viable
- Sites where the assessments indicate there is a high likelihood of poor source water quality or issues associated with achieving the require diffusion and hence potential discharge impacts have been excluded.

On this basis, the sites considered most feasible and suitable to take forward for further evaluation to support the supply of water to the Gawler Craton area include:

- Port Bonython
- Crag Point
- Cowleds Landing

The assessment has flagged a number of issues in relation to site features, constraints, and potential risks, based on the level of assessment conducted to date. These issues should be taken forward for further consideration in the next phase of development of this project.

One of the key outcomes of this report has been to identify that there are a range of feasible sites, but to also identify that there is currently an unequal level of data available on each of these sites. There is therefore currently an unequal level of understanding of the potential risks that may arise as further investigation and project development is undertaken.

Port Bonython is one site that has a greater volume of data, as it has been subject to more investigation historically in past projects.

This assessment has been based on desktop level review of information readily available from publicly available databases. Further work on any of the sites may identify flaws or issues that have yet to be uncovered. It is prudent to move forward with several sites as a shortlist and then undertake site specific investigations to develop the understanding of each site to an equal level. This then would enable a robust assessment and selection of a preferred site for the purposes of detailed assessment within an EIS.

For the three sites identified to be taken forward, it is recommended that the following initial investigations be made to determine whether they enable any further differentiation between the three shortlisted sites:

- SARDI be engaged to undertake high level modelling of plume dispersion and recirculation.

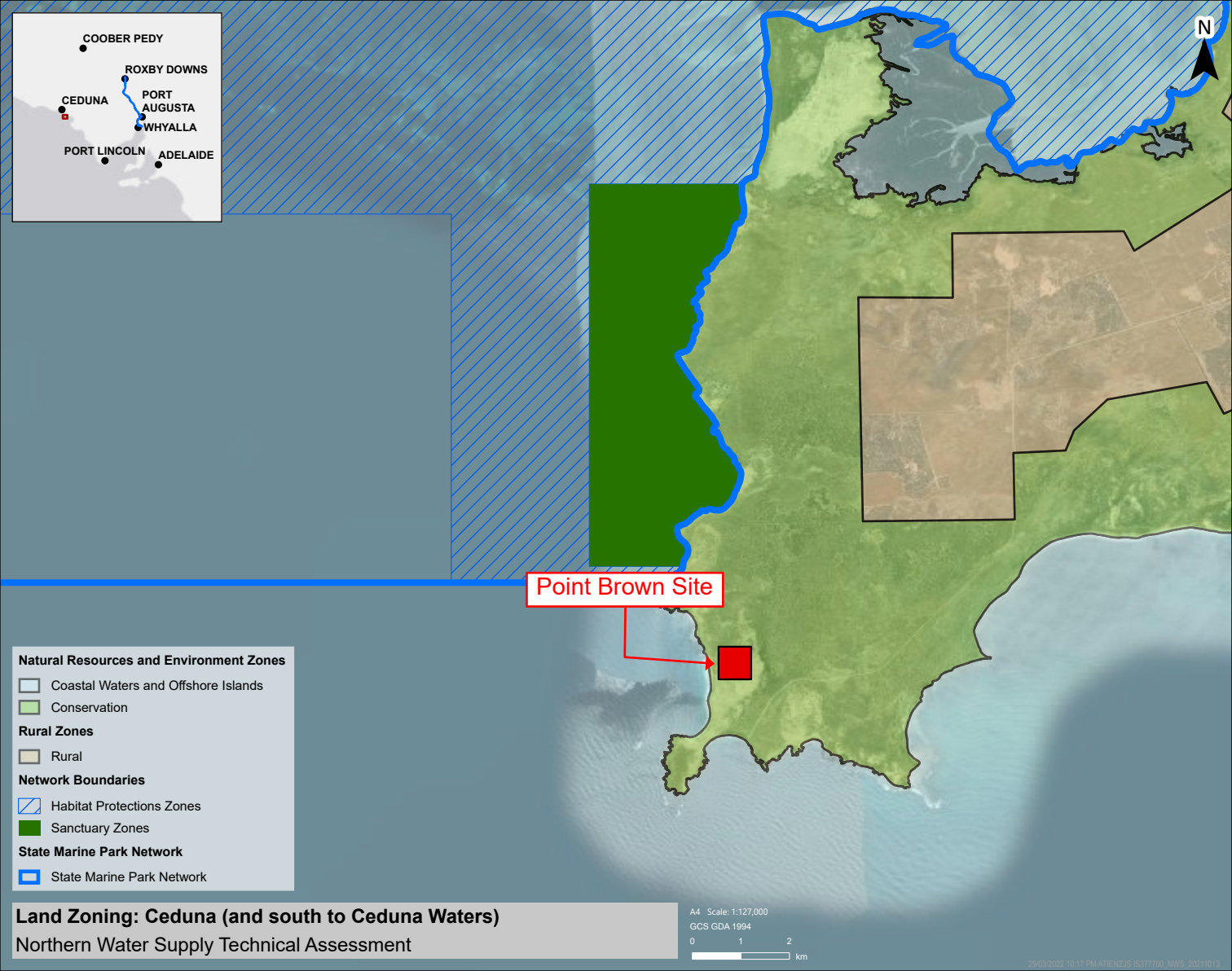
- Liaison with Defence be undertaken regarding the Crag Point site to see what options or limitations exist for provision of an access right of way and pipeline easement to the site location, and to the acquisition of additional area for the site from the Defence Training Area.

Following these initial investigations and assessment of their outcomes, there are further site-specific investigations recommended as prudent to undertake. These investigations are intended to levelise the amount of information available across the shortlist of sites to better support a final site selection process. These include:

- Site terrain and survey mapping and morphology of the site
- Site geology and geotechnical assessment.
- Site specific assessment of the local bathymetry
- Environmental and cultural heritage assessment of the terrestrial environment
- Assessment of aquatic environment
- Assessment of the current level of seawater quality data that exists that would be provided to designers of a plant to base their design on and base the commercial requirements of a construction and operation contract on.
- Further conceptual assessment of the delivery pipeline alignments and system hydraulics
- Development of a better understanding of the power demand requirement
- Liaison with state energy supply authorities to inform them of the project so they can integrate its demand in their network planning and provide a clearer understanding of the scale of network augmentation that may be required, and the timeframe required for this to be delivered
- Further assessment of the anticipated water demand from customers and the timeframe over which this demand would develop

There also needs to be an assessment of the timeframe to deliver these additional investigations so that they can be allowed for the overall delivery program for the project.

Appendix A. Land Zoning Maps


COOBER PEDY
ROXBY DOWNS
CEDUNA
PORT AUGUSTA
WHYALLA
PORT LINCOLN
ADELAIDE
N
Point Brown Site
Natural Resources and Environment Zones
Coastal Waters and Offshore Islands
Conservation
Rural Zones
Rural
Network Boundaries
Habitat Protections Zones
Sanctuary Zones
State Marine Park Network
State Marine Park Network
Land Zoning: Ceduna (and south to Ceduna Waters)
Northern Water Supply Technical Assessment
A4 Scale: 1:127,000
GCS GDA 1994
0 1 2
km



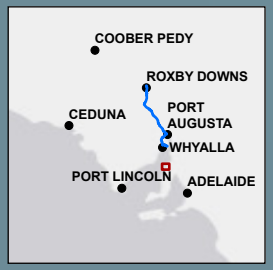
Land Zoning: Crag Point

Northern Water Supply Technical Assessment



Land Zoning: Elliston

Northern Water Supply Technical Assessment



N

Myponie Point

HIGH ST

SPENCER HWY

PORT BROUGHTON RD

BUTE RD

PORT DAVIS

HUGHES ST

Employment Zones
- Employment
- Employment (Bulk Handling)

Infrastructure Zones
- Community Facilities
- Infrastructure
- Infrastructure (Ferry and Marina Facilities)

Natural Resources and Environment Zones
- Coastal Waters and Offshore Islands
- Conservation
- Open Space

Neighbourhood and Corridor Zones
- Home Industry
- Neighbourhood

Rural Zones
- Rural

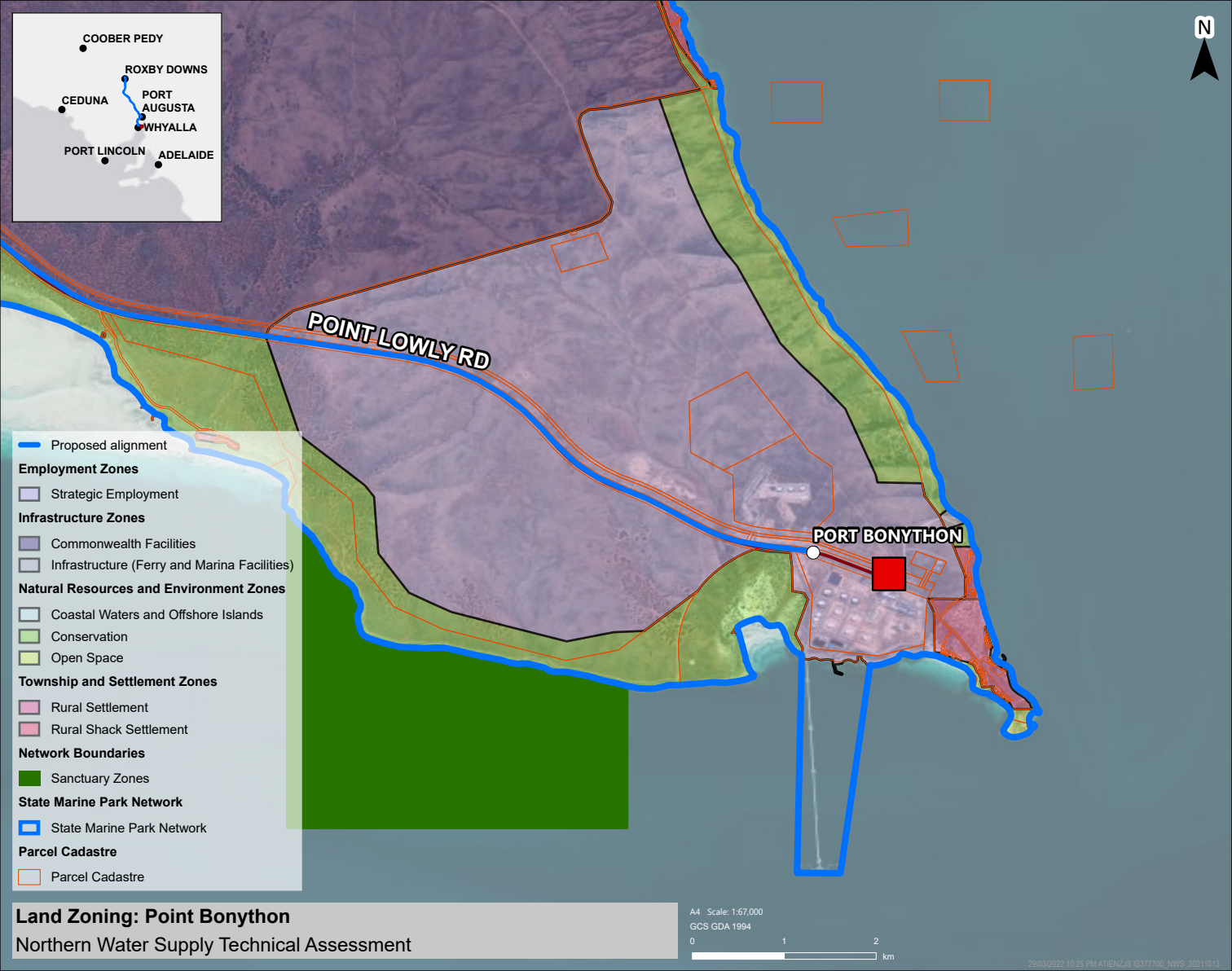
Tourism Zones
- Caravan and Tourist Park
- Tourism Development

Township and Settlement Zones
- Rural Living
- Rural Settlement
- Rural Shack Settlement
- Township
- Township Main Street

A4 Scale: 1:167,000
GCS GDA 1994
0 1 2 km

Land Zoning: Myponie Point

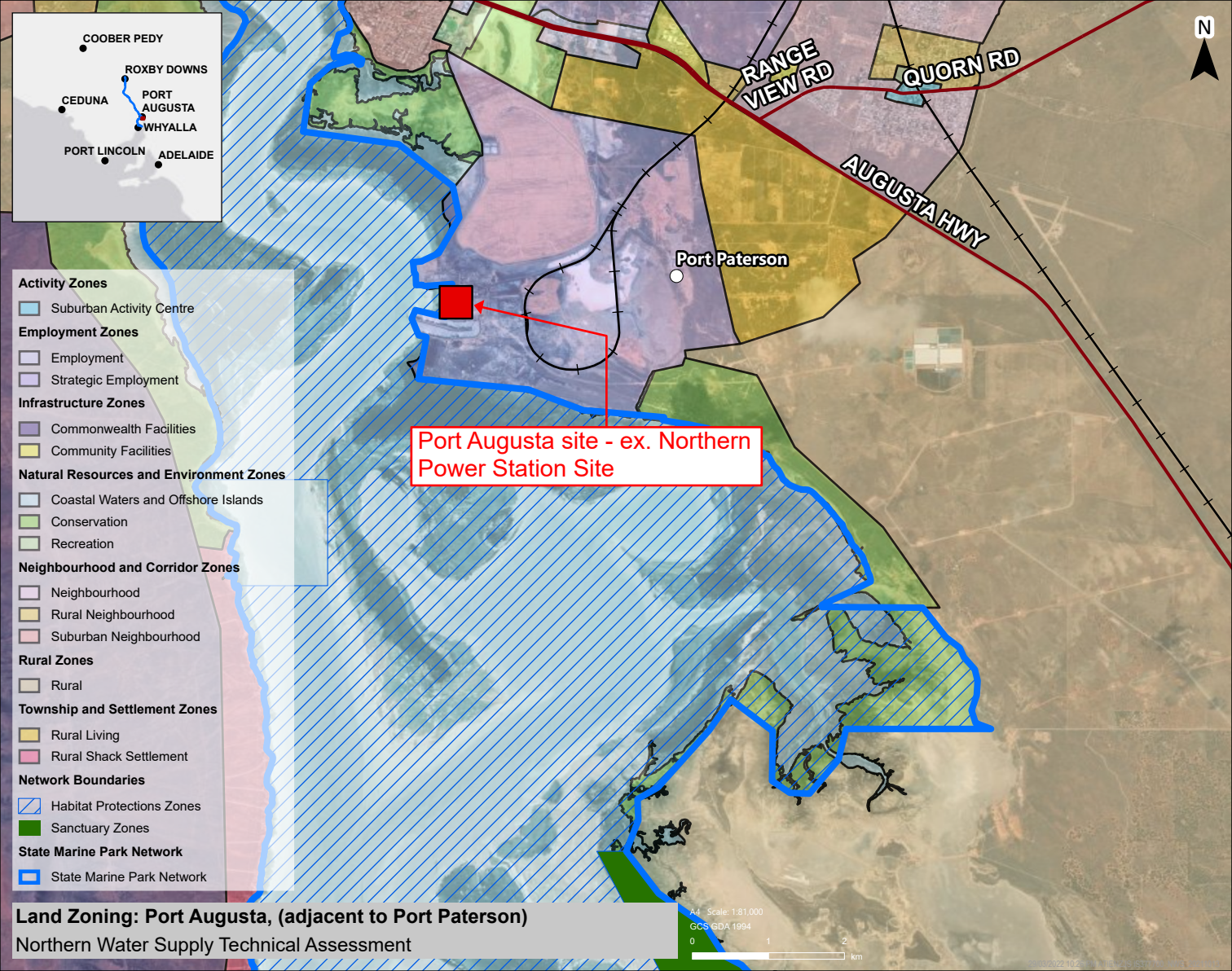
Northern Water Supply Technical Assessment



Land Zoning: Point Bonython

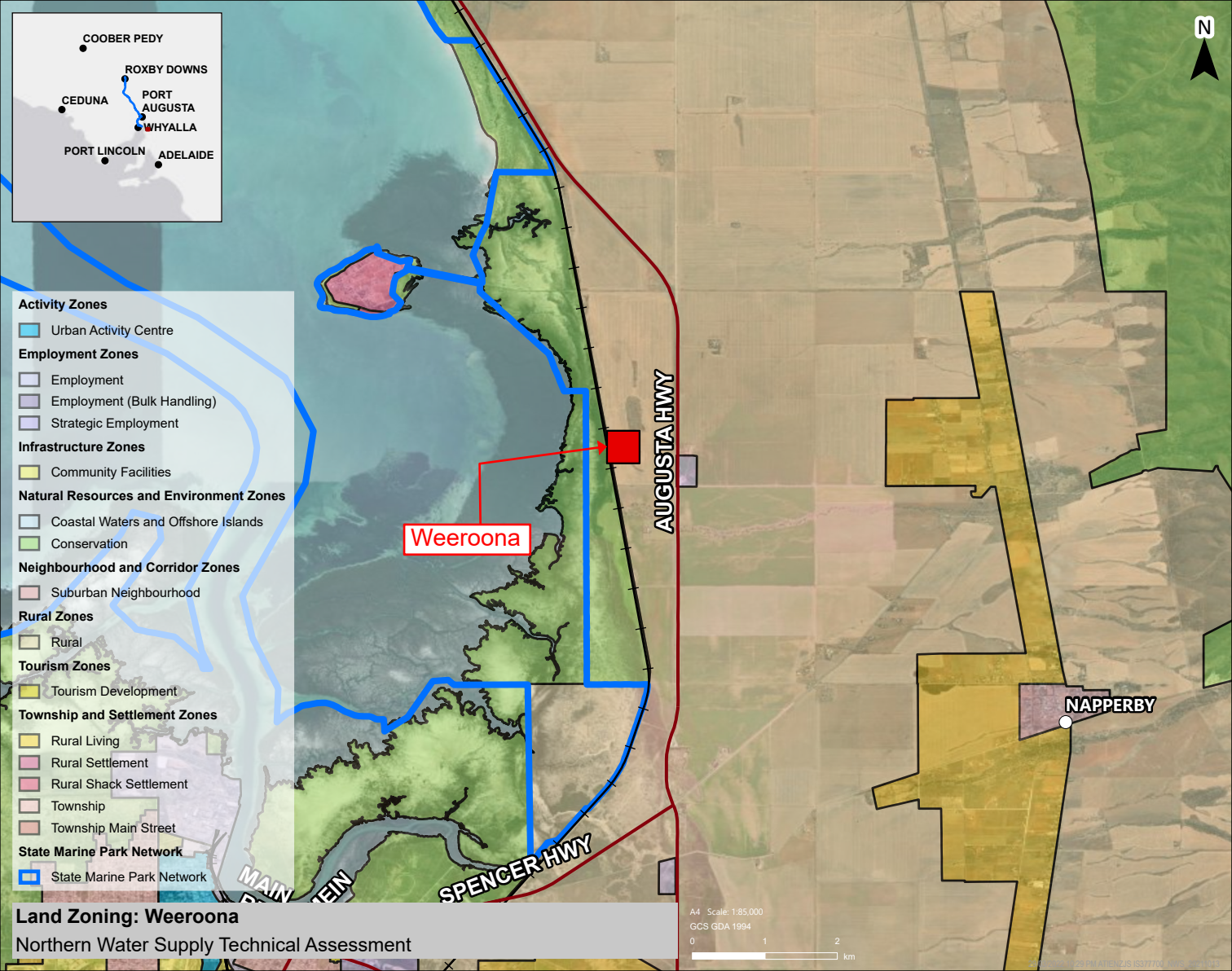
Northern Water Supply Technical Assessment

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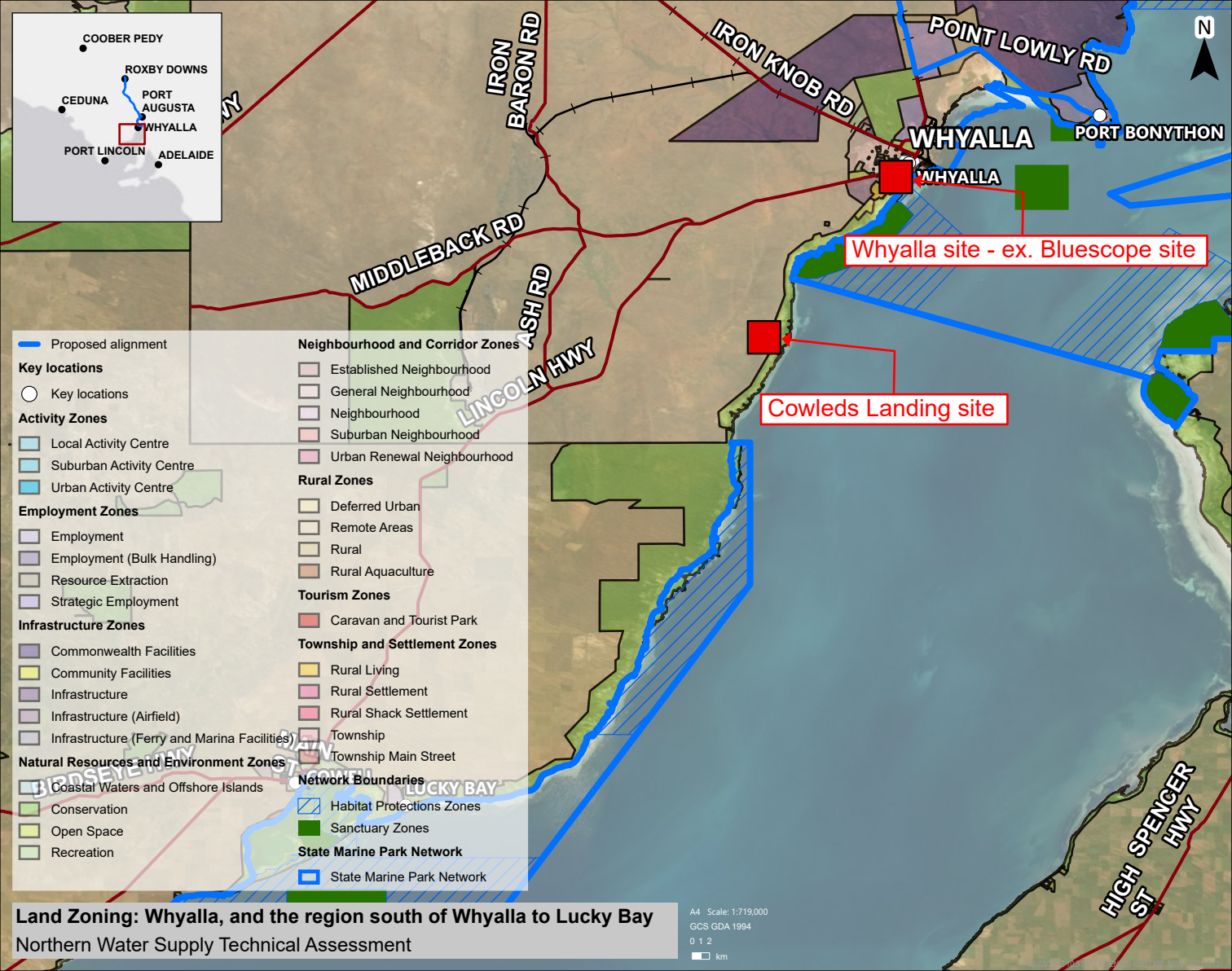
Land Zoning: Port Augusta, (adjacent to Port Paterson)

Northern Water Supply Technical Assessment



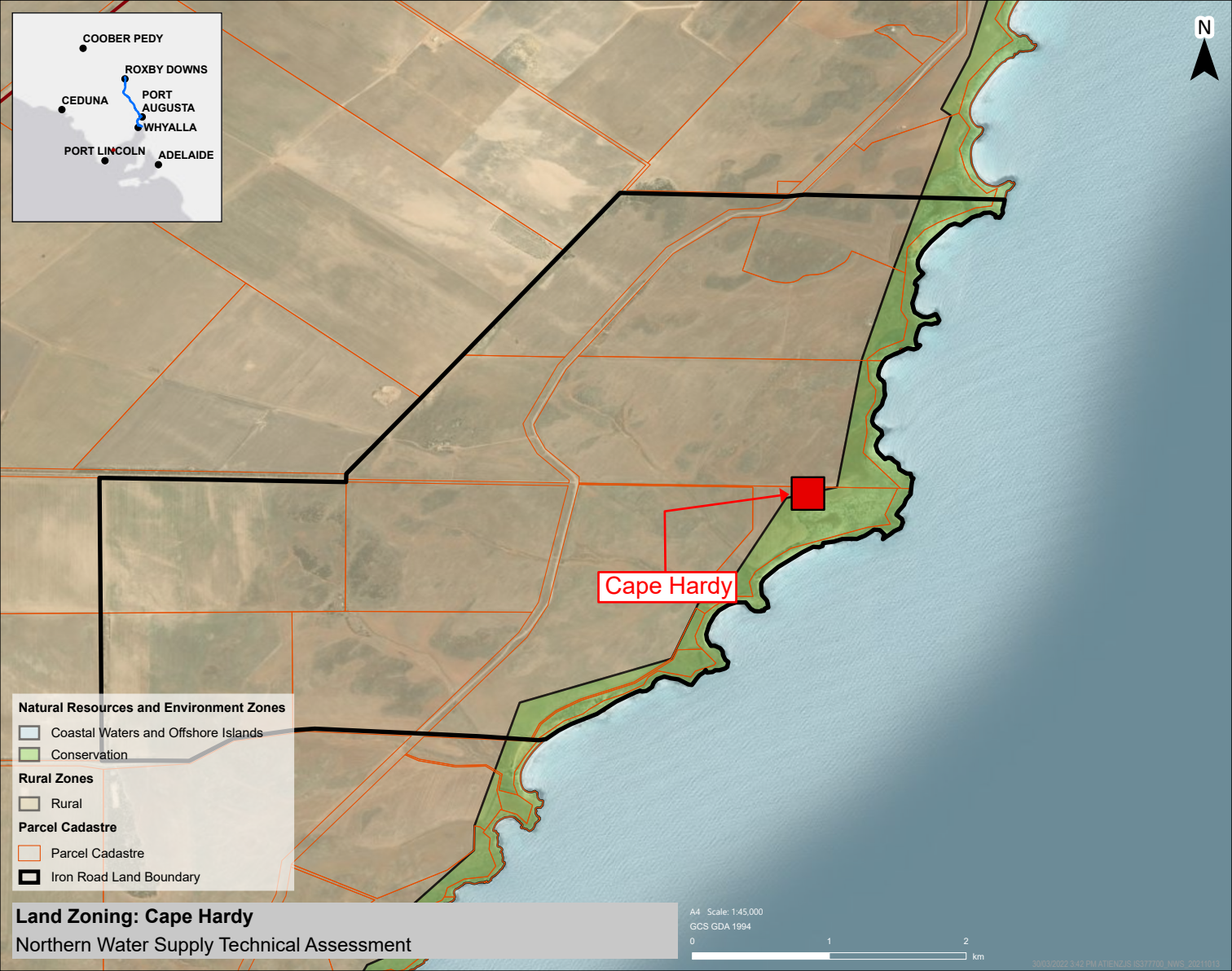
Land Zoning: Weeroona

Northern Water Supply Technical Assessment



Land Zoning: Whyalla, and the region south of Whyalla to Lucky Bay

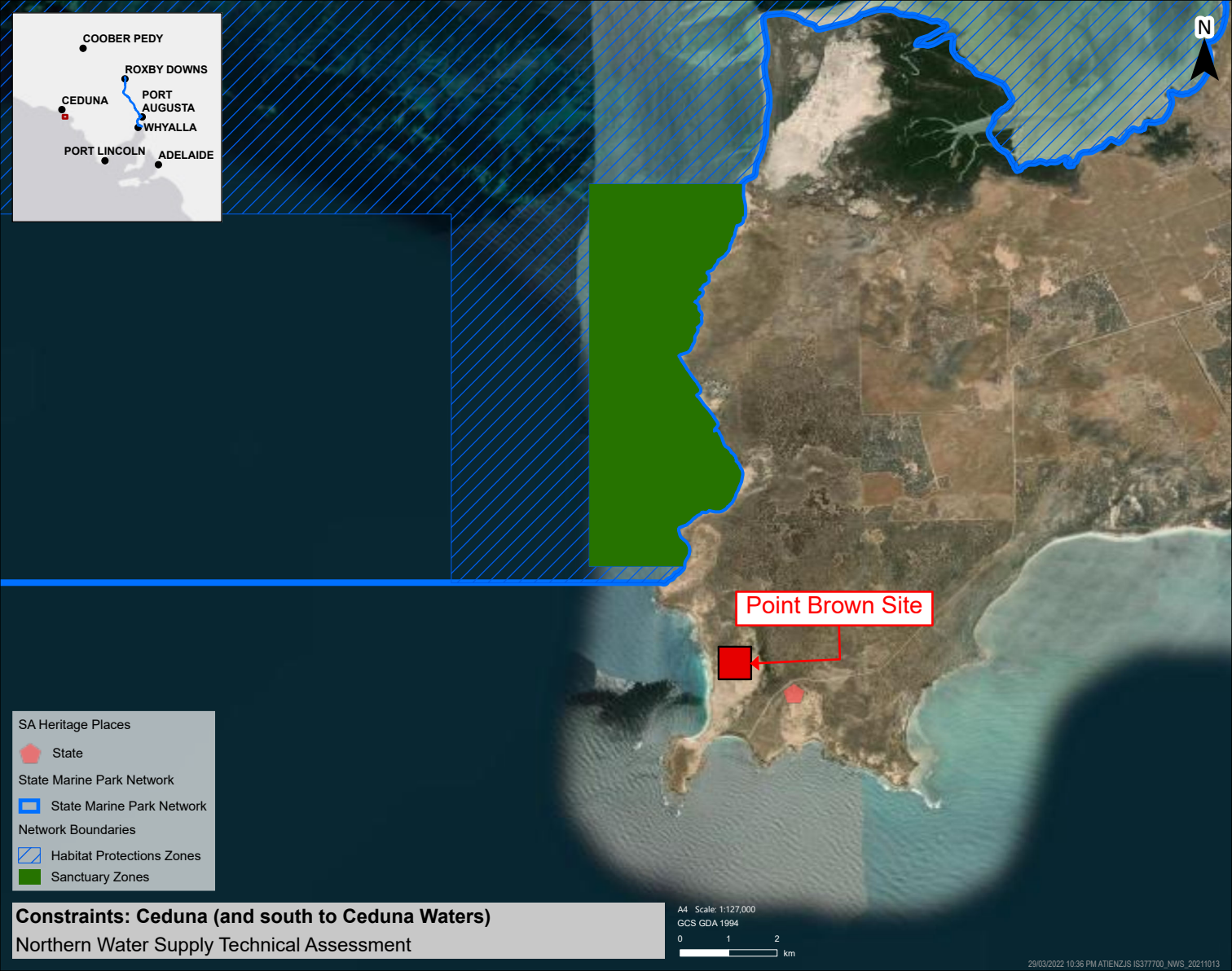
Northern Water Supply Technical Assessment



Land Zoning: Cape Hardy

Northern Water Supply Technical Assessment

Appendix B. Environmental Constraint Maps



Constraints: Ceduna (and south to Ceduna Waters)

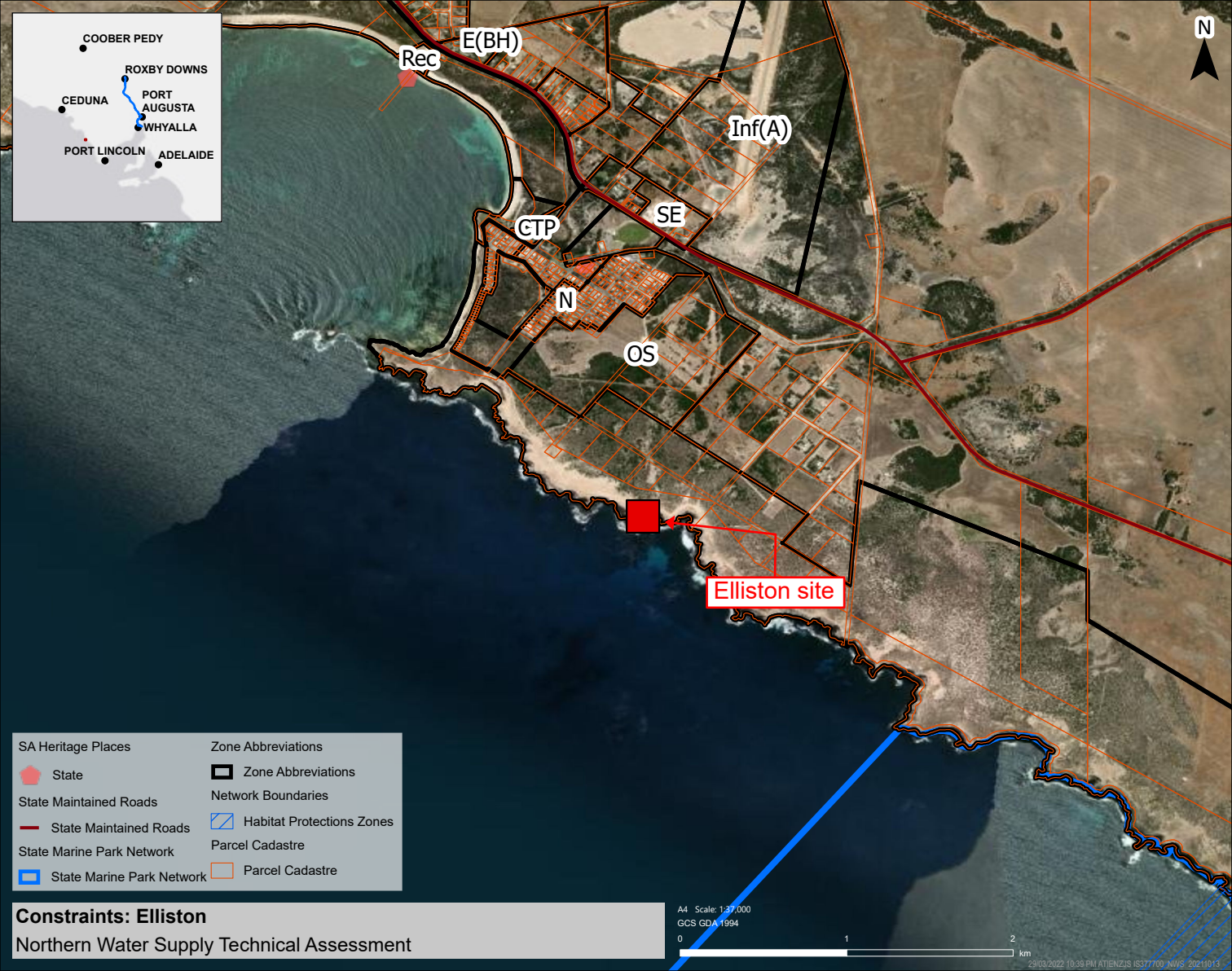
Northern Water Supply Technical Assessment



Constraints: Crag Point

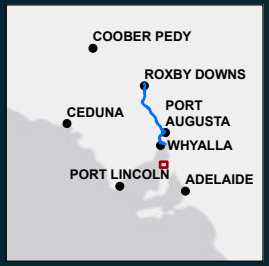
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Constraints: Elliston

Northern Water Supply Technical Assessment



N

Myponie Point

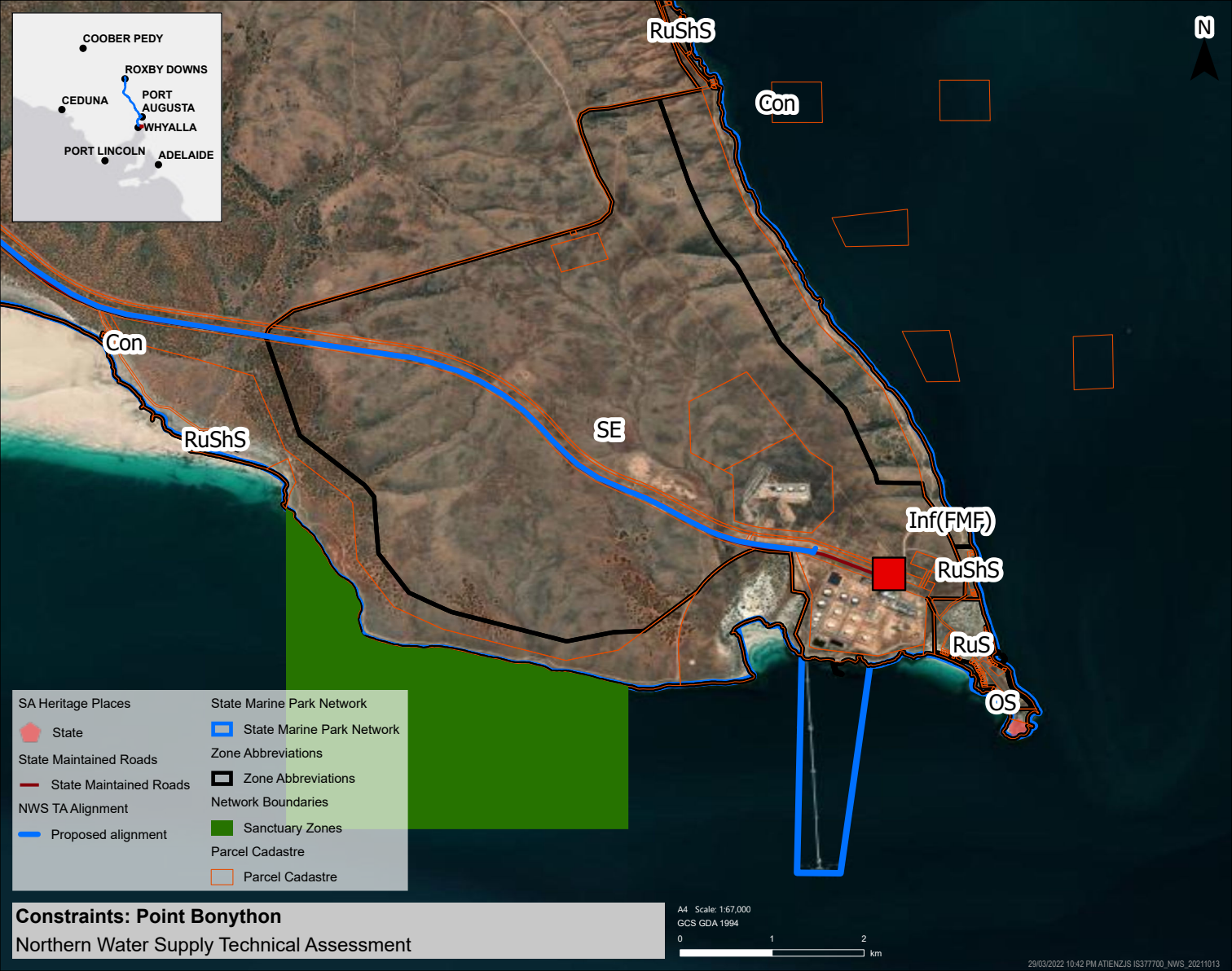
PORT DAVIS

WALLAROO

Key locations
Key locations
SA Heritage Places
State
State Maintained Roads
State Maintained Roads
Railways
Railways

A4 Scale: 1:167,000
GCS GDA 1994
0 1 2
km

Constraints: Myponie Point
Northern Water Supply Technical Assessment



Constraints: Point Bonython

Northern Water Supply Technical Assessment

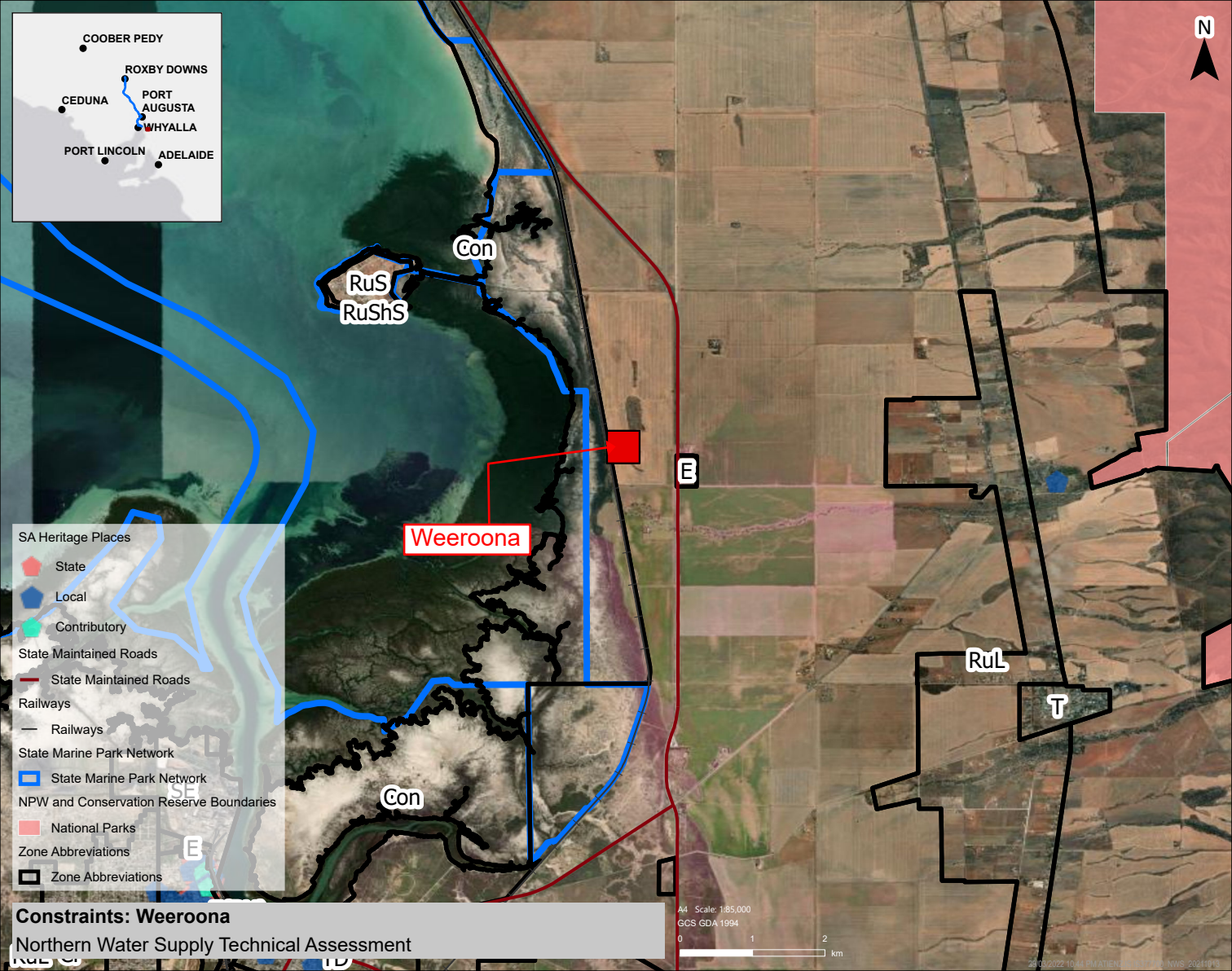
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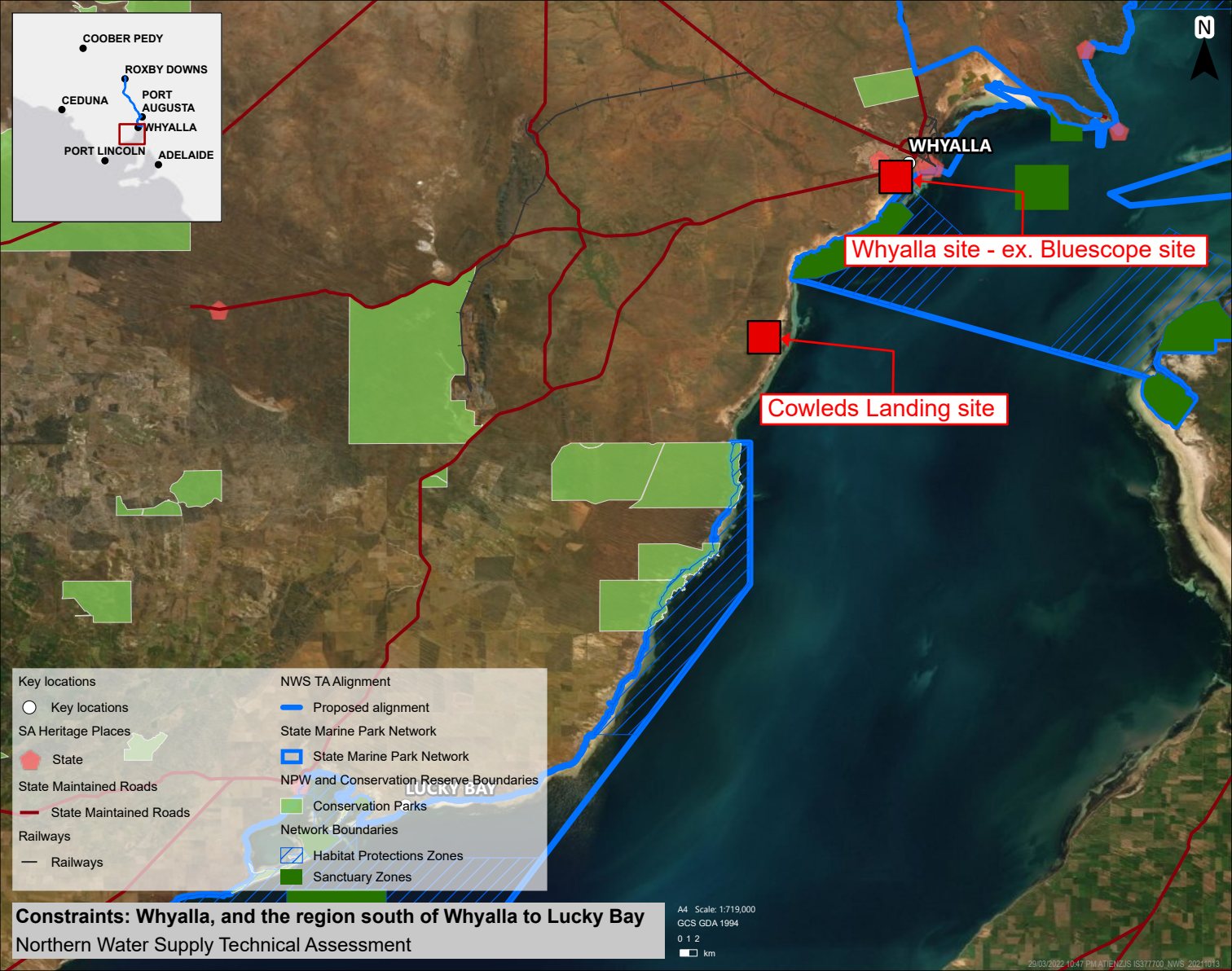
Constraints: Port Augusta, (adjacent to Port Paterson)

Northern Water Supply Technical Assessment



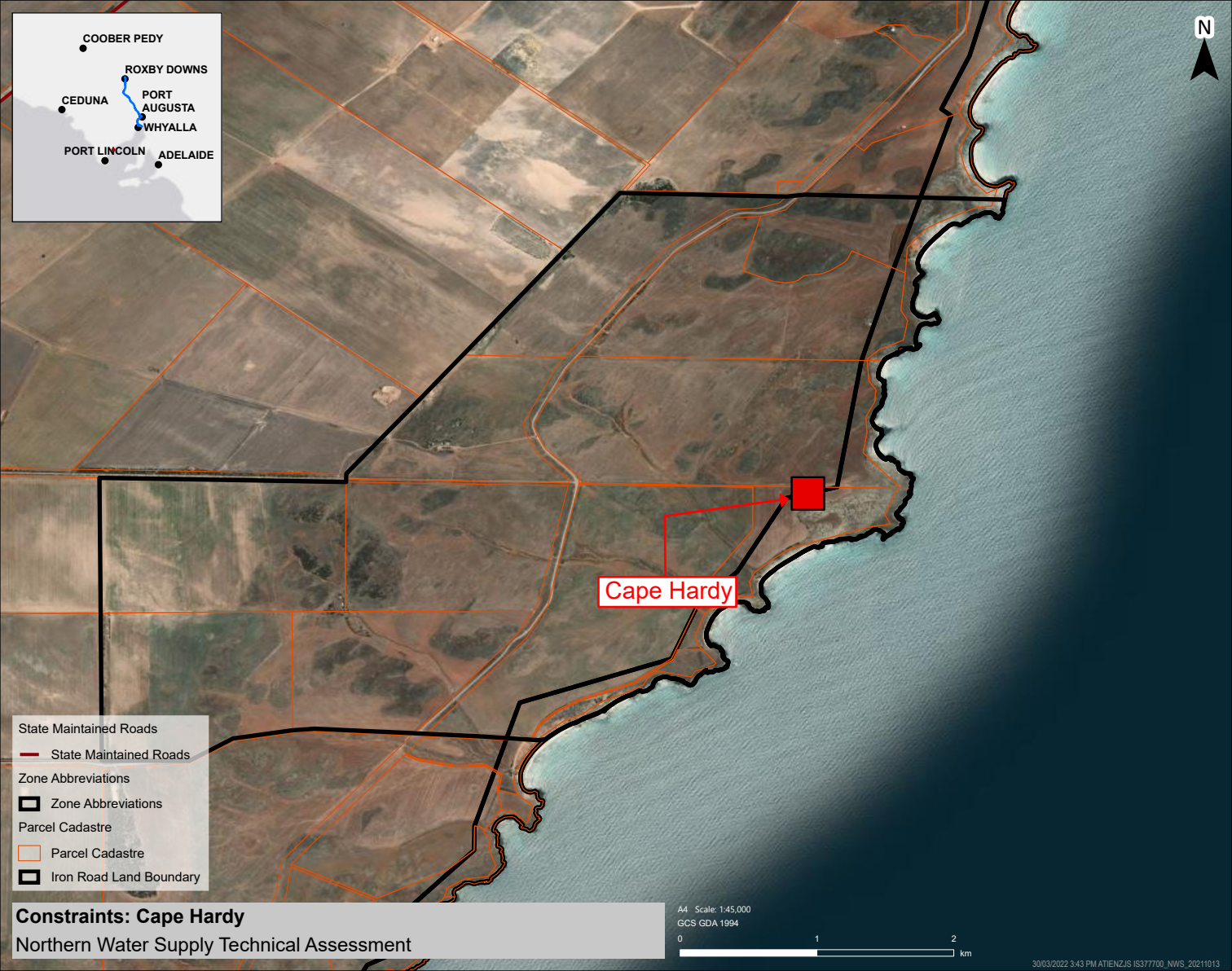
Constraints: Weeroona

Northern Water Supply Technical Assessment



Constraints: Whyalla, and the region south of Whyalla to Lucky Bay

Northern Water Supply Technical Assessment



Constraints: Cape Hardy

Northern Water Supply Technical Assessment

Appendix C. Site Assessment MCA Risk Identification Matrix

Site Assessment MCA Risk Identification Matrix

Criteria

	FINANCIAL	TECHNICAL												ENVIRONMENTAL				
	Relative Cost Differential		**Water Quality/ Diffusion Mixing**		**Water Delivery Complexity**		**Proximity to Support infrastructure**		**Power Supply Complexity**		**Site Acquisition & Compatibility**			**Terrestrial Environmental Impacts**		**Marine Environmental Impacts**	
	Cost Differential with Port Bonython (Design, construction and client costs; intake and outlet; delivery system; power supply)		Potential for access to Good Water Quality; Potential for access to area of high energy to promote diffusion mixing		Accessibility and constructability of a water supply pipeline. Existing road access. Additiona length increase risk of delay in completion. (Cost is treated separatly)		Proximity to roads and telecommunications infrastructure, and logistical and population centres to support construction and ongoing operation.		Assessment of existing power supply or possibility for installation of power supply infrastructure.		Current compatible land use. Ability to acquire the land. Sufficient area for the infrastructure and construction lay down			- Approval pathway - Level/amount of clearing of native vegetation required - Extent of endangered or listed sensitive flora and fauna impacted - Potential for impacts on Aboriginal values - Potential for European Heritage		- Impact on marine environment from intake - Impact on marine environment from discharge (Assumes tunnelled intake and outlet)	
Potential Site	% Increase	$m	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments		Risk : Low Medium High	Comments	Risk : Low Medium High	Comments
Whyalla	9%	$354	High	Subject to contaminated runoff. Potential for entrainment of contam sediments. Likely poor water quality and subject to entrainment of sediments. Potentially poor diffusion potential due to local circular currents within enclosed embayment	Medium	Similar to Port Bonython. Route would traverse some built up areas of Whyalla city	Low	Significant capacity in nearby Infrastructure to service construction and operation of the plant.	Low	Potential available capacity in the network. Upgrading of the Cultana STS and new feeders anticipated.	High	Occupied industrial land currently in use.		Low	Existing metals processing industrial site. Highly disturbed	High	Low circulation and potential for mixing of discharge within embayment opposite Whyalla
Point Lowly - Port Bonython	0%	$0	Low	Clear of shipping lanes. Good potential for high quality water In proximity to fast flowing currents to promote diffusion.	Medium	Total length of pipeline approximately 345km.	Low	Infrastructure and logistics within 30km of site from major centre at Whyalla. Well established logistics in precinct	Low	Upgrading of the Cultana STS and new feeders approximately 25km in length are required.	Low	Potential site available at Port Bonython as identified in 2009 BHP EIS. Surrounding land uses include other consistent industrial type activity.		Low	Existing site with minimal existing vegetation and within industrial precinct, zoned for further industrial development.	Medium	Specific constraints include fauna habitat (Giant Australian cuttlefish) and marine national park. Can be managed by location of seawater intake and brine discharge outside cuttlefish reserve. Good dispersion of brine due to due to strong currents off point, however relatively high turbidity levels.
Crag Point	0%	$0.2	Low	Similar intake and outlet conditions as for Port Bonython.	Medium	Constrained by location of site and adjacent Defence lands. Land currently zoned as Conservation Zone. Right of way for pipeline requires creation. Route not complex but may have to deviate around Defence lands (UXO)	Medium	Minimal infrastructure near by, requires construction of an access road and negotaitaion with Department of Defence for access. Requires 15km road access construction, deviating around Defence land.	Low	Similar to Port Bonython however requires an additional 10 km of transmission line.	High	Site area highly constrained. Coastal fringe, utilised by public for recreation, constrained by terrain and Defence Land. Land currently zoned as Conservation Zone. Potential high community value.		High	Potential for cultural heritage impacts, as site lays along coastal strip. Site sits within coastline Conservation zone.	High	Outside Habitat protection zone. Slighthly higher up Gulf than Pt Bonython, which may result in salinity impacts. Potenially less flushing capacity. Could potentially be re-rated to Medium with additional assessment.
Port Augusta	16%	$614	High	Water depth of 20 m is not achievable. Significant potential for poor water quality Limited current and wave enegy to assist diffusion.	Medium	Similar to Point Bonython when SA Water infrastructure supply to Whyalla is taken into account.	Low	Significant capacity in nearby Infrastructure to service construction and operation of the plant.	Low	Feasible, supplies available from the Davenport substation, which is within 5 km of potential site areas.	Medium	Potential site available at Port Paterson through the acquisition of industrial land. Current land ownership unknown. Potential contamination issues associated with previous land use.		Low	Existing Power station site. Highly disturbed	High	Inside Habitat protection zone. Higly constrained embayment limiting discharge mixing
Cowleds Landing - South of Whyalla	12%	$457	Low	Clear of shipping lanes. Potential for Intake Outlet structures to cause localised impact on commercial fishing. Good potential for high quality water Reasonable current climate anticipated to promote diffusion.	Medium	Connection from the plant site to the demand centres would require a pipeline approximately 50km longer than for a Whyalla option. Route would traverse some built up areas of Whyalla city. Majority of route not complex	Medium	Infrastructure and logistics within 50km of site from major centre at Whyalla. Requires 15km road access construction	Medium	Upgrading of supply from Whyalla may be feasible. Exiisting available capacity likely limited. Supply from the Cultana Yadnarie 132kV feeder an alternative. Requires 25km extension beyond Whyalla	Medium	Rural/ conservation land. Potential high community value. Coastal strip zoned as Conservation would have to be managed.		High	Site impacted by coastline Conservation zone. Minimal existing access. Requires access through existing rural lands. May be reduced to Medium with additional assessment.	Low	Outside Marine habitate zones. Open coastline anticipated to enable high mixing potential, and hence minimise salinity impacts.
Myponie Point - South of Port Pirie	43%	$1,635	Medium	Potential for Intake Outlet structures to cause localised impact on commercial fishing. Potential for good quality but may be impacted by shipping activity.	High	Route traverses open country. Construction not complex. Additional distance of approximately 150km (a main would have to be run back along the Eyre Highway to Lincoln Gap, and then potentially as far back as Whyalla for SA Water supply)	Medium	Limited infrastructure and logistics available from local township of Tickera. Larger center of Walleroo (ppn 4000) within 30km of site	Medium	Feasible, and likely easier than for sites in the region south of Whyalla. Within the Redhill area and south of Port Pirie new transmission lines would be in the order of 20 -50km depending on the final plant site location.	Medium	The region is zoned General Farming and is currently used for general cropping and grazing. Potential medium community value.		Medium	Narrow coastal conservation fringe which can be managed. Site zoned as Rural. Adjacent to coast town of Tickera, with road access.	Medium	Outside Marine habitat zones. Clockwise trend in Gulf currents make it less beneficial than Cowleds for discharge dispersion.
Weeroona (ex. SAMAG site)	54%	$2,035	High	Upper reaches of Gulf. High potential for poor water quality. Low potential for currents to assist diffusion.	Medium	Route traverses open country. Construction not complex.	Low	Significant capacity in nearby infrastructure to service construction and operation of the plant.	Medium	Feasible,likely easier than for sites in the region south of Whyalla . Supplies could be provided from the 132kV Bungama sub-station.For a plant of large capacity, it is anticipated a new transmission line would be required over an approximate distance of 15km depending on site location.	Medium	The potential site is located between the railway line and the Augusta Highway just to the east of the island. It has previously been ear-marked for industrial infrastructure (eg SAMAG, Iron Ore rail/ship loading interface), but is currently zoned as General Farming. SAMAG development did not proceed . Potential community value		Medium	Site had previous approval for industrial development (SAMAG) - which may now have expired. Located on coastal conservation / rural zoned land	Medium	Outside Marine habitat zones . Enclosed nature of embayment creates greater complexity in dispersion and potential risk of plume settlement.

Site Assessment MCA Risk Identification Matrix

	Criteria																			
	FINANCIAL			TECHNICAL											ENVIRONMENTAL					
	Relative Cost Differential			Water Quality/ Diffusion Mixing		Water Delivery Complexity		Proximity to Support infrastructure		Power Supply Complexity		Site Acquisition & Compatibility		Terrestrial Environmental Impacts		Marine Environmental Impacts			
	Cost Differential with Port Bonython (Design, construction and client costs; intake and outlet; delivery system; power supply)			Potential for access to Good Water Quality; Potential for access to area of high energy to promote diffusion mixing		Accessibility and constructability of a water supply pipeline. Existing road access. Additiona length increase risk of delay in completion. (Cost is treated separatly)		Proximity to roads and telecommunications infrastructure, and logistical and population centres to support construction and ongoing operation.		Assessment of existing power supply or possibility for installation of power supply infrastructure.		Current compatible land use. Ability to acquire the land. Sufficient area for the infrastructure and construction lay down		- Approval pathway - Level/amount of clearing of native vegetation required - Extent of endangered or listed sensitive flora and fauna impacted - Potential for impacts on Aboriginal values - Potential for European Heritage		- Impact on marine environment from intake - Impact on marine environment from discharge (Assumes tunnelled intake and outlet)			
Potential Site	% Increase	$m	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments	Risk : Low Medium High	Comments
Ceduna - Point Brown	86%	$3,275	Low	Clear of shipping lanes. Good potential for high quality water High energy wave climate to promote diffusion.	High	Route traverses open country. Construction not complex, however significant length introduces project risk.	Medium	Significant capacity in nearby Infrastructure to service construction and operation of the plant. However location is remote from major supply hubs	High	Power is supplied into Ceduna from existing grid infrastructure centred around the Gulf. A 132kV transmission line from Cultana, via Yadnarie, to Wudinna exists however due to existing loads and distances a connection at 132kV from Wudinna substation is uncertain. If feasible there will be high costs for transmission line construction over 200km and high mobilisation costs.	High	Site is approximately 50 km south of Ceduna on the promontory near Point Brown. Land zoned as Conservation Zone. Considered high community value.	High	Land currently zoned as Conservation Zone. Potential high value natural environment.	Low	Outside Marine Park. Sea coast location. Good dispersion currents reduce potential for plume impacts.
Elliston (South Coast)	60%	$2,261	Low	Clear of shipping lanes. Good potential for high quality water High energy wave climate to promote diffusion.	High	320km of pipeline to reach Whyalla. Route traverses open country. Construction not complex, however significant length introduces project risk.	High	Limited infrastructure and logistics available from local township of Elliston. Location is remote from major supply hubs.	High	Similar as for Ceduna	Medium	Site located aside Elliston on ocean cliff coastline. Land zoned as Conservation Zone. Potential high community value.	High	Site is located on pristine coastline comprising rocky cliffs. Could potentially be re-rated to Medium with additional assessment.	Low	Sea coast location. Outside Marine Park. Good dispersion currents reduce potential for plume impacts.
Cape Hardy	36%	$1,352	Low	Clear of shipping lanes. Good potential for high quality water Open coastline offer good potential for access to currents to assist diffusion	High	~200km of pipeline to reach Whyalla. Route traverses open country. Construction not complex, however additional length introduces project risk. .	Medium	Limited infrastructure and logistics available nearby. Port Neil is 10 km away, Port Lincoln 80 km away.	Medium	ElectraNet have published information on their website for the 2021 commencement of the 'Eyre Peninsula Link' project, with construction of a new double circuit 132kV line from Cultana to Port Lincoln. This is to replace the existing aging 132kV link, so is not "new" capacity. - ElectraNet project is about 50% complete.	Low	Coastline currently zoned as Conservation. Iron Road development owns land and are offering a land swap in the area. Development has been identified as a proposed port and has been through an EIS process.	Low	The site is proposed to be co-located with Iron Rd port development. Iron Rd already have an indigenous land use agreement.	Low	Outside Marine Park. Outside aquaculture zone (Port Neill Aquaculture zone is approximately 2 km from the closest point of the proposed jetty) Potencial for good dispersion currents reduce potential for plume impacts.

Appendix D. Port Bonython Site Review

D.1.1 Site Context, Constraints and Opportunities

Department of Treasury and Finance are currently leading planning for development of a significant mining, energy, and related industrial development in the vicinity of the Port Bonython site. It is understood Treasury's planning work for this energy "hub" development takes into account the location of the proposed desalination plant at Port Bonython, and its potential as a source of feedstock water for 'green' hydrogen generation.

Noting Treasury's current planning, a desktop review of publicly available information on the Port Bonython site and its vicinity has been undertaken to provide additional clarity on the site location and the plant area required. The aim of this review is to add to the data already collated for the project and presented in the Northern Water Supply Technical Assessment Report (Jacobs and GHD, August 2021).

The purpose has been to provide additional clarity on the site location and the site area required for a desalination plant sized to meet the highest demand scenario considered in the NWS. This is to provide some basis for understanding the site requirements for a "larger" plant that may eventually include demand from the energy hub development. Consideration has been given to staging development of the plant, and how this may impact the plant layout and the overall site area required. Consideration has also been given to how the plant may fit within the existing landform, and whether this impacts the associated intake/outfall alignments and location.

The focus has been to investigate the adjacent services and facilities including existing services serving Santos and the port facilities, and the proposed hydrogen hub development, and to give initial consideration to any environmental issues or constraints with the proposed plant site.

The review identified further information on the site from several additional data sources, which have included:

- Acquisition of site-specific LIDAR data
- A property titles search to confirm land ownership details and also determine whether any easements exist over any of the land
- A dial before you dig survey to identify whether any records of additional services exist in the vicinity that may have yet been unknown.
- Information obtained from the initial visual site inspection held between 5-7 October 2021
- Information on the potential locations of land parcels to be set aside for development of the Hydrogen Hub.

The information has been assessed with respect to the constraints and opportunities it presents. The site context and topography are illustrated in **Figure 22**.

Site Topography

LIDAR data has been obtained from Geoscience Australia's 'ELVIS' GIS database for the site and surrounds. This confirms the site is gently sloping upward away from the roadway from nominally RL20. Ground levels range generally from RL 20 - 30m across a distance of, with high points of RL 35 to the north of the site area.

The LIDAR also confirms there is a natural drainage gully that will transport stormwater off the IOR Terminals property across the western corner of the site and drain toward the road. This drainage path and stormwater across the site generally will have to be managed as part of the plant layout design so that the flow rate exiting the site is kept generally consistent with the undeveloped flow regime. As such it is anticipated that a stormwater management pond would be required to be incorporated into the layout of the plant the detain and control flow across and off the site. Space allowance for this has been incorporated into the site layout review.

Land Title Data

The title search conducted on the plant site confirmed ownership of the land (allotment 211, D112514) rests with the Minister for Transport, Infrastructure and Local Government of South Australia. There is also a separate lot which separates the site from Port Bonython Rd (allotments 214 & 215, D112514). Ownership of the these also rests with the Minister for Transport, Infrastructure and Local Government of South Australia.

The title search also identified the following:

- The IOR Terminals site has a narrow right of free and unrestricted right of way around the east and northern perimeters it its property. This is however not anticipated to impact the plant site or plant layout.
- ElectraNet have applied for an easement approximately 40m wide, which runs from an existing compound (allotment 210) on Fitzgerald Bay Rd around the northern and eastern boundaries of the plant site to allotment A80. Allotment A80 is the vacant lot immediately east of the plant site. Ownership of the land rests with the Minister for Transport, Infrastructure and Local Government of South Australia. It is not anticipated to impact the plant site or plant layout.
- The lot adjacent to allotment 80 is occupied by a commercial fish processing business and is owned by Clean Seas Tuna Ltd.
- The Natural Gas Company of Australia, have an easement paralleling Port Bonython Rd on the lot which also parallels the road and separates it from the plant site. This is occupied by the Moomba – Port Bonython gas pipeline. This requires the plant be set back from the road to avoid the gas pipeline.

Existing Services Data

The services searches generally confirmed the services already evident from GIS sources and did not readily identify any in addition to these. The key services in the site area are:

- Epic Energy Moomba – Adelaide gas pipelines, which run along the southern and western boundaries of the plant site
- The 11 kV ElectraNet aerial supply along Port Bonython Rd to the Stony Point substation
- The SA Water main along Port Bonython Rd

Consideration of the gas main locations, and the regulatory requirements associated with development within its vicinity will be required in setting out of the plant site.

The services search did not appear to pick up an oil transfer pipeline running between the export terminal jetty and the IOR Terminals site. The existing of this was identified during the site visit, however it is noted this is generally clear of the plant site, and only a matter for development of the delivery pipeline alignment.

Site Inspection Outcomes

The visual site inspection conducted between 5 and 7 October sought to confirm the physical features of the site and identify whether there were any obvious environmental constraints. The inspection noted the following:

- The petroleum products and gas pipelines identified as Epic Energy's, run from SANTOS loading facility to the IOR oil terminal tanks to the west of the proposed site. The gas pipeline traverses the site west to east, heads north to Fitzgerald Bay Rd and then both east across the Gulf, and west to Whyalla and then eventually northward through Defence Land.
- ElectraNet have aerial lines located on both sides of Port Bonython Rd. From just visual inspection these were interpreted as a high voltage line located on the southern side, and a low voltage line along the northern side. The GIS data is noted to be inconsistent with the information determined on site, and as with all services it should be confirmed as part of the design process.
- No services appear to be located within ElectraNet's proposed easement to the north of the proposed site.

- The SA Water pipeline is located in road verge on northern side of road.
- The site area generally is signed as former defence land and signage on the site perimeter indicates it may contain unexploded ordinance. Clearance surveys will have to be undertaken prior to the site being acquired for the project to provide assurance that there is minimal potential for unexploded ordinance to be encountered during the construction phase.
- The commercial fishing business located to the east of the proposed site was confirmed as operational.
- The access track running diagonally across the site evident in the aerial photos appears not to have any obvious use or basis for its construction, which would limit the plant layout.
- The unsealed road along coming off Port Bonython Rd at the south eastern extent of the site is used for access to east coast of the Gulf, and if impacted by the plant would therefore need to be reinstated, noting that there is an alternate route onto the coastal access track from further south along Port Bonython Rd.
- The site proposed in BHP's concept for the desalination plant for their intake pump station is adjacent to the coastal track along the Gulf, which is the northern emergency access track in the event of a gas leak. This area is also a very popular low cost camping area all along the coast to Freycinet Bay
- The coastal area around the Point Lowly peninsular is used as very popular low cost camp site with council provided facilities. It also contains holiday homes, a commercial fishing Marina and Historic Lighthouse and cottage.
- No specific constraints from an ecological perspective were identified during the inspection. The location for the EPBC listed Temperate Saltmarsh Threatened Ecological Community which was mapped as potentially present was investigated, however no evidence of it was identified on this inspection. Presence of coastal and inland native vegetation will require consideration under the Native Vegetation Act, but that is a process that will have to be worked through rather than a true constraint.
- The site inspection did identify several inconsistencies in services information identified via GIS. This is not unexpected, and serves as a flag to review and confirm the data as the design process continues.

Proposed "Hydrogen Hub" Development

The Department of Finance and Treasury are leading planning for development of a significant mining, energy and related industrial development in the region of Port Bonython. Planning completed to date has developed an initial baseline site plan of land leases in response to an expression of interest process with a range of potential proponents.

Seven projects have been shortlisted for consideration by Government. These include proposals to produce hydrogen and by products for domestic and export markets from Port Bonython.

The site proposed for these projects is west of the IOR terminals property, and does not directly impact the proposed desalination plant site. It is likely however to impact the positioning of the water delivery pipeline as it leaves the desalination plant site and continues along Port Bonython Rd to Fitzgerald Bay Rd. A 310 m wide common infrastructure corridor is proposed from the energy hub development along the road alignment to the existing export terminal jetty. The water delivery pipeline as well as the 132 kV power supply to the plant would have to be accommodated within this corridor along with a range of potential product pipelines.

The proximity of the desalination plant site to the proposed baseline plan land leases is shown in **Figure 21**.

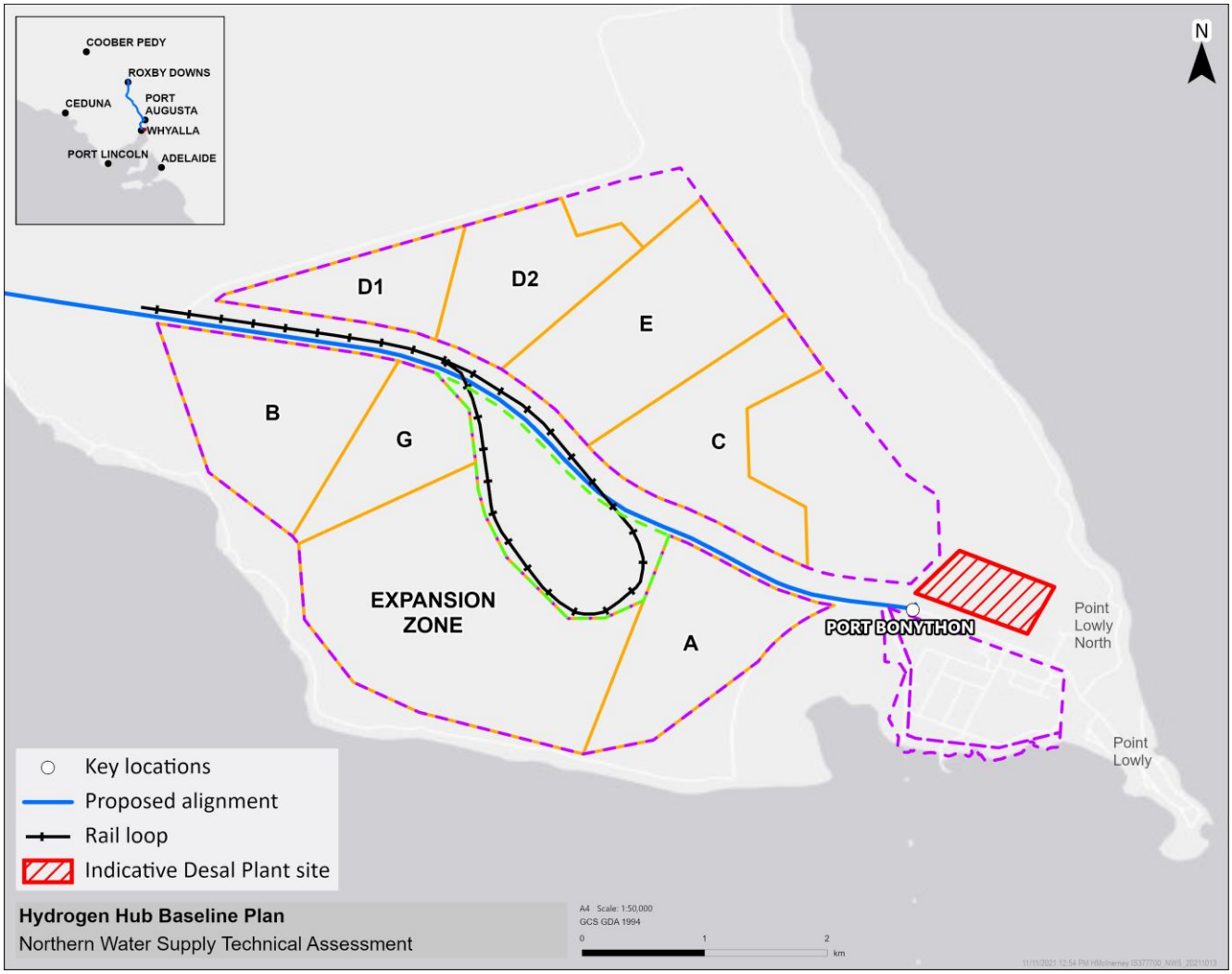


Figure 21 Hydrogen Hub Development Baseline Plan

Constraints Summary

The information identified generally confirms that which has already been established and is additive to that already compiled for the project. No significant constraints were noted other the need to address stormwater that may run on to the site from the IOR Terminals property, and need to accommodate provisions in relation to the presence of the Moomba to Adelaide gas pipeline along the western and southern boundaries of the proposed site area, through referral and liaison with the Department of Energy and Mining and the Petroleum licence holder.

No other proposed developments within the site area were specifically identified through the investigations undertaken for this review.

No further information on the bathymetry of the locations proposed for the intake and outlet sites was developed during the review. Acquisition of this data should be undertaken as a next step in the development of the project.

The site area landform and constraints are shown in **Figure 22**.

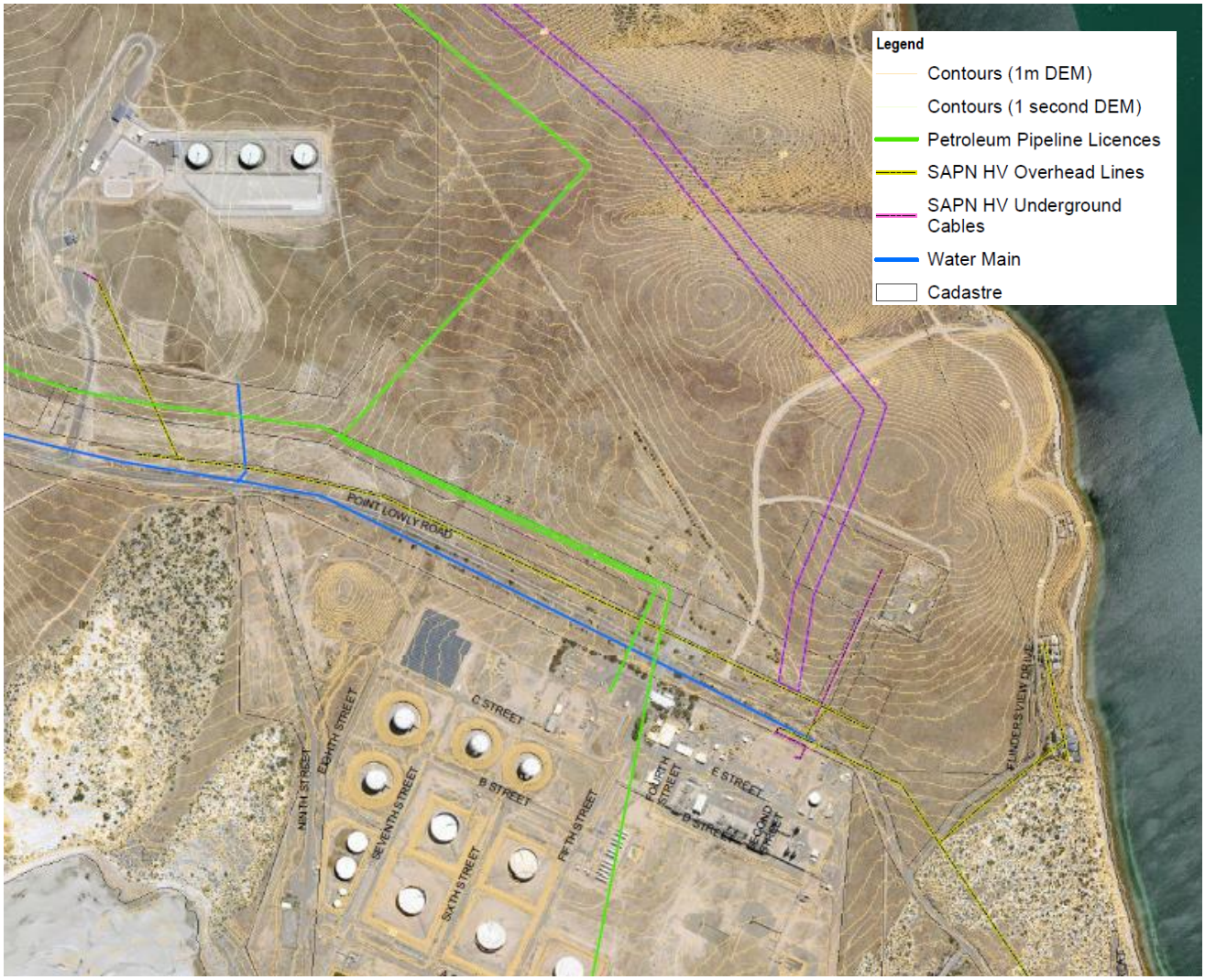


Figure 22 Site Area Landform and Constraints

D.1.2 Plant Layout Review

A review of the site layout and the area of land recommended be set aside now to enable uninhibited development of the plant has been undertaken. This review takes into account the information gathered on the site and adjacent facilities in the course of this study, and advances the understanding of how the plant may fit within the existing land form and whether this impacts the associated intake/outfall alignments and location.

The issue of how much land is needed to execute the project now and in the future is a key consideration in development of the project. It is expected development of the plant will be staged over time to match capacity with demand as it evolves, and so defer expenditure on capacity until it is required. To successfully realise the benefits of this requires planning for the life cycle of the plant now.

One of the greatest risks to the project at this stage is that the site is lost because it has been acquired by others, such as a private developer, for another development. This is a real threat now given the interest the Government has generated in the Port Bonython area by sponsoring the energy hub development.

A further risk is that insufficient land is secured now to enable the build out of the plant in a staged manner. Staging development of the plant will require more land area than if it were built in one stage. The plant needs to be laid out with sufficient services corridors reserved for future pipelines, electrical duct banks, stormwater and structures to be constructed and connected to the existing facilities, and sufficient space in addition to this in

and around the existing structures and services to allow for construction to be undertaken without significantly interrupting ongoing operation of the existing plant. Space is also required for laydown area adjacent to the site during construction of each subsequent stage of the plant to enable this to be done efficiently, cost effectively and with the least impact on the surrounding environment and community.

Based on the constraints identified in this review and the assumptions identified in the Northern Water Supply Technical Assessment Report, 10 August 2021, that report's preliminary layout for a 400 ML/d desalination plant was reviewed and revised. The amended layout, while still at a very preliminary stage of development, better utilises the landform and provides a more conservative allowance for plant staging, construction requirements and capacity growth over time. Conservative in this sense implies a greater site area has been allowed for than in the layout presented previously to mitigate the risks discussed above.

The revised plant layout is presented in **Figure 23**. The key aspects of the revised layout comprise the following:

- A shift in the plant location away from Port Bonython Rd so that it is clear of the gas pipeline easement
- A larger plant footprint with greater spacing between stages to allow construction activities to occur without impacting operation of the previously developed stages of the plant
- Incorporation of laydown area within the overall site area to reserve this for future construction staging.
- The existence of the 'pipeline measurement zones' or buffer zones around the existing gas mains to the west and south of the site are noted. Introduction of the desalination plant into these zones represents a change in surrounding land use with respect to the pipeline classification, design, operation and safety. It will require an assessment of risk with stakeholders. The issues related to managing the risk of development within the buffer zone areas will need to be considered further as the project progresses.
- A space allocation for stormwater management required on site to address water entering the site from IOR Terminals site, and retain water on site has been allowed for.
- Site geotechnical conditions have not yet been taken into account as the conceptual layout is still not yet at a sufficient level of detail to enable this. This could require slight adjustment to the sizing of structures, but at this preliminary stage it may assumed this can be accounted for in this revised layout.
- The revised layout has a minor effect on the alignment of the intake and outlet tunnels as they leave the site, which is indicated in the layout. The end point locations of the intake and outlet zones in the ocean remain unchanged. Further data on the bathymetry of the coastline is required to assess the locations in more detail.

Based on this revised layout a site area of 33 ha is recommended as required, noting that this incorporates within it 6 ha for construction laydown area. The layout is not fully optimised and there is potential for it to be made smaller as the concept is developed in more detail, and the required capacity of the plant is confirmed. However, for planning purposes at this stage advantage should be taken to secure a site area of this order to mitigate the risks highlighted above.

This revised footprint is now more on par with the project assessed in the BHP 2009 EIS. This proposed a 280 ML/d capacity plant sited on 20 ha.

Impact of Dodge Tides

The existence of 'dodge' tides in the Gulf and their impact on tidal fluctuation is identified and discussed in Section 3.1. This noted extreme dodge tides occur every 6 months when both the semi-diurnal and diurnal constituents cancel one another simultaneously. The combination of small tidal ranges and longer duration of the diurnal tide during dodge tides results in limited water movement for a period of up to two days in the Upper Spencer Gulf.

BHP's concept for the desalination plant presented in their 2009 EIS included large ponds on the plant site. It has been inferred these were required for storage of seawater concentrate during periods when dispersion of the return water in the Gulf would not achieve the required dilution targets during a neap tide event.

The EIS assessed the environmental and ecological impacts of return water dispersion, adopting a range of conservative assumptions in relation to current speeds and during neap tide events. The wide range in the natural variability in salinity that occurs within the Gulf was also noted. The results of the hydrodynamic near field modelling undertaken predicted that salinity of the return water would disperse to less than 10% of the background levels at 100 m from the outlet. This performance was noted as within a conservative measure of aquatic life tolerance set by the WHO.

Noting the findings that dispersion of the return water could be managed appropriately during neap tide events, this review of the plant layout has excluded provision for any seawater concentrate storage ponds on site at this stage. Notwithstanding this, it is accepted that return water dispersion is a key environmental issue with respect to any desalination plant development. Further assessment of the dispersion effects will be required as the project progresses, and this may confirm that additional measures are required to manage return water dispersion. Securing suitable site area now to manage this risk would be prudent.

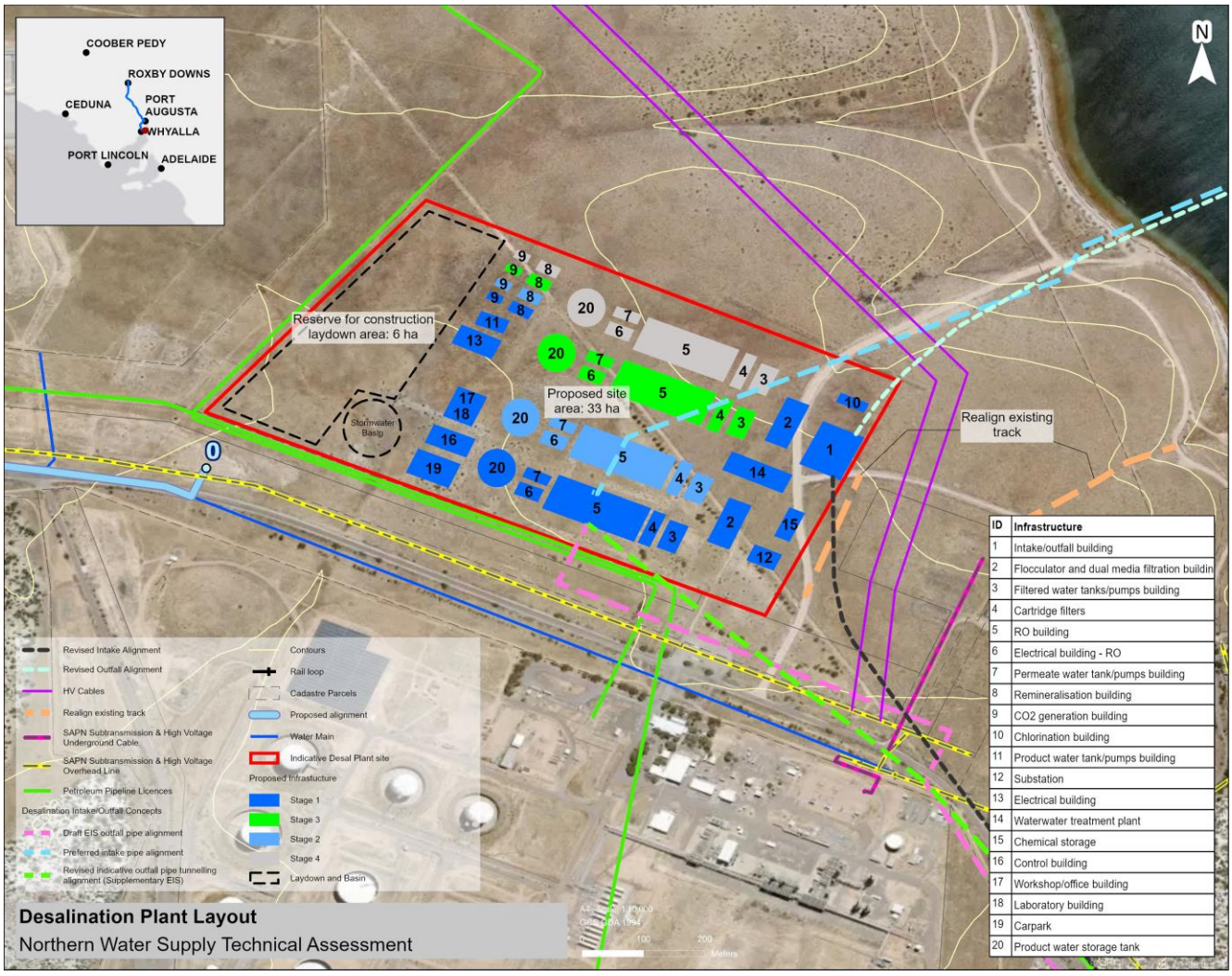


Figure 23 Potential footprint for a staged 400 ML/d desalination plant at Port Bonython