11.4 Receiving environment

11.4.1 Landform

The impacts of the Proposal to landforms is relevant only to the ASDP site. The pipeline will be constructed underground and follow the existing landform.

The majority of the ASDP site occurs in the Quindalup Dunes system. The Quindalup Dunes system in the Alkimos area is 2 km wide and extends approximately 4 km inland with three individual dune types within this feature - parabolic dunes, nested parabolic dunes and blow-outs. Semeniuk Research Group (2004) recognised the nested parabolic dunes as being unusual in that they are perched on a limestone plateau. A small portion of the ASDP site occurs across the Cottesloe unit of the Spearwood Dunes system which is characterised by shallow yellow-brown sands and exposed limestone (Strategen 2017).

Blow-outs form when the parallel dunes along the beach front are breached during heavy storms creating gaps which form wind tunnel through which sand is transported. The parabolic dunes form as a result of the continuation of this process.

The Alkimos Quindalup dune complex comprises four phases overlying the siliceous Spearwood Dunes of the Pleistocene age. All phases are uniquely defined by their profile shape, stability, vegetation type and cover, and soil development as described below.

Table 11-3: Phases of Quindalup dunes

Phase	Descriptions
Q1	This is the oldest phase which has a flattened profile (100 to 150 slopes) and is largely covered by vegetation and soil organic matter to depths of 30 to 50 cm. These dunes are completely stable and are of the order of 6000 years old. This indicates that the complex first began forming when the sea level retreated from the 3 metre level approximately 6000 years ago.
Q2	Intermediate phase with steep slopes; a smooth profile; vegetation cover of approximately 70%, is virtually stable and is approximately 1600 years old.
O3	Intermediate phase with steep slopes, a ‘humpy’ profile; approximately 70% vegetation cover and would become active if disturbed.
Q4	The youngest phase which consists of small, restricted dunes with steep (250 to 330) slopes partially covered (20%) by coastal heath vegetation and virtually no organic layer and is estimated to be aged probably no more than 200 years old. The ‘humpy’ profile indicates instability. If the vegetation were removed, the dunes would become active again.

The high ecological and geoheritage values attributed to the Alkimos parabolic dune system has been recognised since 1977 when the area was identified in the North-West Corridor Structure Plan (MRPA 1977) as ‘Parks and Recreation’ with some strategically located commercial and light industrial zonings in its centre. At this time, it was also recognised that the whole dune complex, or at least a part of it that contained a representative chronological sequence should be preserved.

In 1979, the coastal dune formations in the Alkimos area were identified as having national and world geoheritage significance. The Geological Society of Western Australia (with support from the Geological Sites Committee and the CSIRO) recommended that the Alkimos Dune System be nominated as a Geological Monument to be reserved as open space. Subsequent amendments to the MRS have identified the environmental and geoheritage values identified in the past progressively revised to support to the perceived socially greater value of urban development in the North-West Corridor.

The Quindalup Dunes system in the Proposal area has been described as regionally significant with intact vegetated parabolic dunes, supporting highly diverse upland vegetation units and habitat. These dunes are also important in providing a regional ecological linkage between coastal foreshore reserve and regional conservation areas to the east (RPS 2016).

The EPA previously identified the Alkimos-Eglinton area as a regionally significant landform supporting intact examples of vegetated dunes in good condition, which is a result of its separation distance from populated areas. Consolidated vegetated areas of the Quindalup Dunes protect populations of Tuarts (*Eucalyptus gomphocephala)* (EPA 2005).

11.4.2 Soils

The ASDP site largely occurs across beach sand, sand dunes, coastal dunes, and calcareous and siliceous locally shelly and/or cemented beach rock which is generally referred to as Tamala Limestone (AECOM 2017) (Figure 11-1).

Soils on the western portion of the ASDP site occur within an undulating dune landscape of the Quindalup Dunes, with areas of steep dune slopes driven by aeolian processes. As the pipeline progresses eastward away from the ASDP site, landform characteristics progress to the Spearwood system. This area is characterised as small swales of estuarine deposits over siliceous sands with smaller areas of brown sands and leached sands in the lower, wetter sites (DRIRD n.d).

In the south-eastern portion of the pipeline DAF, Bassendean sands occur comprising sand dunes and sand plains with deep sand, semi-wet and wet soil (DRIRD n.d.).

11.5 Potential impacts

The potential for impacts to landforms resulting from the Proposal are summarised in Table **11-4**.

Table 11-4: Potential impacts

Potential impacts	Context
Loss of landforms	Construction of the ASDP will result in a loss to this network of parabolic and nested parabolic dunes of the Quindalup Dunes within the DAF.
Increased aeolian erosion	Removal of vegetation from the dune systems across the ASDP site and pipeline may result in increased erosion across the DAF.

11.6 Assessment of impacts

11.6.1 Loss of Landform

The ASDP site is located predominantly on undefined geological units of Quindalup Dunes over Spearwood Dunes in a hollow behind the youngest phase of the geological sequence (Q4). Phase Q4 consists of small, restricted dunes with steep slopes partially covered (20%) by coastal heath vegetation. The site is surrounded by the second phase of the Quindalup Dune system.

The ASDP site will be built nestling within the parabolic dune system with excavation from a natural elevation to achieve a finished level similar to that of the existing WWTP.

To the north and the south of the ASDP site, examples of parabolic and nested parabolic dunes are retained in the conservation areas protected by MS 722 (EPA 2006a). Recognised ecological linkages occur across conservation areas 9a, 10a and 10b with significant landforms in areas 9a and 10a (Semeniuk 2004; RPS 2016), resulting in the conservation of a substantial portion of the geoheritage values in the Alkimos cuspate forelands and nested parabolic dune system, and the vegetation associations dependent upon them.

Construction of the ASDP will impact 2.4 ha of conservation area '10b' for plant access and to avoid local roads (Figure 3-2). Conservation area 10b was designated for to protect the integrity, function and environmental value of the bushland it supports. Impacts to conservation area 10b will also result in the loss of landform hosting examples of tuart populations on Quindalup Dunes.

The loss of 2.4 ha of dune system as a result of the ASDP site is unlikely to result in a significant impact considering that examples of this formation are reserved in conservation areas locally and regionally.

11.6.2 Increased erosion

The clearing of vegetation required for construction of the ASDP site can lead to aeolian driven erosion and subsequent impacts to surrounding vegetated dune systems. Large scale vegetation loss on a dune can result in dune instability and the dunes become more susceptible to wind driven erosion processes which cascade into dune instability over a wider area.

This aeolian driven erosion must be considered when detailing design and construction methodologies will require management when excavating sand dunes and removing vegetation. The sand dunes and vegetation are a coastal defence mechanism, and should the dunes be breached during the construction appropriate measure should be taken to safeguard the integrity of the area.

11.7 Mitigation

Water Corporation has applied the mitigation hierarchy to the Proposal to protect landforms. Mitigation measures are summarised in Table 11-5.

Table 11-5: Mitigation hierarchy to potential impacts on Terrestrial Fauna

Potential impacts	Avoid	Minimise	Monitoring and management
Loss of landforms	Planning for the Proposal has considered the topography and vegetation types identified in the DAF. The location of the ASDP has been specifically chosen for several factors including the low-lying nature of the site and the lack of conservation significant species and formations within it. Most of the significant examples of the parabolic dune systems have been avoided by the placement of the ASDP. Water Corporation has chosen to use TBMs for the construction of the marine intake and outfall tunnels. This choice of construction method will be undertaken from within the ASDP site, which significantly reduces the environmental impact on the surrounding landforms. Alternative construction methods such as pipe jacking would have resulted in disturbance to the landforms in the near shore environment.	Construction of the ASDP into the dune system will require some local dunes to be removed or re-contoured to allow for infrastructure. However, the western ASDP site boundary incorporates an earth berm with a finished top surface level of 25 mAHD. This berm effectively connects the existing southern and northern sand dunes and forms a visual barrier to the ASDP from the future western residential development.	-
Increased aeolian erosion		Dust and erosion mitigation techniques will be employed during construction to reduce the effects of erosion on the surrounding area. At the completion of construction of Stage 1, erosion controls in the form of soil binding material will be applied to the ASDP site to prevent further erosion of non-vegetated and un-developed areas until the construction of Stage 2 is required. Where possible, disturbed areas will be permanently revegetated with high visibility external batters such as the western berm approached differently to internal and non-visible batters. Batter revegetation will be done by a combination of direct seeding and seedling planting. Permanently	Implementation of the TCEMF.

Potential impacts	Avoid	Minimise	Monitoring and management
		revegetated areas will be subject to ongoing monitoring and maintenance to ensure vegetation is established.	

11.8 Predicted outcome

Dune landforms within the ASDP site are recognised as regionally significant (RPS 2016; Semeniuk 2004). However, conservation areas occur adjacent to the ASDP site (areas 9a, 9b and 10a), which host similar values which are generally in better condition. In addition, conservation area 10b occurs directly adjacent to the ASDP site with Quindalup Dune landforms in similar condition to that of the ASDP site.

Erosion controls implemented during and post construction will ensure wind driven erosion processes will not impact the surrounding vegetated landscapes. By initiating erosion control practices, significant additional impacts to the Quindalup Dunes system as a result of erosion are unlikely to occur.

Accordingly, it is expected that the EPA's objective for landforms will be met.

12. Social Surroundings

12.1 EPA objectives

The EPA's environmental objective for social surroundings is:

"To protect social surroundings from significant harm" (EPA 2016s).

12.2 Policy and guidance

The relevant EPA policy and guidelines, and the scope of each of these as relevant to the Proposal, are presented in Table 12-1.

Table 12-1: Policies and guidelines

Policy or guidance	Consideration
EPA Factor Guideline – Social Surroundings (EPA 2016s)	The EPA's advice in relation to consideration of impacts to social surroundings has been considered in the design of the Proposal to minimise impacts to heritage values and amenity.

12.3 Overview of studies

Table 12-2 describes the studies that been undertaken in relation to social surroundings.

Table 12-2: Social surroundings studies

Investigation	Scope
Alkimos Seawater Desalination Plant Social Impact Assessment (ERM 2018)	To identify and assess the real and perceived social impacts that may be experienced by the local community; and to develop a social impact management framework to identify potential management measures to minimise impacts of the ASDP.

The Social Impact Assessment (SIA) defined the following potential sensitive receptors within the vicinity of the Proposal:

- residential estates to the north and to the south of the ASDP site
- residential properties along the pipeline
- recreational areas along the beach near the ASDP site and above the intake and outfall tunnels
- conservation areas surrounding the ASDP site
- the SS Alkimos and the Barque Eglinton registered heritage shipwreck sites in the near shore (coastal) environment (Figure 12-1).

In addition to the sensitive receptors identified above, a search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System (AHIS 2017) was undertaken.

12.4 Receiving environment

Social surroundings include aesthetic, cultural, economic and social aspects that could affect or be affected by the Proposal.

Residential estates occur approximately 1 km to the north and 600 m to the south of the ASDP site and a smaller concentration of residential estates and individual properties occurs at various distances from the pipeline DAF. Conservation areas are located directly adjacent to the DAF.

Additional potential receptors surrounding the ASDP site include those identified in the Alkimos District Structure Plan, including future recreational areas of beach and parklands to the east and residential areas to the west.

12.4.1 Aboriginal heritage

The Proposal directly intersects one registered Aboriginal heritage site along the pipeline DAF. Several other sites were identified near the Proposal.

Table 12-3 below identifies the registered Aboriginal sites identified in the desktop search and the location of these sites is shown on Figure 12-2.

Table 12-3: Registered Aboriginal sites close to the Proposal

Proposal component	Place	ID	Description	Distance
ASDP site	Karli Spring	3509	A small wetland in an inter-dunal depression in the foreshore reserve as an expression of groundwater; the result of a topographic depression in the Quindalup Dune system. The spring is 1 m below sea level and located approximately 175 m east of the coast. It contains permanent water and experiences only minor water level fluctuations.	1.1 km to the southwest
ASDP site	Jindalee	20772	Mythical, water source.	2.5 km south
Pipeline	Honey possum site	3503	Mythological.	Intersects
Pipeline	Lake Mariginiup	3741	Mythological, hunting place.	650 m northwest

Several Aboriginal heritage surveys have been conducted over the terrestrial DAF. Table 12-4 below provides a summary of each survey.

Table 12-4: Aboriginal survey history

Heritage survey area	Survey type	Summary
21817	Ethnographic	Ballaruk (traditional owners) Aboriginal site recording project (boundary last updated 27/05/2010).
21818	Ethnographic	Ballaruk (traditional owners of Whadjuk territorial boundaries the lands of the Ballaruk Peoples) Aboriginal site recording project: additional material.
21909	Ethnographic	Study of groundwater – related Aboriginal Cultural Values on the Gnangara Mound, Western Australia.
21910	Ethnographic	Study of groundwater – related Aboriginal Cultural Values on the Gnangara Mound, Western Australia: Volume 1 restricted report.
21911	Archaeological & ethnographic	Study of groundwater – related Aboriginal Cultural Values on the Gnangara Mound, Western Australia: Volume 2 inventory of registered sites restricted report for Department of Environment.
22155	Archaeological & ethnographic	Report on an ethnographic and archaeological survey of the proposed wastewater treatment plant project area at Alkimos, City of Wanneroo, Western Australia. The survey area comprised the land within Site A and Site B buffer zones and included the footprints for Site A and Site B and the launch site on and around Lot 101 at Alkimos, City of Wanneroo.
22224	Archaeological & ethnographic	Report of a survey for Aboriginal sites at the Alkimos wastewater treatment plant site.
102670	Ethnographic	Preliminary Report on the Survey of Aboriginal Areas of Significance in the Perth Metropolitan & Murray River Regions July 1985.
103564	Archaeological	An Archaeological Survey Project: The Perth Area, Western Australia. Apr 1972.
104279	Archaeological & ethnographic	Proposed Clarkson, Eglinton and Alkimos Housing Developments, North West Corridor.

368000 370000 372000 374000

6502000

6500000

6498000

Figure 12-1: European heritage sites

N

Scale 1:20,000 at A3

0 250 500 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 18/03/2019

Legend

Development Area Footprint
ASDP Site
Pipeline
Integration Pipeline
Northern Route Option
Marine Tunnel
Municipal Inventory Site (SHO)
Alkimos Ship Wreck
Eglinton shipwreck

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Data source: Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Client: Water Corporation Project area, 07/2018. Created by: c.thatcher

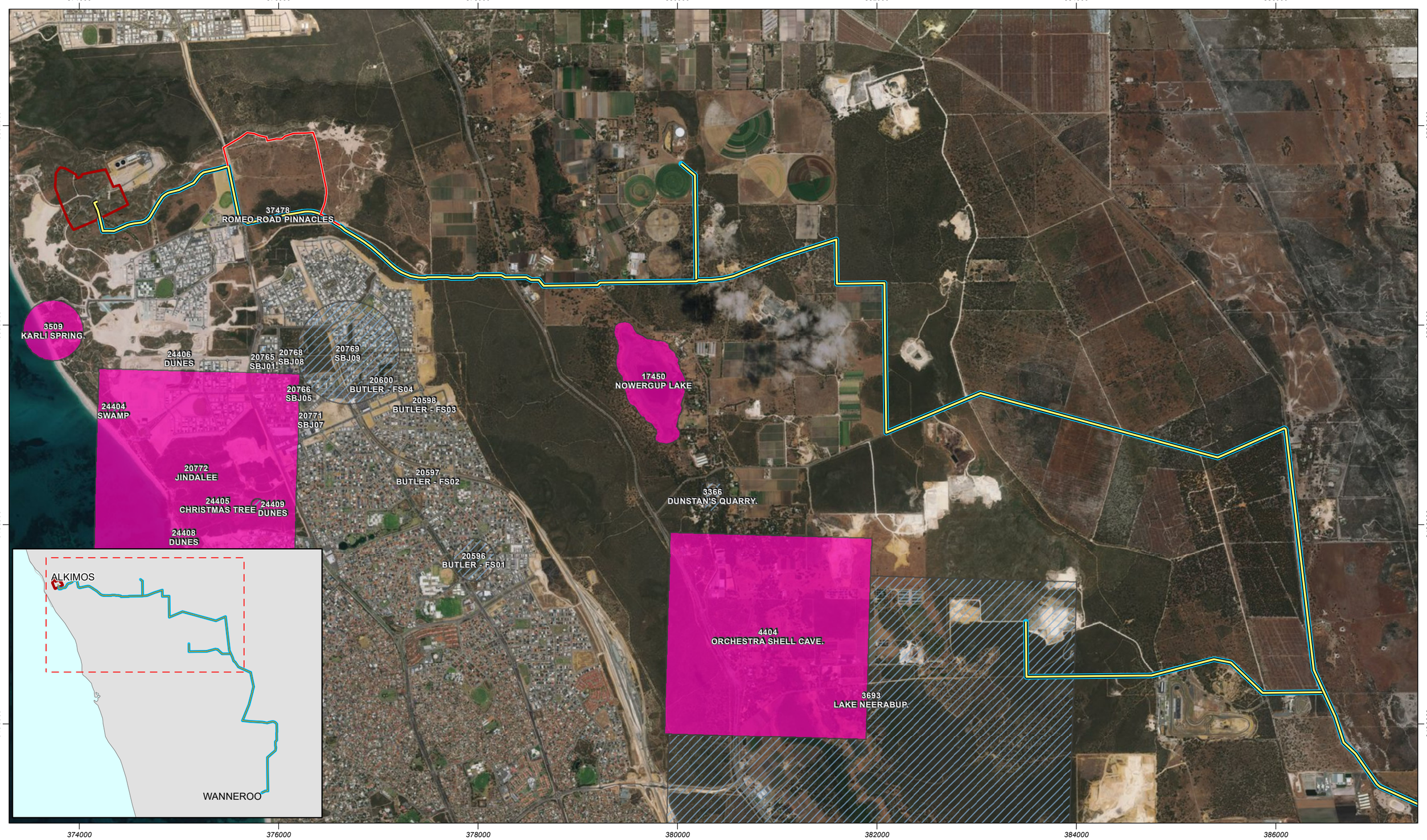

Figure 12-2A: Aboriginal Heritage Sites

N

Scale 1:35,000 at A3

0 0.5 1 km

Coordinate System: GDA 1994 MGA Zone 50

Date: 18/03/2019

Legend

Development Area Footprint
- ASDP Site
- Pipeline

- Northern Route Option
- Integration Pipeline

Aboriginal Heritage Places (DAA-001)
- Registered Site
- Other Heritage Place

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384000 386000 388000 390000

6496000 6494000 6492000 6490000 6488000

3693
LAKE NEERABUP.

3503
HONEY POSSUM SITE

3396
LAKE ADAMS.

22160
MARRYNGINUP

28616
LAKE MARIGINIUP SCARRED TREE

3741
LAKE MARIGINIUP.

3316
LAKE JOONDALUP WEST

22671
JOONDOL MURYANG

3532
JOONDALUP CAVES

ALKIMOS

WANNEROO

6058
D, WANNEROO

384000 386000 388000 390000

Figure 12-2B: Aboriginal Heritage Sites

N

Scale 1:30,000 at A3

0 0.5 1 km

Coordinate System: GDA 1994 MGA Zone 50

Date: 13/03/2019

Legend

Development Area Footprint
- Route Alignment
- Integration Pipeline

Aboriginal Heritage Places (DAA-001)
- Registered Site
- Other Heritage Place

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Data source: Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Client: Water Corporation Project area, 07/2018. Created by: c.thatcher

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12.5 Potential impacts

12.5.1 Potential construction impacts

The potential for construction impacts to social surroundings resulting from the Proposal is summarised in Table 12-5.

Table 12-5: Potential construction impacts to social surroundings

Potential impacts	Context
Increased traffic	For the duration of construction, traffic entering and exiting the DAF may contribute to traffic congestion surrounding the area. The roads surrounding the ASDP site are likely to experience an increase in traffic from trucks and vehicles transporting people and materials to and from the site.
Noise and vibration	Construction noise may impact the surrounding residential areas and conservation areas. Site preparation and construction activities conducted by heavy plant will result in noise for the duration of the development. Some construction activities may also result in vibration causing an amenity impact to the surrounding residential areas. Installation of the intake and outfall tunnels and marine risers will produce noise and vibration in the marine environment. Excessive noise or vibration may disturb marine fauna, resulting in movement away from the area to more favourable conditions potentially causing disruption to commercial and recreational fishing activities.
Dust	Dust generated during construction activities in the DAF may reduce the amenity of residents and the conservation areas. The ASDP site is situated amongst sand dunes; therefore, wind borne sand has the potential to cause impacts to the amenity of the residential and conservation area surrounding the site.
Marine sediment	Construction of the marine risers may result in increased sediment around the activity area. Excessive sediment may disturb marine fauna, resulting in movement away from the area to more favourable conditions potentially causing disruption to commercial and recreational fishing activities. Increased sediment may also result in reduced amenity for recreational swimmers in the area.
Heritage values	Within the DAF, one Aboriginal heritage site has been identified that directly intersects with the pipeline (site ID 3503). This honey possum site of mythological value may be impacted if construction aspects are not adequately managed. Previously unidentified aboriginal heritage artefacts and scatters may also be inadvertently uncovered or destroyed during construction of the Proposal. Two maritime heritage shipwrecks are situated near the DAF and may be impacted by marine construction activity. The shipwrecks also have recreational value as dive sites which may also be impacted.

12.5.2 Potential operational impacts

The potential for operational impacts to social surroundings resulting from the Proposal is summarised in Table 12-6.

Table 12-6: Potential operational impacts to social surroundings

Potential impacts	Context
Noise and vibration	The ASDP will operate 24 hours a day generating noise from pumps, process equipment and auxiliary systems (e.g. heating, ventilation, and air conditioning). Noise can impact local amenity at the nearby residential receptors and conservation areas reducing the quality of the environment for nearby residents.
Odour	Biological material screened out of the intake water (e.g. seaweed) may result in odour impacts at the nearby residential, conservation and recreational areas if not managed appropriately.
Increased traffic	There will be some increased traffic related to the operation of the Proposal, mainly limited to staff accessing the ASDP for work and to vehicles delivering supplies such as chemicals.
Light pollution	Light spill from the industrial ASDP site has the potential to disturb nearby residential areas.
Marine water quality	The discharge of brine has the potential to cause localised salinity stratification which could result in a reduction in water quality. Stratification may result in reduced dissolved oxygen concentrations locally, which may reduce populations of fish and other marina fauna as they move away from unfavourable conditions. If populations are reduced locally, recreational and commercial fishing activities may be impacted.
Heritage values	Operation of the ASDP may impact the heritage shipwrecks sites located off the coast.

12.6 Assessment of impacts

12.6.1 Construction

Increased traffic

The Social Impact Assessment report (ERM 2018) identified that construction traffic entering and exiting the DAF via the local road network is likely to have a significant impact upon local traffic conditions during peak times for the duration of construction. Traffic is likely to be heaviest around Marmion Avenue and Wanneroo Road from the hours of 7 am to 9 am and 4 pm to 6 pm as commuters depart home for work in the morning and then return in the afternoon and evening.

Marmion Avenue and Wanneroo Road themselves are unlikely to be significantly impacted as these arterial roads are designed to cope with heavy traffic (ERM 2018). Local roads surrounding the ASDP site and the pipeline will experience an increase in heavy vehicle traffic which could impact local amenity during construction.

Noise and vibration

Impacts to local amenity due to construction noise may occur. Construction is likely to take three years and residential receptors may be impacted over this period. Currently, residential receptors are 600 m to the south and 1 km to the north of the ASDP site. Above ground construction activities will be conducted between 7 am and 7 pm Monday to Saturday (excluding public holidays) in accordance with City of Wanneroo requirements. By conducting construction activities during these times, the potential for significant impacts to the surrounding residential receptors is substantially reduced. Additionally, as the distance to sensitive receptors at the ASDP site are more than 500 m, noise from construction activities is likely to dissipate to nominal background levels prior to the receptor. Underground construction activities (i.e. use of TBMs for the marine intake and outfall tunnels) will occur continuously; however, associated above ground activities such as truck movements (e.g. carting of spoil) will be limited to the same hours as the main above ground construction activities.

Terrestrial vibration impacts during construction of the Proposal are considered unlikely to cause significant impacts to the residential receptors surrounding the ASDP site. Residential receptors are 600 m to the south and 1 km to the north, which provides sufficient separation distance. Along the pipeline DAF, residential receptors are situated in closer proximity to construction activities. However, the concentration of residences is substantially reduced as the pipeline DAF has been deliberately chosen to avoid residential areas as much as possible. In addition, construction methodology for the installation of the pipeline is to progress installation along the route in sections. As a result, the duration of construction impacts in any one location are anticipated to be short.

The impacts of noise, vibration and increased sediment in the marine environment on benthic communities and marine fauna have been assessed in Sections 7 and 8 of this report. The assessments concluded that there would be no significant residual impact to benthic communities or marine fauna predicted to occur from the construction of the Proposal. As such there are not expected to be any impacts to the recreational and commercial values attached to these elements.

Dust

During construction, dust is likely to be generated due to several factors, including removal of vegetation and top soil across the ASDP site and exposure to strong on-shore afternoon winds typical of the local coastline. It is possible that increased dust and sand created by construction activities could travel to residential areas causing an amenity impact.

Heritage

One registered Aboriginal heritage site directly intersects with the Proposal, as identified above in Table 12-3. In this section of the pipeline, the pipe will be buried to a depth of between 0.6 m to 3 m depending on site-specific characteristics. However, as there is an overhead powerline on the western side of the pipeline at this point, the alignment may be required, in part, to intersect the registered site. Prior to construction, Water Corporation will undertake further consultation with DPLH to discuss how impacts can be avoided or mitigated, including placement of the pipe under the existing road if necessary.

Both the SS Alkimos and Barque Eglinton shipwrecks are listed as heritage sites and the Barque Eglinton is protected under commonwealth legislation. Both wrecks are valued dive locations with commercial relevance locally and regionally. Potential impacts could include damage to the structures because of construction activities, and noise, vibration and sediment impacting marine flora growing on the wrecks and marine fauna who rely on the flora for food and structures for shelter. However, the alignment of the intake and outfall tunnels and the locations of the intake and outfall risers have been chosen to avoid the shipwrecks, which are located at least 700 m from marine infrastructure. Given this separation distance, impacts to the shipwrecks from construction activities are not expected and the heritage and recreational/commercial values will be protected. Similarly, given the use of TBMs and the locations of the marine intake and outfall risers, no impacts to recreational bathers and swimmers in near shore waters are anticipated.

12.6.2 Operation

Existing landforms have been strategically utilised to minimise operational impacts on nearby residential areas. The ASDP site has been located within a natural hollow, which will be further excavated, to minimise aesthetic, light and noise impacts on adjacent residential areas. Additionally, some of the surplus spoil (generated during site excavation) will be used to construct a berm on the western side of the ASDP site. This berm will further attenuate aesthetic, light and noise impacts on the future residential area to the west. The berm will also be revegetated to mitigate potential aesthetic and erosion impacts of the berm.

Currently, residential properties are located 1 km to the north with bushland and conservation areas between the residential areas and the Water Corporation cadastral boundary. Residential properties are currently located approximately 600 m south with no further development area northward toward the ASDP site. Noise from the continual operation of ASDP may result in conflicting land uses as residential development progresses toward the ASDP site.

Individually, each noise source is unlikely to be sufficient to produce a significant impact to local amenity. However, the cumulative impact of all infrastructure required for the ASDP, the WWTP and the Eglinton GWTP has the potential to be a significant impact to residents. Water Corporation commissioned Herring Storer Acoustics to carry out a cumulative acoustic assessment and modelling of noise emissions from the various plants. The purpose of the assessment was to establish whether the Proposal complies with the requirements of the Environmental Protection (Noise) Regulations 1997. The assessment concluded that the Proposal has the potential for significant noise emissions which exceed the regulation ‘assigned levels’ at the residential receptors (Herring Storer Acoustics 2018).

The impacts of the discharge of brine to the marine environment have been assessed in Sections 6, 7 and 8 of this report. The assessments concluded that there would be no significant residual impacts to marine environmental quality predicted to occur from the construction of the Proposal. As such there are not expected to be any impacts to the associated recreational and commercial values.

Washings from the seawater intake band screens are expected to be primarily organic in nature, comprising marine organisms such as seaweeds with a small amount of inorganic material of anthropogenic origin (for example plastic bags, fishing line, cloth). Due to the proximity of the site to the new and existing residential developments, the risk of odour and complaints from due to open air storage of screenings waste is considered high.

12.7 Mitigation

12.7.1 Construction

Water Corporation has applied the mitigation hierarchy to the construction of the Proposal so that social surroundings are maintained. Mitigation measures are summarised in Table 12-7.

Table 12-7: Summary of construction mitigation measures to protect social surroundings

Impact	Avoid	Minimise	Monitoring and management
Increased traffic	Traffic impacts have been avoided where possible via upgrade of the existing access road to the ASDP site and WWTP and connection with Marmion Avenue, to avoiding the local road network.	A Traffic Management Plan will be developed for the Proposal to assist in traffic flow and with the arrival and departure of heavy vehicles at the ASDP site and the pipeline during construction. The traffic management plan will detail appropriate arrival and departure times for heavy vehicles so as not to block roads during times of known traffic congestion.	A Traffic Management Plan will be developed for the Proposal to assist in traffic flow and with the arrival and departure of heavy vehicles at the ASDP site and the pipeline during construction. The traffic management plan will detail appropriate arrival and departure times for heavy vehicles so as not to block roads during times of known traffic congestion. Prior to construction commencing, Water Corporation will develop a Terrestrial Construction EMF which will detail the measures to be employed to mitigate and manage potential impacts from construction activities to nearby receptors, including (but not limited to): • pre-construction inspection of residential properties in close proximity to the Proposal • pre-construction communication with nearby residents, including contact details for Water Corporation and contractors • limitations for construction times i.e. 7 am to 7 pm
Noise and vibration	The pipeline DAF has been designed with specific consideration to the avoidance of private land and property.	Much of the pipeline route is in rural areas devoid of significant numbers of residential receptors. For any receptors that are present, the linear construction methodology means that impacts will have to be managed for relatively short periods at any one location. Construction activities associated with installation of the pipeline are expected to cause localised, temporary impacts at each section.	

Impact	Avoid	Minimise	Monitoring and management
Dust		Following clearing within the ASDP site, dust suppression techniques will be applied to the areas which are cleared for Stage 2 (increase to 100 GL/a) and will continue to be managed across the ASDP site until construction of Stage 2 is commenced.	Monday to Saturday excluding public holidays • dust suppression measures, including (but not limited to): ○ regular use of water carts or cannons ○ regular inspections of stockpiled material and bare earth areas (including roads) across the site ○ speed limits across the site to reduce dust generated from vehicles ○ application of soil binding material and covers to portions of cleared earth which will be left vacant for long periods of time ○ revegetation of disturbed areas with ongoing monitoring and maintenance of restored areas to ensure vegetation is established ○ procedures for known and suspected aboriginal heritage artefacts or scatters uncovered during construction, including contact details for specialists to attend site, and measures to protect suspected material.
Heritage values	The alignment of the intake and outfall tunnels and the locations of the intake and outfall risers have been chosen to avoid heritage shipwrecks, which are located at least 700 m from marine infrastructure.	Before construction commences, Water Corporation will consult with the DAA to obtain the required authorisation to intersect with Registered Heritage Site 3503. Upon obtaining the required permission, Water Corporation will ensure compliance with all conditions required by the DAA. The construction methodology for this portion of the pipeline will be carefully considered to minimise impacts to the registered site, including the use of tunnelling techniques or relocation of the alignment to the opposite side of the road (under the overhead power lines), which will require permission from Western Power.	

12.7.2 Operation

Water Corporation has applied the mitigation hierarchy to the construction of the Proposal so that social surroundings are maintained. Mitigation measures are summarised in Table 12-8.

Table 12-8: Summary of operational mitigation measures to protect social surroundings

Impact	Avoid	Minimise	Monitoring and management
Noise and vibration Light pollution Visual impact	The selection and design of the ASDP site considered the surrounding land uses, particularly the existing and future residential areas to the south and west of the site. Criteria that influenced the location of the ASDP included: • noise emissions • light pollution • visual (aesthetic) impact. The selected site and layout resulted in a solution where the main noise areas are situated at the eastern end of the site, close to the Alkimos WWTP. The western berm will shield future residential areas from visual aspects of the process plant and contain noise.	Noise attenuation measures will be required for all noise generating infrastructure. All noise generating equipment will typically be housed within buildings fitted with noise attenuation features, which will substantially dampen noise, in particular for the future residential area to the west. Operational noise will be substantially reduced through the enclosure of noise emitting equipment and application of noise reduction (acoustic) treatments to process buildings and enclosures. The extent of noise mitigation is significant, requiring the integration of acoustic design into the Proposal during design: • all buildings containing significant noise sources require measures such as acoustic absorptive roof linings, attenuated ventilation openings, and suitable oriented access openings • external noise sources may require low noise selection, acoustic enclosures or barriers • vertical discharge stacks will require low noise equipment selections and/or acoustic attenuators • ventilation fans will require attenuators on the external inlet / discharge openings. The western berm is a required noise mitigation measure.	Noise monitoring will be conducted post construction to ensure that noise levels remain as predicted and that mitigation measures are effective.

Impact	Avoid	Minimise	Monitoring and management
Odour	Given the high risk of odour impacts from the waste screened from the seawater intake, the design of the ASDP includes a channel macerator that will process the waste and direct it to the outfall chamber for discharge back into the marine environment avoiding the need to handle and store the waste on site.	-	-
Increased traffic	Dedicated access roads already exist for the operation of the Alkimos WWTP and will be used for the ASDP.	Traffic congestion as a result of operation is not anticipated to produce any significant impacts, primarily due to a substantial reduction in traffic entering and exiting the ASDP site compared to the construction period.	-

12.8 Predicted outcome

Based on the site selection, design options and mitigation measures to be implemented, the Proposal is not expected to significantly impact social surroundings. Residual impacts can be mitigated through the implementation of the TCEMF.

Accordingly, it is expected that the EPA's objective for social surroundings will be met.

13. Other environmental factors

The following other environmental factors or matters relevant to the Proposal have been identified:

- Coastal Processes
- Subterranean Fauna
- Terrestrial Environmental Quality
- Inland Waters
- Human Health
- Air Quality (Greenhouse Gas Emissions).

Due to the low level of impact, application of industry standard controls and other regulatory mechanisms, these factors are not expected to be required to be assessed in detail by the EPA. Table 13-1 provides a summary of the impacts, mitigations and outcomes for these factors.

Table 13-1: Other environmental factors

Element	Description
Coastal Processes	
EPA objective	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.
Policy and guidance	EPA Environmental Factor Guideline – Coastal Processes (EPA 2016b).
Potential impacts	Sediment transport: Proposed construction methods (i.e. use of TBMs) will not alter the morphology of the coastal zone or the geophysical processes (i.e. wind, waves, currents) acting on the Alkimos coastal zone. The presence of the marine intake and outfall tunnels will not result in any long-term change in sediment transport due to the operation of the ASDP. Public amenity: Proposed construction methods (i.e. use of TBMs) will not result in a change to the public accessibility or use of Alkimos Beach during the construction of the Proposal. Due to the deep location of the intake and outfall tunnels at the shore crossing point (top of pipes approximately 15 m below ground level), the presence of the buried structures will not result in any long-term change in existing beach access and public amenity due to the operation of the ASDP.
Mitigation	Avoid:
	The use of TBMs avoids any direct interaction with the coastal zone that other construction methods (e.g. dredging and trenching) would involve. Tunnelling also means no interruption to public use of the beach area during construction or operation.
	Minimise:
	The use of buried infrastructure minimises any change in sediment transport and erosion/accretion zones; and minimises the need for any long-term restriction to public access or change in beach usage.

Element	Description
Outcomes	Residual impact:
	No significant residual impact to coastal processes (or associated environmental values, including public amenity) is predicted to occur from the construction and operation of the Proposal. The maintenance of sediment transport patterns and the long-term continuity of public access are aligned with relevant objectives of the community component of the WA Coastal Strategy (DPLH 2017).
Subterranean Fauna	
EPA objective	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.
Policy and guidance	EPA Factor Guideline – Subterranean Fauna (EPA 2016j)
Potential impacts	Geotechnical investigations for the Proposal and local and regional area identified that the conditions required for troglofauna (i.e. caves and voids) are unlikely to be present within the intake and outfall tunnels, ASDP site and much of the pipeline. As the pipeline continues east of the ASDP site, it is likely to intersect with landforms consistent with their preferred habitat (Cossill & Webley 2010). Stygofauna (aquatic animals living in groundwater) may be present within the DAF. However, soil conditions within the ASDP site are aeolian in nature with little to no organic content (Cossill & Webley 2010), which is considered important for subterranean habitat (Hose et al 2015). Along the pipeline there is limited potential for impacts to stygofauna and troglofauna, as habitat conditions are more likely to be suitable i.e. alluvial material with higher organic content and caves and voids for habitat. Habitat impacts, limited in nature and duration, may occur because of construction activities along the pipeline. Any impacts would be limited to dewatering during construction and would not be anticipated to significantly impact stygofauna or troglofaunal given the construction depths involved.
Mitigation	Avoid:
	The pipeline design has considered using areas already disturbed by historical activities (e.g. road reserve, cleared tracks).
	Minimise:
	The pipeline will be excavated to the maximum extent necessary to bury the pipe to a minimum depth of 0.6 m and maximum depth of 3 m. Dewatering is unlikely to be required for most of the installation of the pipeline; any dewatering that may be required will be localised and of short duration, minimising the impact to the surrounding area. The deep excavation of the marine intake and outfall onshore shafts at the ASDP site will require dewatering, most likely in the top 5 m of the Ascot Formation. The dewatering is estimated to cause a maximum anticipated radius of influence of approximately 250 m from the excavation and grouting will be used if required to slow the ingress of any water (Jacobs & WorleyParsons 2018b).
Outcomes	Residual impact:
	Significant impacts to subterranean fauna are considered unlikely to occur.

Element	Description
Terrestrial Environmental Quality	
EPA objective	To maintain the quality of land and soils so that environmental values are protected.
Policy and guidance	EPA Factor Guideline – Terrestrial Environmental Quality (EPA 2016m).
Potential impacts	Acid Sulfate Soils (ASS) have the potential to affect soil quality as dewatering for the installation of the launch shafts for the marine intake and outfall tunnels and the pipeline is carried out.
Mitigation	Avoid:
	The ASDP site is considered to have a low risk of ASS, except for the clayey and peaty layers at depth which have been identified as Potential Acid Sulfate Soils (PASS). Acid generation risk is considered low as a large amount of Acid Neutralising Capacity (ANC) is prevalent on the site and PASS is localized (Jacobs & WorleyParsons 2018b). Development of a specific ASS Management Plan (ASSMP) is not considered necessary and localised management of ASS materials can be handled during the earthworks program through the implementation of the TCEMF. Concept design of the pipeline has considered the landscape and much of the route is across land which has previously been subject to clearing activities and is degraded, avoiding the requirement for dewatering in these areas which are most likely to host potential PASS.
	Minimise:
	Any dewatering will be conducted via a Dewatering Management Plan (DMP), which will detail the treatment of soils if PASS is identified. The DMP will be developed in accordance with the Department of Environmental Regulation (now DWER) guideline: treatment and management of soils and water in acid sulfate soil landscapes (2015). The DMP will form part of the TCEMF.
Outcomes	Residual impact:
	The Proposal is not anticipated to cause a significant impact to Terrestrial Environmental Quality.
Inland Waters	
EPA objective	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.
Policy and guidance	EPA Factor Guideline – Inland Waters (EPA 2016w)
Potential impacts	No wetlands occur within the Quindalup Dune system. Therefore, the ASDP site does not intersect or occur near identified wetlands. The deep excavation of the marine intake and outfall onshore shafts at the ASDP site will require dewatering, most likely in the top 5 m of the Ascot Formation. The dewatering is estimated to cause a maximum anticipated radius of influence of approximately 250 m from the excavation and grouting will be used if required to slow the ingress of water (Jacobs & WorleyParsons 2018b). A series of contiguous ephemeral wetlands occur within the small swales of brown and leached sands in the Spearwood Dune system. The pipeline DAF directly intersects with seven wetlands, two multiple use, three resource enhancement and two conservation category wetlands (CCW). Table 13.2 and Figure 11.1 identify the wetlands that are near to or intersect the pipeline.

Element	Description
	Wetlands on the Swan Coastal Plain are generally an expression of groundwater and are responsive to changes in the catchment which can affect soil transmissivity i.e. the rate of water movement through the soil (Water and Rivers Commission 2001). By constructing the pipeline along the boundaries of wetlands, groundwater fed wetlands, sumplands and damplands, flows into them can be restricted. A reduction of flow into the wetlands will put stress on these groundwater expression systems. Dewatering activities can result in impacts to Groundwater Dependent Ecosystems (GDEs) and the construction of the pipeline has the potential to alter local hydrology as the pipe and trench may create a subsurface barrier for hydrological flows into the wetlands.
Mitigation	Avoid:
	The alignment for the pipeline has been placed in already cleared and disturbed areas such as road reserve. The pipeline DAF intersects the boundary of CCWs; however direct impacts will be avoided by placing the pipeline in road reserve and areas of already degraded vegetation. By placing the pipeline in disturbed area, water flow impacts will be avoided as it is expected that the ground will already be compacted due to the construction of features such as road infrastructure and other services. Installation of the pipe in these areas should not impact water flows in the near surface. Creation of a low permeability barrier by installing the pipeline through trenching and compacting soil may result in a hydrological disconnection between subsurface flows and wetlands. However, the depth of the pipe will be to a maximum of 3 m, with the minimum cover required to protect the pipe being 600 mm. Typically, the superficial groundwater flows are between 3 m and 8 m below ground level avoiding the pipeline construction zone.
	Minimise:
	Any dewatering required for the construction of the pipeline will be managed in accordance with the DMP, which forms part of the TCEMF. The DMP will include management and disposal of water, including water quality targets and monitoring. It is expected that at most locations, water will be discharged into suitably sized infiltration basins within, or as close as possible to the pipeline construction corridor. Construction of the pipeline will occur in a linear method resulting in limited (temporal and spatial) disturbance and impacts at each location.
Outcomes	Residual impact:
	Significant impacts to inland waters from construction of the proposal are considered unlikely to occur.

Element	Description
Air Quality (Greenhouse Gas Emissions)	
EPA objective	To maintain air quality and minimise emissions so that environmental values are protected.
Policy and guidance	EPA Factor Guideline – Air Quality (EPA 2016r)
Potential impacts	Due to the criticality of the infrastructure, energy for the Proposal is required to be sought from a reliable source and will be supplied from the Western Power grid. The proposed desalination plant's greenhouse gas emissions are categorised as indirect 'Scope 2' emissions - emissions released to the atmosphere from the indirect consumption of an energy commodity. Table 13-3 presents the estimated power consumption and indirect greenhouse gas emissions per year for each proposed stage.
Mitigation	Avoiding emissions through best practice design:
	The following outlines the key considerations to optimise energy efficiency incorporated into the ASDP concept design; • energy efficiency through site selection: selection of the Alkimos site provides energy savings compared to Seabird, which is the next closest alternative site to the north of Perth. The Seabird site involves pumping treated water an extra 39.5 km resulting in estimated additional energy consumption of 48,246,930 kWh per year based on 100 GL/a production. Consequently, the Alkimos site provides approximately 10% saving in power consumption and greenhouse gas emissions compared to the Seabird site • energy efficiency through site location: Multi-Criteria Analysis was undertaken for site selection within the Alkimos Water Precinct; with a key criterion being low site elevation to minimise energy used in seawater pumping i.e. since seawater reverse osmosis operates with 50% recovery, then half the water is returned to the sea; hence, minimising the pumping lift of this volume of seawater is significant for energy efficiency • the design incorporates gravity intake and outfall tunnels which avoids the requirement for additional energy use in the provision of raw feed water and/or discharge of brine • energy efficiency through equipment selection: the type of seawater intake pumps selected are vertical turbine pumps with 86.2% efficiency whereas the next best alternative were submersible pumps with 78.3% efficiency • energy efficiency through Energy Recovery Devices: Reverse Osmosis uses high pressure pumps to generate high pressure to overcome the osmotic pressure when desalinating seawater. Energy Recovery Devices are included in the design to recover energy from the concentrate stream (brine) and apply this recovered energy to the feed stream to the RO process • energy efficiency through optimised plant recovery: plant design, particularly in the RO process configuration and membrane selection, will aim to optimise overall plant recovery and reduce the volume of seawater that is pumped and pre-treated at the plant, which saves energy.

Element	Description
	Continuous improvement to reduce emissions over project life:
	A key aspect of the operation and maintenance planning for Water Corporation's desalination assets is to optimise energy efficiency and thereby reduce power consumption and the associated indirect scope 2 greenhouse gas emissions. The following summarises the key considerations for the Proposal: • energy efficiency in plant operation: specific energy consumption for the total process will be monitored and Key Performance Indicators set for energy efficiency, which will trigger corrective actions (such as membrane replacement or pump overhauls) to ensure that the plant continues to operate at target energy consumption levels or better • energy efficiency through advances in membrane technology: higher efficiency seawater RO membranes are progressively being released to the market and will be considered for future membrane replacements to improve energy efficiency • energy efficiency through membrane process maintenance: as membranes are fouled and/or scaled during normal operation, the hydraulic efficiency and performance of the membrane can deteriorate which in turn impacts energy efficiency; a common operating intervention is a regular cycle of chemical cleaning and flushing to maintain membrane performance • energy efficiency at future capacity upgrade stages: upgrade of the ASDP from 50 GL/a to 75 and 100 GL/a will trigger a major capacity upgrade to the downstream drinking water transfer system. An option to pump from ASDP to Carabooda Tank site only, and install a booster pump station near Carabooda Tank site for on-transfer to Wanneroo Reservoir will be further examined as a more energy efficient alternative for drinking water transfer.
	Reporting of emissions:
	As a requirement of the *National Greenhouse and Energy Reporting Act 2007* (NGER Act), Water Corporation reports its annual greenhouse gas emissions, energy consumption and production to the Clean Energy Regulator. All greenhouse gas emissions are reported using the emission factors and methodologies as set out under the NGER Technical Guidelines.
Outcomes	Residual impact:
	Significant impacts to air quality (greenhouse gas emissions) from the operation of the Proposal are unlikely to occur.
Human Health	
EPA objective	To protect human health from significant harm.
Policy and guidance	EPA Environmental Factor - Human Health (EPA 2016t).
Potential impacts	Chemical spills during construction or operation may result in significant harm to the health of the operators of the Proposal or recreational user and residents surrounding the Proposal.
Mitigation	Avoid:
	All bulk storage of liquid chemicals will be located on bunded hardstands with fully self-contained storage for spilt liquid in accordance with AS3780.

Element	Description
	Minimise:
	All chemicals will be stored in accordance with their MSDS in vessels designed to contain the material in them and minimise the effects of the corrosive coastal environment. The TCEMF will prescribe chemical spill procedures, including definition of roles and responsibilities and the location of spill kits.
Outcomes	Residual Impact:
	Chemical spills are likely to be contained on hardstand surfaces and the EMFs will contain procedures for clean-up and notification. Significant impacts are unlikely to occur because of chemical spills.

Table 13-2: Wetlands intersecting the pipeline DAF

Wetland Classification	UFI	Name	Type
Resource enhancement	14247	Unknown	Dampland
Multiple use	14248	Unknown	Dampland
Conservation	13373	Lake Pinjar	Sumpland
Conservation	7929	Lake Pinjar	Sumpland
Multiple use	7917	Lake Pinjar	Sumpland
Resource enhancement	7938	Camel Swamp	Dampland
Resource enhancement	8020	Unknown	Sumpland

Table 13-3: Estimated power consumption and indirect greenhouse gas emissions per annum

	ASDP stage			
	25 GL/a + GWTP 6.6 GL/a	50 GL/a	75 GL/a	100 GL/a
Energy consumption (kWh)	115 936 800	227 966 160	407 660 160	500 305 080
Scope 2 GHG emissions (tonnes CO2-e)[1]	81 156	159 576	285 362	350 214

1. Assumes grid emissions average 0.7 tonnes CO_2-e per MWh.

14. Holistic impact assessment

The EIA process needs to consider the connections and interactions between parts of the environment to inform a holistic view of impacts to the whole environment. This requires consideration of the impacts of the Proposal in a regional context as well as at the local scale.

Due to a combination of drying climate and increasing demand, Water Corporation needs to be prepared to enable the supply of sufficient water to meet Perth (and surrounds) long-term requirements. The Proposal, which forms part of Water Corporation's broader IWSS, will in part, help reduce the projected drinking water supply gap and increase the supply capacity of the IWSS.

In a regional context, the Proposal is for the first proposed seawater desalination plant in the northern suburbs of Perth. The existing Perth seawater desalination plant (PSDP) is in the Kwinana Industrial Area and discharges brine into Cockburn Sound, while the second major desalination plant (SSDP) exists a further 110 km south in Binningup, discharging into open ocean waters.

The environmental studies commissioned for this Proposal have considered and assessed potential Proposal impacts at both a local and regional scale, as well as cumulative impacts of the Proposal. The results of these studies have informed the Proposal impact assessment and development of mitigation measures.

Table 14-1 provides a discussion of the predicted outcomes in relation to the environmental principles of the EP Act.

Key and other environmental factors have been considered against EPA objectives and relevant guidelines. The key environmental factors, impacts of the Proposal, and mitigation actions to address potential residual impacts are summarised in Table 14-2.

Water Corporation considers the potential impacts for the preliminary key environmental factors can be appropriately managed through the implementation of specific mitigation measures. Management frameworks applicable to the implementation of this Proposal include:

- Marine Construction Environmental Management Framework
- Marine Operation Environmental Management Plan
- Terrestrial Construction Environmental Management Framework.

Based on the mitigation measures proposed and the use of management measures, the Proposal is considered to meet the EPAs objective for each environmental factor.

Table 14-1: Environmental principles and predicted outcomes

Principle	Predicted outcomes
The precautionary principle *Where there are threats of serious irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In the application of the precautionary principle, decisions should be guided by:* *careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* *an assessment of the risk-weighted consequences of various options.*	The marine and terrestrial environments surrounding the Proposal are well documented following several rounds of mapping and surveying, and approximately 15 years of marine monitoring undertaken as a condition of approval for an existing wastewater treatment plant. The cause-effect pathways associated with the disposal of return seawater (brine) to the marine environment are well established based on decades of international and local experience. Water Corporation has made design decisions regarding the Proposal to avoid environmental impacts where possible based on multi-criteria analysis (risk assessment) of options available.
The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.*	The Proposal is an integral part of Water Corporation's water source planning and requirement to secure sources of potable water in a drying climate for the benefit of the present and future generations. The Proposal has been designed to ensure that relevant environmental factors can be met and the health, diversity and productivity of the environment is maintained.
The principle of the conservation of biological diversity and ecological integrity *Conservation of biological diversity and ecological integration should be a fundamental consideration.*	The ASDP site and pipeline have been specifically designed and located considering the conservation of biological diversity and ecological integration. The choice of construction methods and design options for marine infrastructure have also been chosen to avoid and minimise impacts on the marine ecosystem.
Improved valuation, pricing and incentive mechanisms *Environmental factors should be included in the valuation of assets and services.* *The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement.* *The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.* *Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, which benefit and/or minimise costs to develop their own solutions and responses to environmental problems.*	Water Corporation accepts that costs for environmental mitigation and management are part of the overall Proposal costs. This includes identified rehabilitation and/or residual impact management actions identified through this assessment. Water Corporation considers that the Proposal meets the principle of improved valuation, pricing and incentive mechanisms.

Principle	Predicted outcomes
The principle of waste minimisation *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	The Proposal's approach to waste is consistent with the waste management (avoid, recover, disposal) principles. The key ongoing waste item for the Proposal is the discharge of brine to the marine environment. The mitigation hierarchy has been applied to this waste stream to reduce the impact of this discharge. Waste management for the Proposal is addressed within the relevant construction and operation environmental management frameworks. This also includes consideration of reusing natural materials (e.g. excavated dune sediments) where practicable. Water Corporation considers that the Proposal meets the principle of waste minimisation.

Table 14-2: Summary of environmental assessment for key environmental factors

Context	Potential impact(s)	Management and mitigation	Predicted outcomes
Marine Environmental Quality		EPA objective: To maintain the quality of water, sediment and biota so that environmental values are protected	
Return seawater is slightly warmer and saltier than surrounding seawater. There is potential to affect water quality in the near-field mixing zone. Discharge of chemicals used in ASDP operational processes may adversely affect water quality in the immediate vicinity of the outlets. The introduction of brine may lead to cumulative impacts if the brine interacts with treated wastewater from an existing ocean outlet.	*During construction:* Reduced light (elevated TSS). Smothering / Physical damage (elevated TSS). Toxicity (grouting materials). Toxicity (cleaning and disinfection chemicals). Stressor effects (tunnel residues). Toxicity (hydrocarbon spills and waste generation). *During operation:* Reduction in dissolved oxygen (stratification). Stressor effects (increased salinity & temperature). Toxicity (chemicals used in RO maintenance processes).	Intake and outlet structures: Excavations required for the marine infrastructures are at least 100 m from the nearest seagrass and macroalgal habitats. Sub-sea pipeline: On-shore disposal of excavated sediment from the Tunnel Boring Machine will avoid potential for direct and/or indirect impacts on marine quality associated with disposal of dredge spoil at sea. The planned location of the desalination discharge outlet is sufficiently separated from benthic macroinvertebrate communities so that mixing/dilution occurs prior to the plume reaching these communities. Chemicals to be well managed and used only as necessary. Water Corporation has developed a conceptual model to predict drill cutting dispersion to assess the fate of particles. Pre-selection of the tunnelling method to minimise impacts to the marine benthic environment. Use of an extended sleeve when drilling to manage the dispersal of drill cuttings.	*Outcome(s):* The Proposal is not expected to compromise the EPA's high ecological protection criteria beyond the immediate confines of the drilling site, or any further than 70 m from the outlets. Water Corporation will apply to the EPA to establish a LEPA of a radius 100 m around the outlet diffusers. The establishment of a LEPA based on the area of the near-field mixing zone is in keeping with EPA (2016c) and ANZG (2018) guidance. *Assessment against EPA objective:* After the application of mitigation measures, the EPA objective for marine environmental quality is expected to be met.

Context	Potential impact(s)	Management and mitigation	Predicted outcomes
		Water Corporation has developed a hydrodynamic model to predict changes in marine quality (including toxicants) associated with discharge of brine during operations. Seawater outlet diffusers will be oriented to optimise mixing and therefore minimise stratification. The desalination outlet diffuser ports have been designed to optimise mixing. Implementation of a marine construction EMF. Implementation of an Operational Environmental Management Plan. Spatially define a LEPA to ensure marine quality around the ASDP diffuser is managed to achieve a high level of ecological protection beyond the near-field mixing zone.	
Benthic Communities and Habitats (BCH)		EPA objective: To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	
Temperate macroalgal and seagrass meadows are key elements of the Alkimos marine environment. These communities are susceptible to changes in environmental conditions, such as reduced light, increased salinity and toxicity.	*During construction:* Direct loss of BCH. Secondary & tertiary loss of BCH (shading / smothering). Secondary loss BCH (toxicity). *During operation:* Tertiary effects (reduced DO). Tertiary effects (stressors).	The marine pipeline will be installed via a sub-sea tunnel, using a tunnel boring machine (TBM). Wherever possible, marine infrastructures (risers, intakes and outlets) will be installed on open sandy meadows, while avoiding seagrass and macroalgal communities.	*Outcome(s):* The proposed drilling and infrastructure laydown activities are not expected to contribute tangible losses of BCHs. Consideration of offsets for this environmental factor is therefore considered unnecessary.

Context	Potential impact(s)	Management and mitigation	Predicted outcomes
Sustained increases in salinity and /or exposure to toxicants may affect physiological and reproductive processes in macroalgal and seagrass communities. Similarly, increases in salinity may affect osmotic processes in benthic macroinvertebrate communities. Sustained osmotic pressures may impact more sensitive life stages leading to reduced recruitment success.	Secondary & tertiary effects (toxicity).	Tunnelling effectively eliminates any serious issues associated with turbidity plumes, including increased TSS and reduced light. Excavation is limited to 4 x sites of approximately 12 m radius. Drilling will proceed over several days and is not expected to significantly impact environmental quality. The outlet diffusers have been designed to meet strict minimum performance criteria. This included a requirement to achieve a 1:30 dilution in the near field environment. Surface excavations will be limited to the installation of marine risers at 4 x sites, each of approximately 12 m radii. Excavation requires drilling of approximately 32 m^3 of sediments per site. Risers will be installed by drilling into the seabed within a vertical casing. The intent of the casing is to minimise escape of cuttings and support the integrity of the shaft. The marine environment will be managed to achieve a high level of ecological protection with 100 m of the outlets. Implementation of a marine construction EMF.	*Assessment against EPA objective:* After the application of mitigation measures, the EPA objective for BCH is expected to be met.

Context	Potential impact(s)	Management and mitigation	Predicted outcomes
Marine Fauna		EPA objective: To protect marine fauna so that biological diversity and ecological integrity are maintained.	
Potential direct impacts through the construction and operation of the intake and outlet pipelines (e.g. marine fauna entrained into the intake). Potential impacts to critical marine habitats or lifecycles through the construction and operation of the intake and outlet pipelines. Potential introduction of invasive marine species through marine plant during construction and operational maintenance.	*During construction:* Changes in marine fauna behaviour/hearing damage (noise). Reduced light and smothering/stressor effects (elevated TSS). Injury/mortality of marine fauna (collision/entanglement). Loss of local biodiversity (introduction of IMS). Toxicity effects on marine fauna (introduction of toxicants). *During operation:* Direct loss of marine fauna (impingement/entrainment). Stressor effects on marine fauna (reduced DO). Stressor effects on marine fauna (increased salinity). Stressor effects on marine fauna (increased temperature). Toxicity effects on marine fauna (introduction of toxicants).	The avoidance of stressor effects (i.e. elevated TSS) on marine fauna during marine construction activities is not possible, however, stressor effects will naturally ameliorate once construction ceases. Underwater construction will generate some noise. The presence of construction vessels (jack up barges), machinery and equipment during marine construction activities that may interact with marine fauna via collision/entanglement will not be avoidable. Vessels (jack up barges), machinery and equipment during marine construction activities that may introduce IMS to the Alkimos marine region. Impingement and entrainment of marine fauna, including zooplankton and larvae, during operation is possible. Routine maintenance will contribute stressor/toxicants to the marine environment. The assessment includes a model to predict drill cutting dispersion to assess the fate of TSS particles. The marine construction EMF describes clear management actions to minimise	*Outcome(s):* The disturbance of the benthic environment due to placement of marine infrastructure and the discharge of return seawater (brine) to the marine environment has been mitigated by installing pipelines in sub-marine tunnels (as excavated using a TBM) and optimising the design of the outlet diffusers to achieve dilutions compliant with high ecological protection criteria. The entrapment of larger fauna on the intake screens, and/or the entrainment of larvae and plankton was considered in the engineering of the intakes, which will adopt best practice technology to minimise the intake velocity (0.15 m/s) to allow small fish to escape; to prevent the entry of larger fishes; and to limit the intrusion of drift algae and seagrass wrack. The assessment of noise impacts concluded that constant noise at these levels is not sufficient to cause TTS or injury to marine fauna but may cause behavioural responses in the form of avoidance. In practice, this may result in a zone of avoidance of approximately 300 m radius that travels with the TBM cutting face as it advances towards the intake and outlet locations. Given the slow nature of tunnelling, the proposed soft-start

Context	Potential impact(s)	Management and mitigation	Predicted outcomes
		potential impacts from collision/entanglement, introduction of IMS, and noise on marine fauna during marine construction activities. The seawater intake will be engineered so that: • the screen approach velocity is minimised to allow 33% occlusion by marine growth and ultimate velocity of 0.15 m/s to allow small fish to escape • an intake screen bar will be in place to prevent large fish from entering • the intake is located ~2 m above the seabed to reduce potential of demersal species to enter. Water Corporation has developed a hydrodynamic model to predict changes in marine environmental quality associated with discharge of RO return water during operation. Seawater outlet diffusers will be orientated to optimise mixing and therefore minimise risk of stratification. The desalination outlet diffuser ports have been designed to optimise mixing within the near-field and therefore minimise potential temperature/salinity stress.	procedures are expected to ensure there are no susceptible fauna within the 300 m avoidance zone, during maximum noise generation. *Assessment against EPA objective:* After the application of mitigation measures, the EPA objective for marine fauna is expected to be met.

Context	Potential impact(s)	Management and mitigation	Predicted outcomes
		Establishment of a LEPA to ensure marine environmental quality is maintained to acceptable levels outside of this boundary during operation of the desalination plant. Implementation of a marine construction EMF. Implementation of an Operational Environmental Management Plan.	
Flora and Vegetation		EPA objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	
Potential direct and indirect impacts through the clearing of native vegetation and construction activities close to sensitive ecological areas.	*During construction:* Clearing of native vegetation. Disturbance or clearing of PECs and TECs. Disturbance or clearing of *Bush Forever* sites. Disturbance of wetlands. Fragmentation of vegetation. Spread of declared pest species or dieback. Changes to groundwater level or flow impacting GDEs.	Existing conservation areas immediately surrounding the ASDP site will remain largely intact. Rehabilitation of approximately 11 ha of landscaped and cleared areas. The requirement for clearing of native vegetation has been avoided along large sections of the pipeline by following road reserves and already cleared areas and tracks. The clearing of vegetation has been minimised by reducing the construction corridor width to 12 m to 16 m. The pipeline construction corridor will be rehabilitated to the pre-construction land use. The Proposal alignment has been developed to utilise existing linear	*Outcome(s):* Based on the scale and nature of impacts, the location away from sensitive areas, and the mitigation to be implemented, the Proposal is not expected to result in a significant impact on flora and vegetation, and biological diversity and ecological integrity will be maintained. *Assessment against EPA objective:* After the application of mitigation measures, the EPA objective for flora and vegetation is expected to be met.

Context	Potential impact(s)	Management and mitigation	Predicted outcomes
		infrastructure reducing the fragmentation of vegetation. Implementation of a TCEMF to guide construction activities and provide environmental performance standards, including native vegetation management measures.	
Terrestrial Fauna		EPA objective: To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	
Potential impacts on fauna habitat from the clearing and fragmentation of native vegetation. Disturbance of fauna during construction and operations.	*During construction:* Clearing and fragmentation of habitat for Black Cockatoos, Quenda, and Brush Wallaby. Construction activities have potential to impact on adjacent fauna habitat through erosion, uncontrolled access, dust deposition, noise, and through the spread of weeds and dieback. Construction activities may result in interactions with terrestrial fauna.	Existing conservation areas immediately surrounding the ASDP site will remain largely intact. Rehabilitation of approximately 11 ha of landscaped and cleared areas. The requirement for clearing of habitat has been avoided along large sections of the pipeline by following road reserves and already cleared areas and tracks. The clearing of habitat has been minimised by reducing the construction corridor width to 12 m to 16 m. The pipeline construction corridor will be rehabilitated to the pre-construction land use. The Proposal alignment has been developed to utilise existing linear infrastructure reducing the fragmentation of vegetation. Implementation of a TCEMF to guide construction activities and provide	*Outcome(s):* Based on the scale and nature of impacts, the location away from sensitive areas, and the mitigation to be implemented, the Proposal is not expected to result in a significant impact on fauna habitat. *Assessment against EPA objective:* After the application of mitigation measures, the EPA objective for terrestrial fauna is expected to be met.

Context	Potential impact(s)	Management and mitigation	Predicted outcomes
		environmental performance standards, including habitat management measures.	
Landforms		EPA objective: To maintain the variety and integrity of significant physical landforms so that environmental values are protected.	
Potential impact on the existing landforms (Quindalup Dune system and small portion of Cottesloe unit of the Spearwood Dunes) due to earthworks.	*During construction:* Loss of landforms. Increased aeolian erosion.	The location of the ASDP has been specifically chosen for several factors including the low-lying nature of the site and the lack of conservation significant species and formations within it. Water Corporation has chosen to use TBMs for the construction of the intake and outfall tunnels, which significantly reduces the environmental impact on the surrounding landforms. Dust and erosion mitigation techniques will be employed during construction to reduce the effects of erosion on the surrounding area. Where possible, disturbed areas will be permanently revegetated, which will be subject to ongoing monitoring and maintenance to ensure vegetation is established.	*Outcome(s):* Conservation areas surrounding the Proposal host landforms of similar and better type and conditions of those that will be lost in the DAF. The Proposal is not expected to have significant impact on landforms. *Assessment against EPA objective:* After the application of mitigation measures, the EPA objective for landforms is expected to be met.

Context	Potential impact(s)	Management and mitigation	Predicted outcomes
Social Surroundings		EPA objective: To protect social surroundings from significant harm.	
	During construction: Potential impacts to the amenity of residents and recreational users in the surrounding area and to heritage values from traffic noise, emissions and congestion; noise and vibration; dust; odour; and installation of the pipeline. *During operation:* Potential impacts to the amenity of residents and recreational users in the surrounding area and to heritage values from noise, odour, traffic, and light pollution.	Location of the ASDP site in consideration of noise emissions, light emissions, visual (aesthetic) impact, and traffic movements / site access. Pipeline route selected to avoid private land and property where possible. Use of existing dedicated access roads to the ASDP site. Maceration of screened organic waste and return to the ocean. Noise attenuation designed into the ASDP infrastructure. Implementation of the TCEMF, including traffic management plan and dust management measures. Application for and management of approvals regarding interaction with Aboriginal heritage site on the pipeline route.	*Outcome(s):* Based on the site selection, design options and mitigation measures to be implemented, the Proposal is not expected to significantly impact social surroundings. Residual impacts can be mitigated through the implementation of the TCEMF. *Assessment against EPA objective:* After the application of mitigation measures, the EPA objective for social surroundings is expected to be met.

15. References

AECOM 2012, *Northern Services Corridor Phase 1 Route Selection Report,* report prepared for Water Corporation, September 2012.

AECOM 2015, *Perth Northern Pipeline Corridors (PNPC) Flora and Vegetation Assessment*, report prepared for Water Corporation, January 2015.

AECOM 2017, *Flora, Vegetation and Fauna Assessment – Spring 2017*, Report prepared for Water Corporation of Western Australia, March 2018.

AECOM 2018, *Ecological Assessment - Alkimos SDP Pipeline Integration*, Memorandum prepared for Water Corporation of Western Australia, August 2018.

Aboriginal Heritage Inquiry System (AHIS) 2017, *Aboriginal Heritage Inquiry System*, [Online], Available from https://maps.daa.wa.gov.au/AHIS/ [12 September 2017].

Ahmed M, Ayub M 1999, 'Survival rates of the juveniles of the penaeid shrimp *Metapenaeus stebbingi* in different salinities', Pakistan Journal of Zoology, vol. 31, pp 205–206.

ANZECC, ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1: The Guidelines*, Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

ANZG 2018*, Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, [Online] Australian and New Zealand Governments, Available from www.waterquality.gov.au/anz-guidelines [7 January 2019].

ATA Environmental 20303, *MRS Amendment 1029/33 Environmental Review*, report prepared for Western Australian Planning Commission, September 2003.

Australian Museum 2015, *Leafy Seadragon, Phycodurus eques (Günther, 1865)*, Australian Museum, Canberra, ACT, Available from <https://australianmuseum. net. au/leafy-seadragon-phycodurus-eques> [9 November 2018].

Australian Museum 2016, *Weedy Seadragon, Phyllopteryx taeniolatus (Lacépède, 1804)*, [Online], Australian Museum, Canberra, ACT, Available from <https:// australianmuseum.net.au/weedy-seadragon-phyBllopteryx-taeniolatus> [9 November 2018].

Bamford Consulting Ecologists 2018, *Alkimos Wastewater Treatment Plant, Water Corporation Fauna Assessment,* Prepared for Strategen Environmental, April 2017.

Banks MA, Holt GJ, Wakeman JM 1991, 'Age-linked changes in salinity tolerance of larval spotted seatrout (*Cynoscion nebulosus,* Cuvier)', Journal of Fish Biology, vol. 39, pp 505-514.

Birklund J, Wijsman, JWM 2005, *Aggregate extraction: A review on the effect of ecological functions*, DHI Water & Environment, Deltares.

Blaszkowski C, Moreira GS 1986, 'Combined effects of temperature and salinity on the survival and duration of larval stages of *Pagurus criniticornis* (Dana) (Crustacea, Paguridae)', Journal of Experimental Marine Biology, vol .103, no. 1-3, pp. 77-86.

BMT 2018a, *ASOOM Annual Compliance Report 2017-2018*, Report prepared for Water Corporation, August 2018.

BMT 2018b, *Alkimos Metocean Data (April 2017 to March 2018) Summary Report, Rep No. 1334_01_005/1_RevC*, Report prepared for Water Corporation, May 2018.

BMT 2018c, *Perth Desalination Plant Discharge Modelling: PSDP: Model Scenarios*, *Report No. R.B22253.005.00*, Prepared for Water Corporation, December 2018.

BMT 2018d, *Alkimos Benthic Habitat Map*, Report prepared for Water Corporation, March 2018.

BMT Oceanica 2014a, *Alkimos Strategic Ocean Outlet Monitoring (ASOOM) Annual Report 2014*, Report prepared for Water Corporation, September 2014.

BMT Oceanica 2014b, *Strategic Review of the Alkimos Marine Treated Wastewater Discharge Monitoring and Management Plan*, Report prepared for Water Corporation, May 2014.

BMT Oceanica 2015, ASOOM *Annual Compliance Report 2014-2015*, Report prepared for Water Corporation, September 2015.

BMT Oceanica 2016a*, ASOOM 5 Yearly Sentinel Mussel and Sediment Monitoring Report 2015-2016*, Prepared for Water Corporation, February 2016.

BMT Oceanica 2016b, *ASOOM Annual Compliance Report 2015-2016, Report prepared for Water Corporation*, August 2016.

BMT Oceanica 2016c, *Ocean Reef Baseline Studies - Abalone Habitat and Abundance at Burns Beach Reef, Report No. 1058_01_002/2_Rev1*, Prepared for Strategen Environmental Consultants Pty Ltd, February 2016.

BMT Oceanica 2017, *ASOOM Annual Compliance Report 2016-2017*, Report prepared for Water Corporation, May 2017.

Bray DJ 2017a*, Mobula alfredi in Fishes of Australia*, [Online] Available from <http://fishesofaustralia.net.au/home/species/2738> [9 November 2018].

Bray DJ 2017b, *Mobula birostris in Fishes of Australia*, [Online], Available from <http://fishesofaustralia.net.au/home/species/2035> [9 November 2018].

Bureau of Meteorology (BoM) 2018, Climate Data, [Online], Available from http://www.bom.gov.au/climate/data/ [3 January 2019].

Burke CM, Harris JO, Hindrum SM, Edwards SJ, Maguire GB 2001, *Environmental Requirements of Abalone*, Tasmanian Aquaculture and Fisheries Institute and Fisheries Research and Development Corporation, Available from <http://www.imas.utas.edu.au/__data/assets/pdf_file/0007/743065/Environmental-Requirements-of-Abalone.pdf> [21 November 2018].

Cambridge ML, Zavala-Perez A, Cawthray GR, Statton J, Mondon J, Kendrick GA 2019, 'Effects of desalination brine and seawater with the same elevated salinity on growth, physiology and seedling development of the seagrass *Posidonia australis',* Marine Pollution Bulletin, vol. 140, pp. 462-471.

Chittleborough RG 1975, 'Environmental factors affecting growth and survival of juvenile western rock lobsters Panulirus longipes* (Milne-Edwards)', Australian Journal of Marine and Freshwater Research, vol. 26 pp. 177–196.

Churchward HM & McArthur WM 1980, Landforms and Soils of the Darling System, in *Atlas of Natural Resources, Darling System, Western Australia*, eds Department of Conservation and Environment, Perth, pp. 25-33.

Collier C J, Lavery PS, Masini RJ, Ralph P 2007, 'Morphological, growth and meadow characteristics of the seagrass Posidonia sinuosa along a depth related gradient of light availability', Marine Ecology Progress Series, vol. 337, pp. 103–115.

Cossill & Webley 2010, *Alkimos Eglinton District Structure Plan: Appendix 5 Engineering infrastructure*, Report prepared for the Alkimos Eglinton District Structure Plan (AEDSP), December 2010.

D'Adamo N 2002, *Exchange and Mixing in Cockburn Sound, Western Australia: A Seasonally Stratified, Micro-Tidal, Semi-Enclosed Coastal Embayment,* University of Canterbury: 330, Department of Civil Engineering, Christchurch.

Dall W 1974, 'Osmotic and ionic regulation in the western rock lobster Panulirus longipes (Milne-Edwards)', Journal of Experimental Biology and Marine Ecology, vol. 15, iss. 1, pp. 97-125.

DAWR 2018, *Marine pests*, [Online], Department of Agriculture and Water Resources. Available from <http://www.agriculture.gov.au/pests-diseases-weeds/marine-pests> [21 November 2018].

DHI 2018, *Alkimos Hydrodynamic Modelling: Draft Scenario Report*, Report prepared for Water Corporation, December 2018.

DHI 2019, *Alkimos Hydrodynamic Modelling: Calibration Report*, Report prepared for Water Corporation, January 2019.

Diaz RJ, Rosenberg R 1995, 'Marine benthic hypoxia: A review of its ecological effects and the behavioural responses of benthic macrofauna', Oceanography and Marine Biology vol. 33 pp. 245–303.

Doak C 2004, 'Hydrodynamic modeling of snapper (Pagrus auratus) eggs and larvae in Cockburn Sound', BSc (Hons) thesis, University of Western Australia, Perth, Western Australia.

DoEE 2018, *Lamna nasus in Species Profile and Threats Database*, [Online], Available from <http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=83288> [24 October 2018].

DoEH 2004, *Assessment of the Western Australian Abalone Fishery*, [Online], Available from <https://www.environment.gov.au/system/files/pages/c9610121-2ce7-48fb-8066-59e3582a87d0/files/wa-abalone-assessment.pdf> [13 November 2018].

DoF 2011, Fisheries Fact Sheet – Western Rock Lobster, [Online], Available from <http://www.fish.wa.gov.au/Documents/recreational_fishing/fact_sheets/fact_sheet_western_rock_lobster.pdf> [21 November 2018]. 2017, *Western Australian Shellfish Quality Assurance Program (WASQAP) Operations Manual*, Department of Fisheries, Perth.

DPLH 2017, *WA Coastal Zone Strategy*, Department of Planning, Lands and Heritage, Western Australian Planning Commission, Perth.

DSEWPaC 2012a, *Species Group Report Card – Sharks*, [Online], Department of Sustainability, Environment, Water, Population and Communities, Available from <http://www.environment.gov.au/archive/coasts/mbp/southwest/publications/pubs/report-card-sharks.pdf> [24 October 2018].

DSEWPaC, 2012b, *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species. Commonwealth of Australia*. Department of Sustainability, Environment, Water Population and Communities, Canberra.

DSEWPaC 2013a, *Draft Recovery Plan for the Grey Nurse Shark (Carcharias taurus)*, [Online], Department of Sustainability, Environment, Water, Population and Communities, Available from <http://155.187.2.69/biodiversity/threatened/publications/recovery/pubs/draft-recovery-plan-grey-nurse-shark.pdf> [24 October 2018].

DSEWPaC 2013b, *Recovery Plan for the White Shark (Carcharodon carcharias)*, [Online], Department of Sustainability, Environment, Water, Population and Communities, Available from <http://www.environment.gov.au/system/files/resources/ce979f1b-dcaf-4f16-9e13-010d1f62a4a3/files/white-shark.pdf> [24 October 2018].

DPIRD 2018a, *Rock Lobster Commercial Fishing*, [Online], Government of Western Australia Department of Primary Industries and Regional Development, Available from <http://www.fish.wa.gov.au/Species/Rock-Lobster/Pages/default.aspx> [21 November 2018].

DPIRD 2018b, *Octopus resource of Western Australia harvest strategy 2018–2022*, *Fisheries Management Paper No. 286, Version 1.0*, [Online], Government of Western Australia Department of Primary Industries and Regional Development. Available from < http://www.fish.wa.gov.au/Documents/management_papers/fmp286.pdf > [21 November 2018].

DPIRD [n.d.], *NRInfo*, [Online], Department of Primary Industries and Regional Development, Available from https://maps.agric.wa.gov.au/nrinfo/ [24 October 2018].

Ecoscape 2018, *CW03472 Eglinton Groundwater Investigations Flora, Vegetation, Fauna and Dieback Survey: Site 2*, Prepared for Water Corporation, February 2018.

EPA 1996, *Southern Metropolitan Coastal Wasters Study (1991–1994), Report 17*, Department of Environmental Protection, Perth.

EPA 2000, *Perth Coastal Waters – Environmental Values and Objectives – The Position of the EPA – A Working Document*, Environmental Protection Authority, Perth.

EPA 2005, *Alkimos-Eglinton Metropolitan Regional Scheme Amendment No. 1029/33*, Environmental Protection Authority Bulletin 1207, Perth.

EPA 2006a, *Metropolitan Regional Scheme Amendment 1029/33: Ministerial Statement 722*, Environmental Protection Authority, Perth.

EPA 2006b, *Guidance for the Assessment of Environmental Factors - Rehabilitation of Terrestrial Ecosystems*, Environmental Protection Authority, Perth, June 2006.

EPA 2013, *Environmental Protection Bulletin No. 20 - Protection of naturally vegetated areas through planning and development*, Environmental Protection Authority, Perth, December 2013.

EPA 2016a, *Environmental Factor Guideline: Benthic Communities and Habitats*, Environmental Protection Authority, Perth.

EPA 2016b, *Environmental Factor Guideline: Coastal Processes*, Environmental Protection Authority, Perth.

EPA 2016c, *Environmental Factor Guideline: Marine Environmental Quality*, Environmental Protection Authority, Perth.

EPA 2016d, *Environmental Factor Guideline: Marine Fauna*, Environmental Protection Authority, Perth.

EPA 2016e, *Technical Guidance: Protection of Benthic Communities and Habitats*, Environmental Protection Authority, Perth.

EPA 2016f, *Technical Guidance: Environmental Impact Assessment of Marine Dredging Proposals*, Environmental Protection Authority, Perth.

EPA 2016g, *Technical Guidance: Protecting the Quality of Western Australia's Marine Environment*, Environmental Protection Authority, Perth.

EPA 2016h, *Environmental Factor Guideline: Flora and Vegetation*, Environmental Protection Authority, Perth.

EPA 2016i, *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*, Environmental Protection Authority, Perth.

EPA 2016j, *Environmental Factor Guideline: Subterranean Fauna*, Environmental Protection Authority, Perth.

EPA 2016k, *Technical Guidance: Subterranean fauna survey*, Environmental Protection Authority, Perth.

EPA 2016l, *Technical Guidance: Sampling methods for Subterranean fauna*, Environmental Protection Authority, Perth.

EPA 2016m, *Environmental Factor Guideline: Terrestrial Environmental Quality*, Environmental Protection Authority, Perth.

EPA 2016n, *Environmental Factor Guideline: Terrestrial Fauna*, Environmental Protection Authority, Perth.

EPA 2016o, *Technical Guidance: Terrestrial Fauna Surveys*, Environmental Protection Authority, Perth.

EPA 2016p, *Technical Guidance: Sampling methods for terrestrial vertebrate fauna*, Environmental Protection Authority, Perth.

EPA 2016q, *Technical Guidance: Sampling of short range endemic invertebrate fauna*, Environmental Protection Authority, Perth.

EPA 2016r, *Environmental Factor Guideline: Air Quality*, Environmental Protection Authority, Perth.

EPA 2016s, *Environmental Factor Guideline: Social Surroundings*, Environmental Protection Authority, Perth.

EPA 2016t, *Environmental Factor Guideline: Human Health*, Environmental Protection Authority, Perth.

EPA 2017, *Environmental Quality Criteria Reference Document for Cockburn Sound – A Supporting Document to the State Environmental (Cockburn Sound) Policy 2015*, Environmental Protection Authority, Perth.

EPA 2018a, *Instructions on how to prepare an Environmental Review Document*, Environmental Protection Authority, Perth.

EPA 2018b, *Statement of Environmental Principles, Factors and Objectives*, Agency EP, Perth.

EPA 2018c, *Environmental Factor Guideline: Landforms*, Environmental Protection Authority, Perth.

EPA 2018d, *Environmental Factor Guideline: Inland Waters*, Environmental Protection Authority, Perth.

Environmental Resources Management (ERM) 2018, Alkimos Seawater Desalination Plant – Social Impact Assessment, Prepared for Water Corporation, August 2018.

Ersts PJ, Rosenbaum HC 2003, 'Habitat preference reflects social organization of humpback whales (Megaptera novaeangliae) on wintering ground', Journal of Zoology, vol. 260, pp. 337–345.

Fehmarn AS 2013, *Benthic Fauna of the Fehmarnbelt Area, Marine Fauna and Flora – Impact Assessment*, E2TR0021 Volume II, Fehmarnbelt Fixed Link Marine Biology Services, Horsholm.

Foster SJ, Vincent ACJ 2004, 'Life history and ecology of seahorses: Implications for conservation', Journal of Fish Biology, vol. 65, pp. 1–65.

Freeman KA 2001, *Aquaculture and related biological attributes of abalone species in Australia – a review*. Fisheries Research Report No. 128, Department of Fisheries, Perth.

Gallop SL, Verspecht F, Pattiaratchi C 2012, 'Sea breezes drive currents on the inner continental shelf off southwest Western Australia', Ocean Dynamics, vol. 62, pp. 569–583.

Gaughan D, Santoro K 2018, Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17: The State of the Fisheries, Department of Primary Industries and Regional Development, Perth.

GHD 2018, *Alkimos-Wanneroo Trunk Main Route Assessment Discussion Paper*, prepared for Water Corporation, September 2018.

Gibson N, Keighery B, Keighery G, Burbidge A & Lyons M 1994, *A Floristic survey of the southern Swan Coastal Plain*, report prepared for the Australian Heritage Commission, 1994.

Government of Western Australia. (2018a). 2017 South West Vegetation Complex Statistics. Current as of October 2017. WA Department of Biodiversity, Conservation and Attractions, Perth, https://catalogue.data.wa.gov.au/dataset/dbca.

Government of Western Australia. (2018b). 2017 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of December 2017. WA Department of Biodiversity, Conservation and Attractions.

Gray H 1992, *The western rock lobster Panulirus Cygnus. Book 1: a natural history*, Westralian Books, Geraldton.

Guerin JL, Stickle WB 1997, 'Effect of salinity on survival and bioenergetics of juvenile lesser blue crabs, *Callinectes similis',* Marine Biology, vol. 129, iss. 1, pp. 63-69.

Hart AM, Leporat SC, Marriott RJ, Murphy D 2016, *Innovative development of the Octopus (cf) tetricus fishery in Western Australia. FRDC Project No 2010/200*, Fisheries Research Report No. 270 prepared for the Department of Fisheries Western Australia, February 2016.

Heddle EM, Loneragan OW, and Havel JJ 1980, *Vegetation of the Darling System*, In DCE 1980 Atlas of Natural Resources, Darling System, Western Australia, Department of Conservation and Environment, Perth.

Herring Storer Acoustics 2018, *Environmental Noise Assessment Proposed Alkimos Desalination Plant*, report prepared for Water Corporation, October 2018.

Hexagon Geospatial 2016, *ERDAS Imagine Classification Supervised Classification*, [Online] Available at <https://hexagongeospatial.fluidtopics.net/reader/~P7L4c0T_d3papuwS98oGQ/r3McCpL65xdeQ0Mcu5SfzA> [11 October 2017].

Hildebrand JA 2005, *Impacts of anthropogenic sound*, In J. E. Reynolds, W. F. Perrin, R. R. Reeves, S. Montgomery and T. J. Ragen (Eds), Marine mammal research: conservation beyond crisis, The Johns Hopkins University Press, Baltimore.

Hose CG, Sreekanth J, Barron O and Pollino C 2015, *Stygofauna in Australian groundwater systems: extent of knowledge*, CSIRO, Australia.

Hyndes GA, Kendrick AJ, MacArthur LD, Stewart E 2003, 'Differences in the species and size composition of fish assemblages in three distinct seagrass habitats with differing plant and meadow structure', Marine Biology, vol. 142, iss. 6, pp. 1195-1206.

Jacobs & WorleyParsons 2018a, *Investigation and Concept Design of the Alkimos Seawater Desalination Plant – Stage 1, Phase 2 – Concept Design Report,* Report prepared for Water Corporation of Western Australia, June 2018.

Jacobs & WorleyParsons 2018b, *Alkimos SDP Concept Design Onshore Geotechnical Site Investigation - Interpretive Report,* Report prepared for Water Corporation of Western Australia, July 2018.

Jacobs 2018, *Potential Noise Impacts of Inlet/Outfall Construction on Marine Life,* Technical Memorandum prepared for the Water Corporation of Western Australia, September 2018.

Jernakoff P 1990, 'Distribution of newly settled western rock lobsters Panulirus cygnus' Marine Ecology Progress Series, vol 66, pp. 63–74.

Kemps H, Masini R 2017, *Estimating dredge source terms – a review of contemporary practice in the context of Environmental Impact Assessment in Western Australia, Report of Theme 2 – Project 2.2*, Report prepared for the Dredging Science Node, Western Australian Marine Science Institution (WAMSI), August 2017.

Kendrick AJ, Hyndes GA 2003, 'Patterns of abundance and size distribution of syngnathid fishes among habitats in a seagrass-dominated marine environment', Estuarine and Coastal Shelf Science, vol. 57, pp. 631–640.

Koper RP, Plön S 2012, *The potential impacts of anthropogenic noise on marine animals and recommendations for research in South Africa*, EWT Research & Technical Paper No. 1. Endangered Wildlife Trust, South Africa.

Kranz PM 1974, 'The anastrophic burial of bivalves and its paleoecological significance', Journal of Geology, vol. 82 pp. 237-265.

Lord DA, Pattiaratchi C, Burling M 2019, *Peer Review Panel Comments: Alkimos Seawater Desalination Draft Scenario Report*, Prepared for DHI, February 2019.

Littler MM 1980, 'Morphological form and photosynthetic performances of marine macroalgae: tests of a functional/form hypothesis', Botanica Marina, vol. 22, pp. 161–165.

Littler MM, Littler DS 1980, 'The evolution of thallus form and survival strategies in benthic marine macroalgae: field and laboratory tests of a functional form model', The American Naturalist, vol. 116, pp. 25–44.

Luu, R. and English, E. 2005, *Interim Recovery Plan No. 193 - Melaleuca huegelii – Melaleuca systena shrublands of limestone ridges*, Wanneroo, Department of Conservation and Land Management.

Mattiske E & Havel J 1998, *Vegetation Mapping in the Southwest of WA*, Department of Conservation and Land Management, Perth.

McCauley RD, Jenner C 2010, *Migratory patterns and estimated population size of pygmy blue whales (Balaenoptera musculus brevicauda) traversing the Western Australian coast based on passive acoustics*., [Online] Available from <http://iwcoffice.co.uk/_documents/sci_com/SC62docs/SC-62-SH26.pdf> [9 November 2018].

Mihanovic H, Pattiaratchi C and Verspecht F 2016, 'Diurnal sea breezes force near inertial waves along Rottnest Continental Shelf, Southwestern Australia', Journal of Physical Oceanography, vol. 46, pp. 3487-3508.

Miller Dc, Muir CL, Hauser OA 2003, 'Detrimental Effects of Sedimentation on Marine Benthos: what can be learned from natural process and rates?', Ecological Engineering, vol. 19, pp. 211-232.

Mitchell D, Williams K & Desmond A 2002, 'Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion)', in *A biodiversity audit of Western Australia's 53 Biogeographical Subregions in 2002*, eds Department of Conservation and Land Management, Perth, pp. 606-623.

Molnar JL, Gamboa RL, Revenga C, Spalding MD 2008, 'Assessing the global threat of invasive species to marine biodiversity', Frontiers in Ecology and the Environment, vol. 6, iss. 9, pp. 485-482.

MRPA 1977, *Planning Structure for the North-West Corridor*, The Metropolitan Region Planning Authority, Perth.

Neff J 2005, *Composition, Environmental Fates and Biological Effect of Water Based Drilling Muds and Cuttings Discharged to the Marine Environment: A Synthesis and Annotated Bibliography*, Report prepared for Petroleum Environmental Research Forum and American Petroleum Institute, United State of America.

Nell JA, Gibbs PJ 1986, 'Salinity tolerance and absorption of L-methionine by some Australian bivalve molluscs', Australian Journal of Marine and Freshwater Research, vol. 37, pp. 721–728.

Nichols JA, Rowe GT, Clifford CH, Young RA 1978, 'In situ experiments on the burial of marine invertebrates', Journal of Sedimentary Research, vol. 48, pp. 419-425.

NRC 2005, *Marine Mammal Populations and Ocean Noise: Determining when Noise causes Biologically Significant Effects*, National Academies Press, Washington.

Oceanica 2005a, *Alkimos Marine Studies Programme – Interim Water Quality Characterisation Data Report – December 2004 to July 2005*, Report prepared for Water Corporation of Western Australia, November 2005.

Oceanica 2005b, *Alkimos Marine Studies Programme – Sediment Survey, Report No. 439/1*, Prepared for Water Corporation of Western Australia, May 2005.

Oceanica 2005c, *Alkimos Marine Studies Programme – Benthic Habitat Mapping and Infauna Survey, Report No. 438/1,* Prepared for Water Corporation of Western Australia, July 2005.

Oceanica 2009, *Alkimos Wastewater Treatment Plant – Algal Reef Community Composition and Stable Isotope Signature: 2009*, Report prepared of Water Corporation of Western Australia, May 2009.

Oceanica 2010, *Alkimos Wastewater Treatment Plant – Environmental Management of Temperate Macroalgal Communities Exposed to Treated Domestic Wastewater: Developing Appropriate Triggers for Action*, Report prepared for Water Corporation of Western Australia, September 2010.

Oceanica 2011, *Alkimos Wastewater Treatment Plant – Marine Treated Wastewater Discharge Monitoring and Management Plan (2010 to 2020), Report No. 635_001/1*, Prepared for Water Corporation of Western Australia, January 2011.

Oceanica 2012, *Alkimos Strategic Ocean Outlet Monitoring (ASOOM) – Annual Report 2011*, Report prepared for Water Corporation of Western Australia, January 2012.

Oceanica 2013, *Alkimos Strategic Ocean Outlet Monitoring (ASOOM) Annual Report 2013,* Report prepared for Water Corporation of Western Australia, August 2013.

Okely P, Antenucci JP, Marti CL, Imberger J 2007, *Field Investigations into the Impact of the Perth Seawater Desalination Plant Discharge on Cockburn Sound*, Centre for Water Research, University of Western Australia, Perth.

Popper AN, Hastings, MC 2009), 'The effects of anthropogenic sources of sound on fishes', Journal of Fish Biology, vol. 75, iss. 3, pp. 455-489.

Richardson WJ, Greene Jr CR, Malme CI, Thomson DH 1995, *Marine Mammals and Noise*, Academic Press, San Diego.

RPS 2016, *Alkimos Coastal Node Local Structure Plan - Local Environmental Impact Assessment and Management Strategy*, report prepared for LandCorp, February 2016.

Semeniuk V & C, Research Group (2004). *A description of the coastal and marine zones of the Alkimos area, October 2004*, report to Syrinx Environmental P/L for the Water Corporation, October 2004.

Shepherd, DP, Beeston, GR, and Hopkins, AJM 2001, *Native Vegetation in Western Australia (Technical Report 249)*. Department of Agriculture and Food Western Australia, Perth.

Southall BL, Bowles AE, Ellison WT, Finneran JJ, Gentry RL, Greene Jr CR, Kastak D, Ketten DR, Miller JH, Nachtigall PE, Richardson WJ, Thomas JA, Tyack PL 2007, 'Marine mammal noise exposure criteria: initial scientific recommendations', Aquatic Mammals, vol. 33, pp. 411–520.

Steneck RS, Dethier MN 1994, 'A functional group approach to the structure of algal-dominated communities', Oikos, vol. 69, pp. 476–498.

Strategen Environmental 2017, *Flora and Vegetation Survey – Spring 2016.* Prepared for Water Corporation of Western Australia, November 2017.

Threatened Species Scientific Committee (TSCC) 2016, Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community, Canberra, Department of the Environment and Energy.

Threatened Species Scientific Committee (TSCC) 2017, Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain Ecological Community, Draft Conservation Advice Including Draft Listing Advice, Canberra, Department of the Environment and Energy.

UNEP 2012, *Scientific synthesis on the impacts of underwater noise on marine and coastal biodiversity* and *habitats*, [Online] Convention on biological diversity, Available from https://www.cbd.int/doc/meetings/sbstta/sbstta-16/information/sbstta-16-inf-12-en.doc [3 January 2019].

Water and Rivers Commission 2001, *Living Wetlands: An Introduction to Wetlands*, Government of Western Australia Water And Rivers Commission, April 2001, Perth.

Water Corporation 2016*, Alkimos Wastewater Treatment Plant – Marine Treated Wastewater Discharge Monitoring and Management Plan*, Water Corporation, Perth.

Water Corporation (in prep), *Alkimos Seawater Desalination Plant – Operational Environmental Management Plan*, Report prepared by Water Corporation in support of the Alkimos Seawater Desalination Plant Environmental Review.

Weilgart L S 2007, ‘The impacts of anthropogenic ocean noise on cetaceans and implications for management’, Canadian Journal of Zoology, vol. 85, pp. 1091-1116.

Wildsmith MD, Potter IC, Valesini FJ, Platell ME 2005, ‘Do the assemblages of benthic macroinvertebrates in nearshore waters of Western Australia vary among habitat types, zones and seasons?’, Journal of the Marine Biological Association of the United Kingdom, vol. 85, iss. 4787, pp. 4781–4716.

Appendix A: Summary of stakeholder consultation

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
DWER & EPA	17/11/2017	**Meeting** Tom Hatton (EPA) Anthony Sutton (DWER) Hans Jacob (DWER) Sarah Carroll (WaterCorp) Ashley Vincent (WaterCorp) Sue Murphy (WaterCorp)	Discussion on the progress of the Proposal and the proposed approach to delivery.	-
DWER	20/12/2017	**Meeting** Hans Jacob (DWER) Sarah Carroll (WaterCorp) Ben Boardman (WaterCorp) Bree Atkinson (WaterCorp)	Discussion on the marine modelling and the proposed Peer Review Panel.	-

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
Department of Health (DoH)	22/02/2018	**Meeting** Richard Theobald (DoH) Aaron McCreath, (WaterCorp) Stefan Davidov (WaterCorp)	Proposal briefing (ASDP and PSPD2): 1. Energy sources/carbon footprint. 2. Outer harbour: a. Potential impact on infrastructure due to use of capsize vessels; mainly around damage and future depth of the Sound, I did note we were looking at mitigation to this and tunnelled options b. Water quality from outer harbour not noted to be as big concern but still obviously something to think about 3. Consideration around the decision to focus on desal as the source and what other work was taking place in the recycling space.	-
Minister for Water	12/12/2017	**Meeting** Hon. Dave Kelly Sarah Carroll (WaterCorp) Ashley Vincent (WaterCorp) Sue Murphy (WaterCorp)	Briefing on projects including stakeholder engagement.	-
Department of Primary Industries and Regional Development (Fisheries)	5/04/2018	**Meeting** Ben Boardman (WaterCorp) Bree Atkinson (WaterCorp) Aaron McCreath, (WaterCorp)	Briefing on projects. Alkimos geotech works.	-

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
Department of Treasury (DoTr)	1/12/2017	**Meeting** Kaylene Gulich (DoTr) Ross Murphy (DoTr) Jarrad Gardner (DoTr) Clint Brimson (DoTr) Sue Murphy (WaterCorp) Ashley Vincent (WaterCorp) Ross Hughes (WaterCorp) Deb Evans (WaterCorp) Brian Robertson (WaterCorp) Ingrid Bell (WaterCorp) Natalie Williams (WaterCorp) Sarah Carroll (WaterCorp)	Briefing on the Early Investigations Projects.	-
Main Roads WA (MRWA)	5/07/2017	**Meeting** Lindsay Broadhurst (MRWA) Mike Ambrose (WaterCorp) Shane Farquharson (WaterCorp)	Trunk main pipeline route discussions - future proposals for MRWA road works, timing of works, other knowledge of proposed utilities in this area.	-
Department of Premier and Cabinet	5/12/2017	**Meeting** Hon. Dave Kelly Sarah Carroll (WaterCorp) Ashley Vincent (WaterCorp) Sue Murphy (WaterCorp)	Briefing on the Early Investigations Projects.	-

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
City of Wanneroo (CoW)	16/02/2018	**Council Meeting** Elected Members (CoW) Kirstie Lee (WaterCorp)	Briefing - Early investigations Alkimos Seawater Desalination Plant.	Information shared with Council members.
City of Wanneroo – Administration (CoW)	23/01/2018	**Meeting** Chris Langsford (CoW) James Duff (CoW) Grant Chettleburgh (CoW) Jim Singleton (CoW) Phil Thompson (CoW) Nick Stawarz (CoW) Aaron Baxter (CoW) Sarah Carroll (WaterCorp) Aaron McCreath (WaterCorp) Bree Atkinson (WaterCorp) Shane Farquharson (WaterCorp) Tarryn Truscott (WaterCorp) Stefan Davidov (WaterCorp)	Proposal briefing.	General advice noted and subject to subsequent meetings.

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
Lendlease - Sustainability and Community Development	11/04/2018	**Meeting** Nadja Kampfhenkel (Lendlease) Jason Cleary (Lendlease) Jacob Abbott (Lendlease) Aaron McCreath (WaterCorp) Bree Atkinson (WaterCorp) Shane Farquharson (WaterCorp) Tarryn Truscott (WaterCorp)	Proposal briefing. Community engagement approach and liaison on opportunities to utilise community channels to ensure accurate messaging and opportunity for residents to be informed and consulted.	General advice noted and considered during community engagement planning.
Alkimos Eglinton Landowners Group (AELG)	11/04/2018	**Meeting** Tasio Cokis (AELG) Ryan Hunter (AELG) Damien Giudici (AELG) Ian Ardron (AELG) Damian Molony (AELG) Aaron McCreath (WaterCorp) Bree Atkinson (WaterCorp) Shane Farquharson (WaterCorp) Tarryn Truscott (WaterCorp) Brian Handcock (WaterCorp)	Proposal briefing - focus on Eglinton bore locations, reuse scheme, impact on community.	Information noted.

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
City of Wanneroo (CoW)	14/07/2017	**Meeting** Zanya Khama (CoW) Mike Ambrose (WaterCorp) Shane Farquharson (WaterCorp)	Trunk main pipeline route discussions - constraints, future developments, CoW projects in the area.	Information noted and utilised for pipeline planning.
LandCorp	23/04/2018	**Meeting** Abi Wheatley (LandCorp) Bree Atkinson (WaterCorp) Tarryn Truscott (WaterCorp)	Briefing on community engagement, opportunities to connect with community, key learnings from other engagements underway in community.	General advice noted and considered during community engagement planning.
WA Fishing Industry Council (WAFIC)	11/04/2018	**Meeting** John Harrison (WAFIC) Aaron McCreath (WaterCorp) Bree Atkinson (WaterCorp) Shane Farquharson (WaterCorp) Tarryn Truscott (WaterCorp)	Proposal briefing. Discussion on Cockburn Sound marine impacts and associated fisheries and Alkimos offshore investigations.	General advice noted. Subsequent meeting with Executive Officer held.
Recfishwest	10/04/2018	**Email** Matthew Gillett (Recfishwest)	Advice regarding seismic and geotechnical work and likely concerns from recreational fishing community.	Information only.

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
City of Wanneroo (CoW) - offshore works	18/04/2018	**Meeting** Rory Ellyard (CoW) Tenaha Wilson (CoW) Jim Singleton (CoW) Aaron McCreath (WaterCorp) Tarryn Truscott (WaterCorp)	Briefing on offshore work (seismic and core sample drilling), briefing on coastal surveys underway, request for inputs into Social Impact Assessment.	Advice noted in planning for offshore investigations and inputs received from the City and incorporated into Social Impact Assessment.
Alkimos Beach Progress Association (ABPA)	7/05/2018	**Letter** sent to 1,000 Alkimos Beach home owners and occupiers with invitation and details of Progress Association briefing **Community meeting** ABPA President Chris White Water Corporation attendees Aaron McCreath (WaterCorp) Bree Atkinson (WaterCorp) Tarryn Truscott (WaterCorp) Stefan Davidov (WaterCorp)	Letter issued three weeks prior to community meeting which described the Proposal 36 participants in attendance at the meeting issues raised at the meeting are described below: • why has the site been identified as feasible? • what are the anticipated impacts from noise light amenity and odour? • what are the impacts to the marine environment? • how can the community be involved?	A response to each point is described below: Water Corporations long term planning has identified this site as a possible location for a desalination plant to secure Perth water supply (Kwinana is another location). A number of sites have been considered and Alkimos is well places to service the growing norther suburbs while providing an appropriate volume of land and access to the coast. Concept planning for the possible plant has lowered the site into the dunes to reduce visibility from the surrounding residential properties (future homes are very unlikely to be able to see the plant). Lowering the buildings into the dunes will reduce light spill and support containing light within the property. Plant design will minimise noise emissions by fitting

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
				the quietest fit for purpose, noise attenuation designs, position noise infrastructure away from the boundary. Studies on the impacts to the marine environment are ongoing and form an integral part of the approvals process so we can make the best decisions on the placement of offshore infrastructure, current studies include a geophysical survey and core sample drilling. The marine survey will soon be referred to the federal department of Environment and Energy for their consideration prior to the commencement of the survey. Once we learn more about the marine environment we will identify where pipelines may be located, how they may be installed and the impacts they may have, we will then share that information with the stakeholders and the community. We will seek community feedback throughout the process (feedback webpage given).

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
Alkimos Beach Surf Lifesaving Club (ABSLC)	21/05/2018	Email	Meeting booked - 21 May 2018. Cancelled. Email sent 24/5 containing information of the work to be conducted at the Alkimos Site including the offshore surveys and core sample drilling ABSLC responded via email on 5 June 2018 with questions such as: • access to the beach for community events during construction work • will the fishing exclusion zone be maintained throughout the work	Water Corporation responded via email on 5 June 2018, in which the ABSLC was informed: • access to the beach would not be affected during the works • the fishing exclusion for the entire zone will be in place for about three weeks, and then reduced to about 25 m around the barge from then on. Water Corporation also requested at this time, details of the ABSLC social media channels, so that Water Corporation can communicate information to the public in the lead up to and during the works.
Western Rock Lobster Council (WRLC)	Water Corporation email provided 2/5/2018 WRLC response Date unknown Water Corporation email response to letter via email 21/05/2018	Email	Questions raised in relation to geophysical and geotechnical works, such as: • why is another geotechnical investigation required then the WWTP outfall was installed only 10 years ago and there was geotechnical work done? • why is the intake positioned so close to the outfall of a WWTP?	Water Corporation responses are below: During construction of the WWTP outfall, only limited geotechnical investigations were performed, further investigations are required to ensure the risks are fully understood. Marine modelling is being conducted to inform the preferred route for the intake and outfall pipes, which will consider the existing WWTP outfall to

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
			• there is concern the fishing exclusion zone will be closed permanently • there is concern about the long-term impacts of the seismic test and the loss of fishing grounds into the future • the puerulus collection pods are only a few hundred meters south of the seismic tests and fisheries research may be at risk of false data which could affect quota setting into the future • there is concern regarding the discharge raising salinity in the local area affecting breeding stock plant • has any research been done on brine discharge affecting the puerulus? • what affect will the chemicals in the discharge have on the lobsters, seagrasses and other marine animals? • is there compensation for loss of income during the three-week fishing exclusion?	ensure the two processes remain independent. The exclusion zone will only be in place for three weeks while the geotechnical investigations are conducted, there is no intention to extend the exclusion zone beyond this timeframe. Future construction works may require marine access restrictions; however, consultation with all stockholders will occur in advance of this possible event. A study completed by the Fisheries Research and Development Corporation in 2016 assessed the impacts of marine seismic surveys on lobster fisheries (this was provided to stakeholder). Their results indicate that any impacts are likely to be short in duration, behavioural and isolated to the immediate area surrounding vessels conducting the survey. Seismic surveys have also considered the prime spawning time for rock lobsters and avoided this time. The approvals process requires the Water Corporation to undertake an assessment of the possible environmental impacts and follows best practice principles, all works

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
				remain subject to the relevant approvals at this time. The brine stream re-enters the ocean via a diffuser which is specifically designed to disperse the brine to ensure it adequately mixes throughout the water column. Currently, studies into the effects of brine discharge on the puerulus has not been completed. The Water Corporation has undertaken a Whole of Effluent Toxicity (WET) test using the brine stream from the existing desalination plants. WET testing is used to determine a minimum brine dilution that is required to be met at the protection boundary which will need to be approved by environmental regulators. Any claims for compensation for loss of income would need to be raised with the Water Corporation on an individual basis and are subject to a comprehensive loss of business claims process which includes review by an independent loss adjustor.

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
City of Wanneroo -	8/06/2018	**Pipeline route workshop** Attended by: Phil Thompson - Special Project Planner (PT) Aaron Baxter - Snr Land Engineer (AB) John Watson – Coordinator, Parks (JW) Chelsea Timms – Snr Landscape Officer (CT) Tenaha Wilson – Environmental Planner (TW) Phil Bland – Land Acquisition Officer (PB) Pas Bracone – Manager, Approvals (PBr) Benny Chang – Acting Manager Strategic Assets (BC) Jackie Kallen – Communications Specialist (JK)	Workshop to finalise route Proposal briefing and stakeholder engagement including a presentation of the project to all stakeholders present. Discussions on the Pipeline route and the planned road widening of Whiteman - Yanchep Hwy around 2031by the Main Roads. City of Wanneroo officials questioned: • what the trigger would be for the construction of the Nowergup Tank? • the extent of the land clearing and the impact of the clearing on the landscape • if the Freeway or rail reserve was considered as a possible option for the alignment of the pipeline.	Water Corporation responses were: growth to the area and the Wanneroo gravity supply schemes ability to service that growth are the key factors for the construction of the tank. placement of the pipeline within the road reserve limited the clearing requirements, flora and fauna surveys have been conducted for a majority of the route and that further opportunities to reduce the clearing extent will be considered once the whole alignment has been surveyed. Main Roads have communicated to Water Corporation that it does not support the pipeline being positioned within the road reserve.
WA Fishing Industry Council	20/06/2018	**Meeting** Mannie Shea (WAFIC) - Executive Officer	Briefing of Proposal and discussion on interest and engagement with commercial fishing sector.	Advice noted and ongoing discussions maintained.

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
Department of Biodiversity, Conservation and Attractions (DBCA)	27/06/2018	**Meeting** Michael Roberts (DBCA) Jacqui Clinton (DBCA) Lyndon Mutter (DBCA)	Proposal briefing and Alkimos integration.	-
Alkimos Beach Progress Association	2/07/2018	**Community Meeting** Chris White (ABPA) Mayor Tracy Roberts (CoW) Deputy Mayor Nat Sangalli (CoW) Aaron McCreath (WaterCorp) Tarryn Truscott (WaterCorp) Bree Atkinson (WaterCorp) Vanessa Moscovis (WaterCorp) Various community members	Concerns on impact to property value. Questions regarding community engagement process and opportunities.	Water Corporation provided information.
Sprout Hub community sessions	12/06/2018 & 28/06/2018 & 10/07/2018 & 26/07/2018	**Community event** Various community members Deputy Mayor Nat Sangalli (CoW) Tarryn Truscott (WaterCorp) Bree Atkinson (WaterCorp)	General enquiries from community about investigations.	Information noted. Minimal interest.

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
Recfishwest	12/07/2018	**Meeting** Matt Gillett (Recfishwest) Lleyton Campbell (Recfishwest) Aaron McCreath (WaterCorp) Tarryn Truscott (WaterCorp) Bree Atkinson (WaterCorp)	Proposal briefings and advice regarding engaging recreational fishing community.	Information noted.
MP and electoral officer	20/07/2018	**Meeting** MP John Quigley Tarryn Truscott (WaterCorp) Vanessa Moscovis (WaterCorp) Bruce Campbell Fraser (WaterCorp)	Briefing and discussion of community engagement.	Information noted.
Metronet Yanchep Rail Extension community event - Yanchep	21/07/2018 (Yanchep) and 31/7/2018 (Alkimos)	**Community event** MP John Quigley Deputy Mayor Nat Sangalli (CoW) Councillor Sonet Coetzee (CoW) Various community members Tarryn Truscott (WaterCorp) Vanessa Moscovis (WaterCorp)	Information booth.	Information shared.

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
City of Wanneroo – Retro Rewind event	10/03/2018	**Community event** MP John Quigley Deputy Mayor Nat Sangalli (CoW) Councillor Sonet Coetzee (CoW) Various community members Tarryn Truscott (WaterCorp) Sophie Firth (WaterCorp)	Information booth - displayed ASDP info.	-
Conservation Council WA (CCWA)	27/07/2018	**Meeting** Professor David Harries (CCWA) Aaron McCreath (WaterCorp) Bree Atkinson (WaterCorp)	Initial briefing on ASDP and PSDP Main concerns are: • marine impacts • increase in the electricity load • renewable energy sources.	-

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
Sprout Hub community sessions	10/07/2018 & 26/07/2018	**Community event** Various community members Tarryn Truscott (WaterCorp)	Community information session Issues raised: • water quality – water hardness, taste, chlorination, fluoridation • groundwater – allocation to local government (and resulting 'browning' of Yanchep), environmental impacts, use it or lose it approach to licence holders • infill sewerage to "Old Yanchep" • general enquiries on wastewater work underway • groundwater replenishment - status of, future plans, pathogen removal • pipeline from the north • energy supply to desal – could we/ are we looking at wave energy.	-
Metronet Yanchep Rail Extension community event - Alkimos	31/07/2018	**Community event** Various community members Tarryn Truscott (WaterCorp) Aaron McCreath (WaterCorp) Stefan Davidov (WaterCorp)	Information booth - displayed ASDP info.	-

Stakeholder	Date	Form of engagement and attendees	Topic/issue raised	Water Corporation response/outcome
Lendlease communities	1/08/2018	**Meeting** Rebecca Clarkson (Lendlease) Tarryn Truscott (WaterCorp)	General update - discussion ahead of community event.	-
WALGA forum	2/08/2018	Event Mayor Logan Howlett (City of Cockburn) Cllr Kevin Allen (City of Cockburn) Tarryn Truscott (WaterCorp)	Discussion about PSDP2 and integration pipeline into Cockburn area. Questions about timing/ preferred location.	Discussion only.
Alkimos Information Showcase	19/08/2018	**Community event** hosted by Lendlease Various community members	Information booth - displayed ASDP info.	-
WA Fishing Industry Council and all active fishing licence holders	May to June 2018	**Engagement re: offshore investigations.** WAFIC undertook engagement	Notification of offshore investigations. Report submitted as part of work approvals.	Feedback captured and noted.
Alkimos Residents	February to March 2019	**Email** Alkimos residents survey (3800 residents)	Email survey on new sources, engaging local community with Water Corporation website.	2615 emails issued to residents in Alkimos area with 1790 opened; 258 visits to project page; and 21 surveys completed

Appendix B: Alkimos Hydrodynamic Modelling: Draft Scenario Report

Appendix C: Alkimos Hydrodynamic Modelling: Calibration Report

Appendix D: Peer Review Panel Comments: Alkimos Seawater Desalination Draft Scenario Report

Appendix E: EPBC Protected Matters Report

Appendix F: Flora, Vegetation and Fauna Assessment – Spring 2017 (AECOM 2017)

Appendix G: Ecological Assessment - Alkimos SDP Pipeline Integration (AECOM 2018)

Appendix H: Alkimos Flora and Vegetation Survey – Spring 2016 (Strategen 2017)

Appendix I: CW03472 Eglinton Groundwater Investigations Flora, Vegetation, Fauna and Dieback Survey: Site 2 (Ecoscape 2018)

Appendix J: Alkimos Wastewater Treatment Plant Water Corporation Fauna Assessment (Bamford 2018)