

NORTHERN WATER

TECHNICAL STUDIES

SUMMARY

Northern Water have engaged a team of consultants to undertake baseline environmental studies to support the environmental assessment of the Project. Table 1 provides a list of the studies and a summary of their scopes. Scopes are only indicative and subject to change.

Table 1: Technical Studies supporting the environmental assessment for the Northern Water project.

Study	Scope
Marine Environment - Ecology	Objective: To characterise the distribution, abundance and condition of marine habitats, species and communities at Cape Hardy. Benthic and Epibenthic Assessments The marine ecology baseline studies encompass various benthic habitat, infauna, and fish/invertebrate epibenthic surveys. A preliminary reconnaissance habitat survey along the intake and outfall alignment has been completed, as well as a native vegetation (seagrass) survey to aid geotechnical investigations. Benthic habitat health surveys will be conducted throughout the four seasons, covering different habitat types across the site. These surveys use video tows and diver assessments. A more detailed habitat survey will be conducted in the concentrated seawater plume impact zone and pipeline alignments, including transect surveys, photo quadrats, and invertebrate counting. Infauna and meiofauna sampling will be completed across the winter and summer seasons. Fish/invertebrate epibenthic surveys will be carried out in five main habitat types using various methods such as video tows, scuba surveys, and baited remote underwater video stations (BRUVS). The impact assessment and reporting involve reviewing existing data/literature to assess potential impacts on various marine species, including protected and priority species. Inputs from other technical reports are used to evaluate likely ecological impacts and recommend mitigation measures for the desalination plant's construction and operation. Plankton and Fish Larvae Plankton and Fish larvae surveys will be conducted across the seasons

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	at the intake and outfall sites as well as reference sites. These surveys will target key commercial endemic fish and crustacean species in demersal and pelagic regions. The methodology includes oblique tows with samples being collected both day and night. Identified fish and crustacean assemblages in the predicted impact zone and reference location will be described and compared. eDNA-metabarcoding techniques are used for species classification, and input is provided for the Invasive Marine Species (IMS) study by screening samples for feral species presence.
Marine Environment - Hydrodynamic Modelling	Objective: To determine the dilution and dispersion of the concentrated seawater in the local environment and determine impacts of the desalination plant on the hydrodynamics of the spencer gulf. Near field: Near-field and mid-field hydrodynamic modelling of the concentrated seawater discharge will be conducted for various climate conditions and intake/diffuser flow rates, considering the cumulative effects of other approved infrastructure. Based on the modelling results, the study will provide optimal locations for the concentrated seawater diffuser/s and seawater intake, predict concentrated seawater dispersion plume patterns for different flow rates, delineate the 'area of influence' of concentrated seawater discharge until diluted to background levels, and determine the proximity of the plume to sensitive receptors. Hydrodynamic modelling will be conducted to assess the entrainment of marine organisms at the intake pipeline. Far field: Oceanographic data collected by the South Australian Research and Development Institute (SARDI) and Integrated Marine Observing System (IMOS) will be used to develop, improve, and validate a 1km-resolution hydrodynamic model for Spencer Gulf (SGM1000). Long-term (ten-year) model hindcast simulations, with and without current and proposed desalination concentrated seawater outfalls, will be assessed to understand the long-term dispersal and flushing of concentrated seawater discharges from the Spencer Gulf. Model results will also be used to support near-field modelling studies needed to: (i) optimise the design of concentrated seawater diffusers and (ii) inform particle tracking studies to understand the far-field larval connectivity of two key commercial fisheries species (prawns and snapper) with the proposed desalination intake locations.

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	Climate Change: Projections of future (2090-99) ocean conditions along the southern Australian coastline will be determined from global ocean-atmosphere climate models under the RCP8.5 scenario; the projection with the greatest increase in greenhouse gasses and global temperatures. Climate model projections will then be dynamically downscaled through a series of nested 1-way hydrodynamic models of increasing resolution to understand the future ocean conditions and circulation in the Spencer Gulf. Desalination (concentrated seawater) discharges from existing and proposed plants in Spencer gulf will then be modelled under these conditions to assess the future capacity of the gulf to adequately disperse concentrated seawater discharges.
Marine Environment - Underwater Noise and Vibration Impact Modelling	Objective: To characterise baseline sound and vibration levels at the site and assess impacts of the construction and operation of the desalination plant on underwater noise and vibration. The underwater noise and vibration assessment will involve a review of background information and data gaps identification before conducting baseline monitoring at the Cape Hardy desalination plant site. Marine species potentially affected by noise and vibration will be identified, and their hearing and communication abilities will be reviewed. Suitable noise exposure criteria will be established for these species. The assessment will consider both the base case and future case, including the combined impact of underwater noise from the desalination plant and port construction and operations. Underwater noise modelling will be conducted for significant noise sources, and management and mitigation measures will be proposed to minimize adverse effects.
Marine Environment - Water Quality Monitoring	Objective: To establish baseline water quality within the vicinity of the intake and outfall. A 12-month water quality monitoring program will be conducted at nine monitoring locations, spaced across a 5km area in a 3x3 grid formation, along the 13, 18, and 21m contour lines. Sampling will be done at the same locations throughout the program, with exact coordinates confirmed during the reconnaissance survey. All sampling events will occur during the same tidal regime, such as high tide. Samples will be taken 1m from the benthos and 1m from the surface at each sampling event. Various parameters will be measured at all nine locations, including weather data for each event and the three days prior. Water samples will be sent to an NATA accredited laboratory for testing.

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Marine Environment - Ecotoxicology	Objective: To determine the toxicity of the concentrated seawater in the marine environment. The study will involve a literature review and gap analysis to assess the relevance, reliability, and gaps in existing ecotoxicity studies from other desalination plants. An Ecotoxicology Testing Program will be developed to validate or update Species Protection Trigger Values as necessary to determine an acceptable dilution factor for the concentrated seawater discharge at Cape Hardy.
Marine Environment - Sediment Quality Survey	Objective: To determine the physico-chemical characteristics of the sediment at the site. The broadscale sediment quality survey will involve core sample collection and processing at 15 sample sites. The sites will be plotted in a grid formation roughly 200-250m apart around the intake and outfall locations. Five sites will be sampled along three different contour lines. Sediment cores will be collected using a Vibecor. A NATA credited Laboratory (EnviroLab) will test the samples against the National Assessment Guidelines for Dredging and a comprehensive report will be generated based on the results.
Marine Environment - Sidescan Benthic Habitat Mapping	Objective: To obtain a broadscale benthic habitat map of the 30 km² marine survey area The study will utilize Sonar, Sidescan (Mosaic), Biobase™ and camera drops to complete 3D scan transects in the following manner: six 4km transects will be conducted perpendicular to the shoreline, and another six 4km transects will run along the depth contours, creating a 6x6 grid pattern that covers 48km of transects. Camera drops will be used to confirm habitat types through video and stills, enabling the calibration of automated habitat classifications. The survey will also confirm depth contours and refine benthic mapping using C-MAP Genesis.
Marine Environment - Invasive Marine Species	Objective: To establish a baseline of Invasive Marine Species at the site. A desktop Risk Assessment will be conducted to evaluate current and future Invasive Marine Species (IMS) risks to Cape Hardy. This assessment will consider various factors, including the National Priority Marine Pests list, existing marine pest and disease records for Cape Hardy, potential connections of infected ports and nodes to the site, and potential vectors of IMS introduction during the construction and operational phases of the NWP. Additionally, The plankton and larval fish samples will be screened for the pest species presence/absence via qPCR techniques which will be

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	used to supplement the desk top review. Invasive marine species will also be identified during any diver and/or video habitat surveys.
Hazard and Risk Assessment	Objective: Risk assessment of construction and operational phases of the project to assess implications for, and the impacts on, surrounding land and marine uses and users. This assessment includes the identification of potential hazards and risks to public, occupational, and environmental health during construction and operation. The process involves reviewing existing reports and data to consolidate key constraints and factors.
Terrestrial Ecology	Objective: To characterise the existing conditions and significance of flora and fauna at the desalination plant site and along the pipeline alignment The baseline survey flora and fauna surveys will focus on targeted EPBC listed fauna surveys and gathering vegetation data to support mapping and habitat assessment for the EPBC referral, EIS, and preliminary Native Vegetation Clearance application/offsets. The baseline reporting outputs will include desktop likelihood of occurrence assessments, field assessments targeting species of concern, and initial RAM/BAM vegetation and habitat assessments. Mapping of EPBC threatened species records, key habitats, and hotspots, along with reporting on weed infestations and vegetation descriptions of communities along the alignment, will also be provided. Opportunities for mitigation and avoiding ecological constraints will be identified.
Groundwater	Objective: To characterise the existing environment and identify potential risks to groundwater from the construction and operation of the NWS pipeline and desalination plant A desktop groundwater study to support the pipeline route groundwater EIS assessment report will be undertaken. The assessment will review potential impacts to groundwater from contamination, groundwater depletion and potential changes to groundwater quality, aquifer recharge or inflow and discharge. The study will also assess the potential for groundwater inflow to excavations along the pipeline route. Water regulation issues such as water licensing and allocation will also be reviewed as part of this exercise. Water supply requirements and regulation will be identified and discussed. A considerable volume of water will be needed for the construction phase of the project and as such a short desktop investigation of

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	potential groundwater sources and likely quality and quantities is included.
Great Artesian Basin Reduced Extraction Study	Objective: To provide an assessment of the impact of a reduction in groundwater take from the aquifers of the Great Artesian Basin (GAB) and how this will impact on spring pressure levels and spring flow rates from spring tails. This aspect of the work deals with the development of hydrogeological modelling-based evidence through predictive scenario analysis of the response of aquifer pressure to reductions in water extractions from the Great Artesian Basin. This project will use the GAB hydrogeological model developed by the SA Department for Environment and Water (DEW) as a starting point. Up to 6 modelling scenarios regarding reduction in groundwater take from the GAB will be run.
Air Quality	Objective: To predict and assess air quality impacts and provide recommendations to manage and mitigate those impacts. An initial desk top assessment will conduct a comprehensive assessment of the meteorological and air quality aspects within the project region. It will analyse climatic factors such as rainfall, extreme weather events, and natural hazards, which may affect the local meteorological environment. By estimating existing ambient air pollution levels through air monitoring data, the assessment will identify and describe current sources of air pollutants, including emissions data from the national pollutant inventory (NPI) for local industries. Using NPI emissions estimation techniques and other referenced sources, it will assess and compare airborne emissions from the construction, operation, and decommissioning phases, considering NPI reporting thresholds. No air quality modelling is proposed at this stage.
Coastal Processes	Objective: To understand the coastal processes at the proposed site location and potential impact of the proposed intake and outfall infrastructure. A qualitative assessment of the potential impact of the proposed coastal works on the local sediment transport regime will be conducted. The study involves the collation and review of existing information on metocean conditions, bathymetry, morphology, and coastal processes near the proposed development site. The extent and configuration of the proposed intake and outfall infrastructure, as well as the proposed construction approach, will be reviewed. The potential for the proposed construction or permanent coastal works to impact coastal processes will be assessed.

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Noise and Vibration (Terrestrial)	Objective: To predict and assess environmental noise and vibration impacts and provide recommendations to manage and mitigate noise and vibration impacts. The Noise and Vibration Impact Assessment will evaluate potential impacts on sensitive receivers during construction and operation phases of the Project. The study aims to identify environmental risks and propose mitigation measures to minimize noise and vibration impacts. Criteria for impacts will be established, and baseline noise monitoring will be conducted at affected receivers. The assessment will predict noise and vibration impacts using modelling software for construction and operational phases. Mitigation measures will be recommended to comply with guidelines and legislation. Cumulative impacts with the Iron Road project will also be assessed.
Surface Water Hydrology and Flooding	Objective: To characterise the existing conditions and significance of the surface waterways and water impoundments along the proposed pipeline route from a water quality, geomorphology, freshwater ecology, hydrology and flooding perspective as well as flood risk at the desalination site. Water Quality: The water quality assessment methodology considers the arid landscape and intermittent streams, accounting for limited data availability. It identifies environmental values and appropriate objectives for surface water quality in the Project area. Data from public records and previous assessments are reviewed, with identification of data gaps. If data is insufficient, monitoring goals and methods will be proposed. Potential impacts on surface water quality will be assessed, and mitigation recommendations to minimize environmental harm will be provided. No model development or modelling is included in this scope. Geomorphology: Desktop assessment to identify and characterise the waterways crossed by the pipeline based on existing information. Assess scour and stream avulsion potential of the watercourses crossed including potential pipeline scour discharge during commissioning and ongoing maintenance and assess potential impacts that the proposed pipeline will have on the geomorphological processes operating on streams and other waterbodies.

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	Aquatic (freshwater) ecology: The aquatic ecology methodology addresses challenges in the arid landscape, reviewing data on freshwater fauna, identifying conservation-listed species and potential data gaps. If necessary, a field investigation may study freshwater communities near major creek crossings. Risks to aquatic communities from pipeline crossings are assessed, and construction guidelines proposed for mitigation. Hydrology and catchment context: Existing plans and legislation will be reviewed, considering water resources and current users downstream. The assessment will analyze historical data on rainfall, streamflow, and flood extents, identifying flow paths and constraints. Existing models and water balance estimates will be reviewed. Climate change projections will be assessed for hydrological impacts. Risks to flow regimes will be summarized, and appropriate mitigation measures proposed. Flooding: a desktop study will assess the likelihood of flooding along the alignment and at the desalination site. Historical data, rainfall records, flood frequency estimations, and publicly available elevation data will be reviewed. Recommendations for detailed flood modeling will be provided where the pipeline intersects significant flow paths to assess potential impacts on the surrounding environment.
Topography, Geology and Soils	Objective: To assess potential project impacts and risks on topography, geology and soils, and propose mitigation measures to eliminate or minimise risks to the physical environment. The topography assessment will review and assess existing elevation data, selecting appropriate map scales and contour intervals for optimal presentation. Geomorphology will conduct a desktop assessment to identify landforms and assess erosion potential, followed by targeted fieldwork. A Geomorphological Assessment Report will be prepared with recommendations to mitigate impacts. Geology and soils will undertake a desktop review of geological and geotechnical information, identifying potential geohazards and proposing mitigation measures. Existing geotechnical reports will be reviewed, and field investigations will be recommended to fill data gaps. The report will summarize geological conditions, geohazards, and earthquake hazard information, providing recommendations for further investigations.

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Traffic Impact Assessment	Objective: To assess and address potential whole-of-life impacts of the desalination plant, distribution pipeline and ancillary infrastructure so that a satisfactory level of road user safety and transport efficiency is maintained. In preparation for the Traffic Impact Assessment (TIA), key tasks involve data collection, site visits, and consultation with relevant stakeholders. Identification of road access routes for construction and operation of the pipeline is essential, including assessing existing road network deficiencies and safety aspects. Trip generation and traffic distribution will be determined, considering alternative haulage routes if necessary. Access regime and junction design requirements for project accesses will be defined. Cumulative impacts with other approved developments, including Iron Road, will be evaluated. Mitigation measures, such as road upgrades, traffic control, and demand management, will be proposed to address identified impacts on the road network.
Maritime, Rail and Air Operations	Objective: To assess and address potential impacts of the construction and operation of the desalination plant, distribution pipeline and marine infrastructure on maritime and rail operations. The assessment preparation involves several key tasks for addressing potential impacts on maritime, rail, and air operations. For maritime operations, it includes describing marine traffic volumes, movements, and patterns to/from ports, as well as assessing impacts on State marine parks and proposing mitigation measures. The assessment also evaluates potential marine traffic impacts on navigation aids and interactions with other vessels and existing operators. Measures are outlined to protect water quality, marine parks, and the marine environment while ensuring public safety. Regarding rail operations, the focus is on understanding construction and operation activities that could affect rail services and assessing potential disruptions to freight and passenger services due to track works, increased rail traffic, or subsidence. Mitigation measures are detailed to address these impacts. Additionally, the assessment considers the capacity of existing airports/airfields to handle air transport demand, including potential new facilities or alterations if needed. It also describes the anticipated increase in flights, aircraft size, frequency, and timing, with a focus on night operations. Measures are outlined to mitigate any impacts on air transport, considering features like the placement of electricity transmission towers beneath flight paths. These tasks aim to ensure the compatibility of the project with existing transport sectors and

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	implement measures to manage and mitigate any potential adverse effects.
Landscape and Visual Amenity	Objective: To assess the visual impact of the proposed infrastructure design on the landscape and visual amenity. The Visual Landscape Characterisation will assess the visual aspects of the proposed NWP, encompassing a desktop assessment, Theoretical Zone of Visual Influence (TZVI) modelling, and visual impact predictions. The desktop study will identify key visual elements, map the baseline landscape, and perform a sensitivity analysis. The TZVI will be calculated based on topography, and viewshed analysis will be conducted from predetermined visual receptors. Predicted visual impacts will include characterisation, assessment, and mitigation strategies for the desalination plant, pipeline, and associated infrastructure. Photomontages will illustrate future visual states, and mitigation strategies will be proposed. The Landscape Character and Visual Impact Assessment Report will qualify existing and proposed visual impacts, analyse cumulative effects, and provide recommendations for mitigating visual amenity impact.
Non-Aboriginal Cultural Heritage	Objective: To Identify listed or nominated heritage places and areas, summarise, and assess potential impacts and recommend appropriate mitigation methods and management practices to reduce risk. The desktop assessment will analyse the potential impacts on non-Aboriginal cultural heritage, considering the location and significance of historic heritage sites, including State and Commonwealth-listed places and shipwrecks. The assessment will evaluate the development's potential effects on State and other listed historic heritage sites, as well as Commonwealth, National, and World Heritage places. Mitigation methods and management practices will be identified to minimize impacts on non-Aboriginal heritage values.
Land Use Planning and Zoning	Objective: To characterise existing land uses and land tenure, identify and describe relevant Planning and Design Code Overlays and Zones, and summarise and assess potential impacts upon adjoining land and alignment with established planning policy. The assessment will review the existing environment, including land uses, land tenure, and protected areas near the project site. It will describe proposed site services and infrastructure, considering relevant Planning Policy documents and Codes. Options will be outlined, along with reasons for their selection or rejection. Potential impacts on adjoining land and land uses will be summarized, and an evaluation of the project's effects on neighbouring areas will be conducted within

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	the framework of the Planning and Design Code. Mitigation measures to minimize impacts and risks, supported by relevant environmental studies, will be described.