Hassyan Seawater Reverse Osmosis Independent Water Project (180 MIGD) Dubai, UAE

Environmental and Social Impact Assessment

Non-Technical Summary

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1 PROJECT OVERVIEW

This Environmental and Social Impact Assessment (ESIA) is for the development of a new Seawater Reverse Osmosis (SWRO) plant with a capacity of 180 Million Imperial Gallons (MIGD), hereby referred to as "the Project" that will be located in the Saih Shuaib area, near the Hassyan Ghantoot border of Dubai, United Arab Emirates (UAE).

Dubai Electricity and Water Authority (DEWA) and ACWA Power are working together to develop the Phase 1 of the Project with a capacity of 180 MIGD as an Independent Water Project (IWP), which for ACWA Power includes owning, financing, designing, engineering, procurement, and operation under a long-term Water Purchase Agreement (WPA). ACWA Power's scope also includes laying the seawater intake and outfall pipelines for the planned future expansion for Phase 2 (additional 60 MIGD) of the Project to meet the SWRO final capacity of 240 MIGD. ACWA Power has appointed Société Internationale de Dessalement (Sidem, a fully owned subsidiary of Veolia) and SEPCO Electric Power Construction Co. Ltd. (SEPCO III) as the joint Engineering, Procurement and Construction (EPC) contractor.

It is to be noted that the phasing of this project has been changed from an earlier proposed scheme for which the capacity of Phase 1 was 120 MIGD instead of the currently proposed 180 MIGD.

The Project has been proposed by DEWA to meet the increasing demand for potable water in the Emirate of Dubai as a result of significant business growth and increasing population that is occurring and anticipated in future. The location of the Project will be adjacent to the Hassyan Power Plant (HPP) on DEWA's land holding with access to the coast and seawater required for the production of potable water and is the only feasible site for implementing this desalination project with DEWA's coastal land portfolio.

The Project intake/outfall configuration has been subjected to an extensive design review process, which has resulted in the IWP outfall diffuser sections being strategically located close to the HPP outfall diffusers within approved Planning Corridors. This will facilitate enhanced mixing and dispersion of the discharges, by the near proximity of denser reject brine from the IWP and the buoyant cooling water from the HPP.

This ESIA for the SWRO Project has been undertaken and reviewed by three Dubai Municipality Registered Environmental Consultants including HydroQual ASA (Marine Dispersion Modelling), Innovation Delta Environmental (Ecology and Marine Water Quality) and 5 Capitals Environmental & Management Consulting who are responsible for the overall ESIA preparation and submission to Dubai Municipality Air Environment Sustainability and Environmental Assessment Section (DM-AESEAS).

1.1 Site Location

The Project site is located within the Jebel Ali Wildlife Sanctuary, also referred to as Jebel Ali Marine Sanctuary (JAMS) which was designated in 1998 for its terrestrial and marine ecology and biodiversity. A smaller coastal area including intertidal lagoons and mangrove known as the Jebel Ali Wetland Sanctuary (JAWS) was designated under the RAMSAR Convention in 2018. The IWP Plant will be located outside of the RAMSAR site together with temporary construction laydown facilities, storage and treatment of dredge material and a temporary jetty. There will however be a requirement to lay the buried intake/outfall pipelines (30m width) within an 80m planning corridor passing through the lagoons and mangrove and under the seabed to their determined end points offshore, which will cross the RAMSAR boundary as indicated in the following Figure 0-1. The pipelines will include those required for future Phase 2 of 60 MIGD (total 240 MIGD) to avoid disturbance and future dredging works in this sensitive environment.

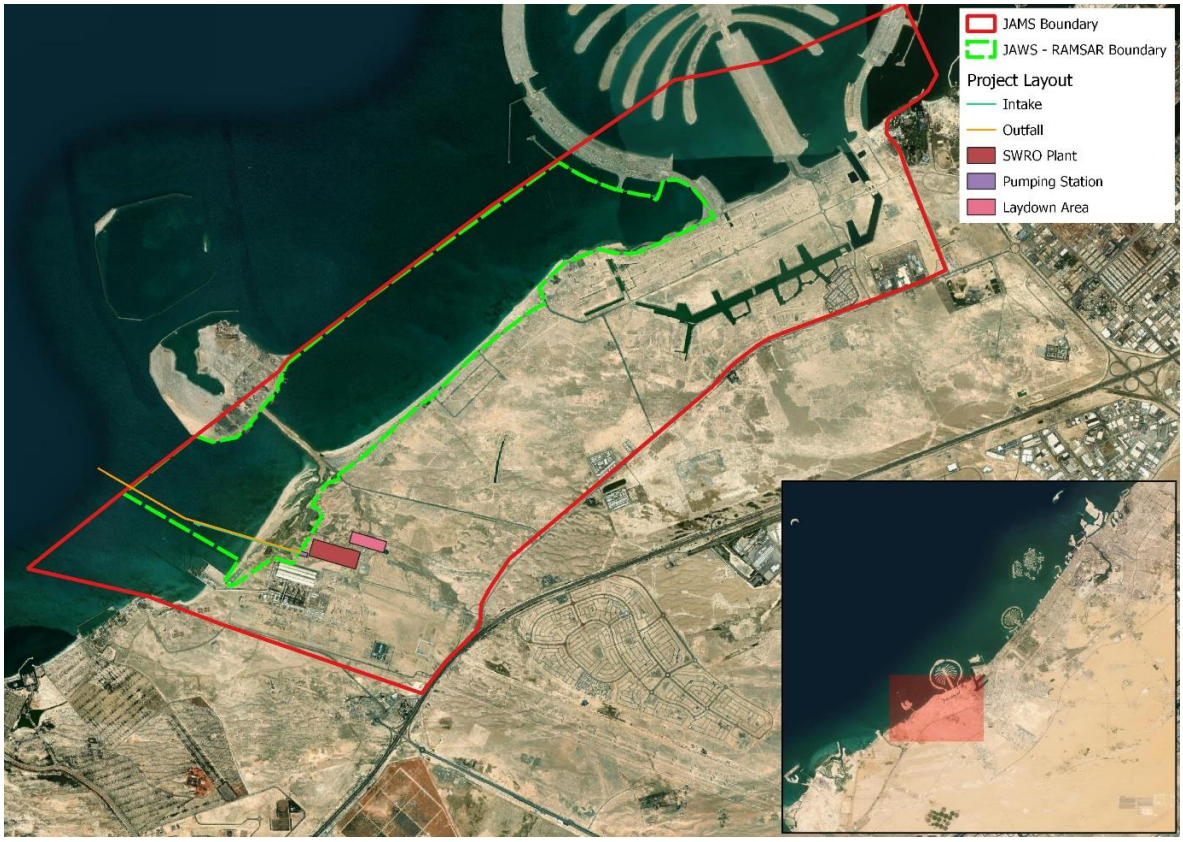

Figure 1-1 Project Layout in relation to 1998 Designation (red line) and 2018 RAMSAR (green line)

As per the current scheme, the seawater intake pumping station will be located close to the IWP Plant and outside of the RAMSAR boundary as indicated in above figure. Alternative locations for the pumping station previously assessed by HydroQual were reviewed, including a possible site close to the shoreline on the beach. However, this option has been rejected at the design review stage, considering the sensitivity within the RAMSAR site and the potential impacts on turtles that use the beach for nesting.

The shoreline beach extending from Hassyan to the north of Dubai Waterfront and on to Palm Jebel Ali is a known nesting location for Hawksbill Turtles which are listed under the International Union for Nature Conservation (IUCN) as being a "*Critically Endangered*" species.

Currently, no residential, cultural, or other sensitive human receptors are in the immediate vicinity. However, there are certain receptors within a 5km radius. The main land use in the area is the adjacent HPP which is in its final stages of construction and commissioning and expected to be fully operational by the end of 2023. There is no accommodation here and the plant is an industrial facility for the operational work operatives.

Emirates Marine Environment Group (EMEG) personnel are stewards of a DM-ESD office facility located north of the Project close to the boundary of DEWA landholding and are considered as sensitive receptors that could be affected by noise and dust due to construction activities.

The key receptors are the sensitive coastal and marine ecological habitats and species in the intake/outfall corridor, most notably the coastal lagoons, mangrove and turtle nesting beaches through which the intake/outfall pipelines are to be buried in a trench.

1.2 Key Design Components of the Project

As with any SWRO plant, the main Project components are those listed below:

- Seawater intake installations, including screening and chlorination system;
- Pre-treatment: Dissolved Air Floatation followed by Single Stage Filtration;
- Dual Media Pressurized Filter (DMPF);
- Cartridge filter 5µm;
- Reverse Osmosis Membranes involving 2 passes;
- Flushing and neutralization systems;
- Post-Treatment: Limestone filter with carbon dioxide injection;
- Sludge dewatering systems; and
- Potable Water Tanks and export system.

1.2.1 Seawater Intake System

As outlined earlier, the Seawater intake system has a design capacity to include for the future Phase 2 of 60 MIGD (i.e., final capacity of 240 MIGD) of the project and, once fully operational, will draw seawater from eight (8) intake risers located between 950 m to 1,100 m from the shoreline in suitable depth water. Raw seawater will be transferred to the Plant using four (4) number pipes, each having a diameter of 3m. The offshore and onshore sections of the intake pipes will be laid within a common trench which will also accommodate the outfall pipes.

The seawater intake pipes will feed the intake forebay chamber, located before the pumping station. The pumping station will be located adjacent to the SWRO and will therefore be outside of the RAMSAR/JAWS boundary.

The intake chamber will be equipped with a bar screen (50mm mesh) followed by a travelling band screen to avoid particles larger than 5mm passing through and to protect the downstream intake pumps. The screens will prevent the entrainment of marine fauna into the intake system. The seawater abstraction point at the end of the intake pipes will also be installed with screens of 100mm mesh to prevent fish and other marine fauna from entering the Plant.

There will be intermittent shock chlorination of seawater using sodium hypochlorite solution from a small pipeline located inside the intake pipes to avoid any risk of leaks into the sea. This will prevent bio-fouling in the pipeline as water is transferred to the pumping station.

In order to protect the Plant from reduced capacity if seawater feedstock is outside the specified design parameters, the raw water quality will be monitored continuously for relevant parameters using online analysers.

1.2.2 Pre-treatment of Water

The following main pre-treatment processes will be carried out to ensure the quality of water that enters the RO system:

- Clarification by Dissolved Air Floatation (DAF);
- Dual Media Pressurised Filtration; and
- Cartridge Filters.

The filtered water will also be continuously monitored online for certain water quality parameters.

1.2.3 Seawater Reverse Osmosis System

Prior to passing through the RO system, dosing of chemicals using antiscalants will be used sparingly to protect the RO membranes. The antiscalants are approved by membrane manufacturers as non-toxic and have been developed from extensive research and development conducted by the membrane manufacturers and the chemical suppliers. The antiscalant complies with both environmental and product water standards.

The RO system of the Plant will consist of a two-pass configuration with a partial split of the front permeate for power and water quality optimisation purposes. A recovery rate of ~45% on the first pass RO and ~90% on the second pass RO has been selected. The first pass RO system consists of 24 separate trains with one stage. In order to further optimise the Plant's energy consumption, the first pass RO includes an efficient energy recovery system. The permeate from the RO train is extracted from both the front end and the rear end of the pressure vessels.

The 2nd Pass RO system consists of a two stage RO design where concentrate from the first stage is the feed of the second stage and comprises 16 trains on duty. The two stages are designed to operate at an overall recovery yield of approximately ~90 %. The permeate from the 2nd pass RO trains is mixed in line with 1st pass RO front permeate before it undergoes a remineralisation process.

1.2.4 Remineralisation and Disinfection Process

The RO process produces water that is very pure. However, the handling and consumption of such high purity water can lead to issues related to corrosion of infrastructure components (pipes, tanks etc.) as well as potential health issues from human consumption. As a result, there is a need to increase the hardness of the water, which is achieved in the remineralisation process with the use of dissolved carbon dioxide gas and limestone.

Additionally, disinfection is carried out as a final treatment process, just before the Plant outlet by injection of chlorine dioxide prepared on site using dilute Hydrochloric acid and Sodium Chlorite. Prior to being sent to the potable water tanks, the product water quality is checked and adjusted continuously online. Confirmation of compliance is also performed downstream the potable water storage tank before transferring water to the export system.

1.2.5 Potable Water Storage

The Plant's potable water storage tank will have a maximum design capacity to store 12 hours of production water. Four (4) interconnected tanks, each having a useful storage volume of approximately 103,000 m^3 equivalent a total capacity of 412,000 m^3 (approximately 90 MIGD) will be installed towards the eastern end of the Project site.

1.2.6 Seawater Outfall System

Offshore seawater outfall pipes will be installed as part of the Project in order to discharge the reject brine generated from the Plant, along with off-specification water, overflows and the treated process effluents from the desalination plant. The discharge will take place offshore, through a pipeline diffuser outside of the RAMSAR site boundary. These pipes will be buried under the seabed within offshore trenches that will be created by dredging. The discharge pipes for brine and treated effluent will comprise two (2) number of 3-meter diameter configuration up to the final discharge point in the sea. The size of these offshore pipes will meet the Plant's planned final capacity of 240 MIGD as required by DEWA.

Diffusers, designed and modelled by marine experts HydroQual ASA and checked by H R Wallingford will be installed at the end of the twin outfall pipes to ensure optimal mixing of the brine and compliance with Dubai Municipality regulations including Local Order 61, 1991, in relation to the defined Mixing Zone.

1.3 Main Construction Works

As outlined earlier, SEPCO III will be the EPC Contractor appointed to execute the construction works and will be supported by specialist marine contractors to carry out the marine engineering works and dredging of the trench within which the intake and outfall pipes will be laid.

The construction works can be broadly classified as follows depending on their area of execution:

- Construction works at the main RO Plant site;
- Construction of the onshore seawater intake and outfall pipelines; and
- Construction of the offshore intake and outfall pipelines

1.3.1 Construction works at the Main RO Plant Site

Prior to commencement of construction works, geotechnical investigations and topographical surveys will be carried out as part of early site investigation works. An investigation of any existing facilities including those above ground and buried within the plot area allocated for the Project will also be carried out.

Excavation of the ground will be required for the purpose of foundation construction, based on the findings from the geotechnical studies and detailed design of the Project. Excavation will be mainly required for the construction of the seawater intake and outfall structures.

It is anticipated that dewatering of groundwater will be required during the excavation works for the pumping station, buildings, underground piping installations etc. According to preliminary ground investigation data, dewatering will be required for excavations which are about 2m below ground level.

During the construction stage, all temporary facilities including offices will be installed in the site at designated areas. The temporary work area used during construction for laydown, warehouses, and workshop, will be barricaded by a fence and the access will be controlled and restricted for the staff.

1.3.2 Construction of Onshore Seawater Intake and Outfall Pipes

As outlined earlier, the combined seawater intake and outfall pipes will cross the RAMSAR site, within an 80m wide corridor as shown on the Affection Plan for the site. Mangroves within the onshore part of the corridor will be removed prior to construction. Pipes will be laid inside a trench, 5 m to 11 m below ground that will be dug within the corridor. The width of the trench will be approximately 25 m within which six GRP pipes (4 for seawater intake and 2 for brine discharge) will be installed.

The sequence of construction will take into account the turtle nesting season sensitivity at the nesting beach and ensure protection of the mangroves and other species within the coastal lagoons on either side of the onshore trench.

This will include the following:

- Depending on the timing of construction permits, the construction program will be scheduled to avoid activity close to the beach during the turtle nesting season.
- Provision of staged construction to ensure that there is connectivity between the lagoon areas on either side of the pipeline route during construction by means of providing small channels to ensure water flow. The detailed sequence of construction works within the corridor in the RAMSAR site will be detailed in the management plans when applying for specific No Objection Certificates (NOCs).

1.3.3 Construction of Offshore Seawater Intake and Outfall Pipes

The scope of works for construction involves dredging of existing seabed level to form a trench (with a maximum dredging depth of -13.5 m CD) for intake and outfall. An estimated volume of approximately 530,000 m^3 of existing seabed will need to be dredged to create the trenches required to bury the intake and outfall pipelines. Dredging depths will vary from 5m up to 6m below the seabed. Design width of the trench varies from 7.2m (2 outfall pipes) to 24m (6 pipes, 4 intake and 2 outfalls). Before commencement of the dredging works, a joint bathymetric survey in dredging area will be arranged by both the EPC contractor and their appointed dredging contractor.

Dredging will be carried out using a Cutter Suction Dredger (CSD), which is selected due to the high percentage of rock identified during the geotechnical studies and due to the limited negative environmental effects compared with other methods of dredging. All the dredged materials will be discharged to the designated onshore stockpile area which will be surrounded by perimeter bunds.

The cutter suction dredger will cut and mix the material inside the cutter head and then pump it towards the shore via a pipeline. The dredged material transfer pipeline will consist of the onboard pipeline, a floating pipeline, submerged pipeline, and a land pipeline to dispose at the onshore sedimentation tanks area. The submerged pipelines are mainly used to avoid hindrances to vessel navigation and damage.

The design of the discharge area for dredged material (to be confirmed by the marine and dredging contractors) is subdivided into three sedimentation basin areas surrounded by perimeter bunds, referred as:

- Stockpile area 1 (~25,000 m^2)
- Stockpile area 2 (~100,000 m^2)
- Stilling area (~60,000 m^2)

The sedimentation areas will be connected by pipe (between stockpile areas 1 and 2) and weir boxes. Upon discharging of dredged materials, the dredged slurry will be stockpiled in the stockpile area, whilst the effluent will flow into the stilling pond. The construction of a perimeter bund will allow settlement of dredged materials and control of the water flow from the filling areas whereby the suspended solids in the surrounding waters are reduced to acceptable levels, which is largely dependent on the dredged material characteristics, mainly silt content.

The fill material will be deposited furthest away from the weir box/outlet of each basin to allow for the dredged material and water mixture to flow the maximum possible distance and achieve maximum settlement before discharge to the subsequent basin.

Depending on the nature of the material to be dredged, excess water drained from the filling areas through the weir box may contain a high percentage of fine solids. To protect sensitive environmental receptors in the surrounding waters (if any), some silt screen / netting may be installed at the dewatering points within the basins to mitigate environmental impacts and ensure compliance with DM Marine Water Quality Discharge Standards (Ref: EC Guidance for Development. Infrastructure and Industrial Projects, updated 5th July 2023).

The stilling area will be used as a temporary settling pond for removing fines which are still suspended in the discharge coming from the stockpile areas. At the end of the stilling pond, a weir box will be installed to control the return of water back to the sea. Two layers of silt curtains will be used outside the final discharge location at the sea. In addition, silt curtains will be deployed close to the dredging area to avoid spreading of spilled sediments based on site observations and turbidity monitoring at identified sensitive areas. Two continuous monitoring stations will be installed during dredging, one close to the Nakheel Waterfront Island which supports the earlier translocated corals and another one towards the HPP seawater intake to monitor for turbidity and suspended solids.

A temporary onshore jetty will be constructed, adjacent to the existing HPP jetty for the purpose of launching the dredging crew, equipment and pipeline sections. Construction works including dredging will not be carried out during night-time during the nesting season from March to June. Potential impacts from artificial construction lighting will be minimised while planning works offshore during the turtle nesting season, including avoidance of light spill onto the adjacent sea and reduction in night time working.

1.3.4 Construction of Access Road

A temporary access road will be constructed for the movement of vehicles and transport of construction plant and equipment, immediately adjacent to the existing paved road from the HPP to a new temporary jetty. This will also link up with the EPC compound and laydown area and will be entirely outside of the RAMSAR site.

1.4 Project Timeline

An outline delivery schedule highlighting important milestones for the project is provided in the table below.

Table 1-1 Project Timeline

Implementation Milestone	Tentative Date
Effective Date of WPA and LNTP under EPC Contract	8th September 2023
Financial Closing Date	8th December 2023
Notice to Proceed to EPC Contractor (NTP)	8th December 2023
Start of Mobilization	8th December 2023 (to be confirmed)
Start of Site Installation	8th December 2023 (to be confirmed)
Scheduled Project Commercial Operation Date (PCOD)	20 December 2026

1.5 Scoping Exercise

Based on the outcomes of the scoping process with considerations of potential impacts and effects, the technical disciplines that are scoped in for consideration during the ESIA are summarised in the following table.

Table 1-2 Scoping Summary

Discipline	Scoped In (Yes/No)	Justification
Geology, Soil and groundwater	Y	Project activities entail using existing land allocated for the project (including temporary use of land for construction laydown) with potential impacts on site soil. Dewatering of groundwater will also be required, potential effects of which needs to be studied.
Climatic conditions, climate change and air quality	Y	GHG emissions associated with the construction activities will be limited and not expected to result in a significant effect on climate, however, the operation of the plant will require consumption of significant energy resulting in GHG emissions. Generation of dust and emissions (including operation) during Project activities has the potential to affect the workforce and other nearby receptors.
Noise and vibration	Y	Operation of generators, heavy machinery and the daily vehicle movements during construction and operation have the potential to effect nearby receptors.
Oceanography and coastal processes	Y	Project involves construction in the marine environment for the construction of seawater intake and outfall infrastructure in addition to offshore discharges during operation which needs detailed studies for potential impacts an their effects on the marine environment.
Water and sediment quality	Y	Marine construction and operational discharges could have potential adverse impacts on water and sediment quality without mitigation.

Discipline	Scoped In (Yes/No)	Justification
Marine ecology and nature conservation	Y	Project is located within and close to sensitive marine and costal ecological area including some areas designated as marine sanctuary and RAMSAR wetland. There are significant ecological sensitivities such as the presence of turtle nesting beach and mangroves in the area that can be potentially affected without proper mitigation.
Terrestrial ecology and nature conservation	Y	Most of the main plant construction site are disturbed ground from earlier activities. However, the project footprint includes part of the existing lagoons consisting of mangroves and other terrestrial ecological sensitivities (lagoon areas designated as RAMSAR wetland) which need to be assessed and mitigated including compensation for potential effects on terrestrial ecological receptors.
Archaeology and cultural heritage	N	Project site is located within an area close to an existing large power plant and is not expected to have any archaeological sensitivities or cultural heritage significance.
Socioeconomics	Y	The Project is expected to have considerable socioeconomic impacts, largely beneficial to the society and local economy.
Community health, safety and security	Y	While the project is located in an area with industrial facilities, there are some residential and commercial receptors in the wider area. There could be potential emergency impacts that could relate to the project and the security of the project that need to be assessed.
Workers conditions and occupational health and safety	Y	There are potential health and safety risks associated with the use of plant, machinery and construction processes of any project. Moreover, since the Project requires bringing in expatriate workers, potential impacts related to workers accommodation, welfare, sanitary provision, health care, hygiene, food and potable water etc. need to be assessed.
Waste generation and management	Y	It is anticipated that solid and liquid waste will be generated during Project activities, which if not appropriately managed have the potential to result in significant effects.
Traffic and transportation	Y	The Project will likely have a minor impact on Highway E11 from increase in traffic, especially heavy vehicles during the construction stage of the project.
Landscape and visual amenity	Y	The project consists of an approximately 60m wide pipeline corridor through a RAMSAR site. This will temporarily alter the natural landscape during construction and later on, however will be gradually restored in accordance with the mangrove restoration plan.

2 ENVIRONMENTAL BASELINE INFORMATION

Characterization of the environment was achieved using the following sources:

- Review of existing available literature;
- Survey data from the previous HydroQual ESIA;
- Survey data from the HPP BAP Marine and Terrestrial Monitoring; and
- New baseline surveys to fill gaps; and
- New supplementary baseline surveys specific to ACWA Power design.

2.1 Review of Existing Baseline Data

This ESIA has been informed by a review of relevant desktop information which included previous studies including the previous EIA conducted by HydroQual ASA on behalf of Utico in 2021. This report is hereby referred to as "120 MIGD EIA, 2021" in this ESIA.

In addition to the HydroQual EIA data, 5 Capitals have been undertaking environmental monitoring activities for the operation of the nearby HPP, based on a contract with the plant's O&M Company NOMAC. Environmental data in relation to water and sediment quality, as well as marine and terrestrial ecology are being collected from the Project area since March 2021 for submission to Dubai Municipality. Relevant data from this routine monitoring exercise have also been used to inform the environmental baseline characteristics in this ESIA, hereby referred to as "HPP Operational Monitoring, 2021 - 2023".

The following baseline data were collected during the study which are used to inform this ESIA:

- Oceanography, hydrodynamic regime and coastal processes:
- Water and sediment quality
- Marine Ecology
- Terrestrial Ecology

2.2 Additional Baseline Data Collection

In order to address the gaps in baseline data discussed in the above section, a series of physical site surveys were carried out within the Project's area of influence, which have been described in the relevant environmental and social impact assessment chapters of this report. The environmental baseline surveys carried out as part of the ESIA included those listed in the following table.

Table 2-1 Summary of Additional Baseline Surveys

Site Survey	Description
Site Walkover	Site visit conducted on several occasions during the course of the ESIA
Land Use	
Terrestrial Ecology Surveys	6 June 2023
Soil Sampling	Soil samples were collected from five (5) locations spread across the project site and surrounding area on the 26th May 2023
Groundwater sampling	Groundwater samples were collected from two (2) locations, within the main project site and planned laydown area on the 26th May 2023
Ambient air quality monitoring	Short term (24hr) ambient air quality monitoring was conducted at a central location within the main project site commencing 26th May 2023
Ambient noise monitoring	Ambient noise levels were recorded at six (6) locations within and around the project area. Monitoring was carried out during both weekday and weekend days to cover for both day and night time hours. Monitoring was carried out between the period 26th May to 13th June 2023.
Lagoon fish survey	The lagoon fish survey was conducted during 29th May 2023 to monitor fish count at five (5) sampling locations within the HPP "restored "lagoon, previously used for settlement of dredge material
Marine ecological survey of the Eastern HPP breakwater	A marine ecological survey was conducted along eastern HPP breakwater on 31st May 2023 to monitor marine ecological conditions at four (4) sampling locations for epibenthic habitat, fish species, marine mammals (including cetaceans) and turtles.

2.3 Summary of Baseline Survey Findings

2.3.1 Site Geology, Soil and Groundwater Conditions

The current site condition at the main SWRO Plant site is a combination of disturbed ground and sabkha. A proportion of the site was cleared previously in 2021/2022 for the construction of a 120 MIGD Plant (for which there is a valid Conditional Environmental Clearance issued 3rd January 2023).

The onshore intake/outfall pipeline is planned to be located within an 80m wide corridor that comprised of a sandy beach, lagoon, mangroves and sabkha. Other than the area already cleared, there are no other impacts observed on site. No sources of pollution, visual or olfactory were observed.

Soil and groundwater sampling and analyses conducted during May 2023 did not show any exceedance of tested parameters against Dubai Municipality or international standards. The groundwater levels at the site are expected to be shallow all year round due to the presence of low-lying areas of sabkha and proximity to the shoreline.

2.3.2 Meteorology and Air Quality

The meteorological conditions at the Project area is typical of Dubai which is a sub-tropical arid climate with hot and humid conditions during the summer months and moderate temperatures during winter. High humidity is particularly experienced in the coastal regions during summer months. The recorded meteorological data recorded at the Ras Ghanadah weather station from 2006 to 2022 by the UAE National Centre of Meteorology has been referenced in this ESIA. The recorded ambient temperature from 2006 to 2022 at this station ranged between a minimum temperature of 6.2°C and a maximum of 48.9°C. The wind direction indicates wind predominantly coming from a westerly direction in Dubai.

A short-term (24-hours) ambient air quality monitoring campaign was undertaken during May 2023 for a suite of air quality parameters which did not show any air quality issues as majority of the parameters were below their detectable limits.

2.3.3 Ambient Noise

The Project is located in close proximity to the HPP which is already operational for several of its units, with full operations expected this year. Operation of the HPP does result in discernible noise in the project area, although this will be limited at the main SWRO Project site due to the large coal sheds providing a barrier and noise attenuation.

Project specific baseline noise survey covering daytime & night-time periods on weekdays and weekends was undertaken during May 2023. Considering the presence of the nearby HPP, noise results were compared to industrial standards. While most recorded noise levels were within the applicable limits, three exceedances were observed, once each at locations to the main SWRO project site, laydown area and one closer to the beach. No single noise source was identified while onsite, as such these are likely attributed to prevailing background conditions, such as activities at the HPP, traffic from the highway and noise from wave action on the beach at that time.

2.3.4 Water and Sediment Quality

Water Quality

Historical water and sediment quality monitoring data from previous campaigns (from 2006 to 2023) conducted in the area are presented in this ESIA. In order to identify any recent changes and current conditions, monthly water and sediment samples collected by Innovation Delta Environmental (IDE) on behalf of 5 Capitals from the area have been utilised. These records consist of monthly data for the period March 2021 to April 2023, collected as part of the HPP Monitoring Programme.

Overall, the majority of water quality parameters have recorded values within what is considered typical for the southern Arabian Gulf. The nitrate concentrations recorded were slightly elevated in exceedances of the DMWQOs during surveys conducted in 2014, 2015 and

2018. Maximum recorded concentration of Chromium and Copper also slightly exceeded the DMWQO in the 2015 survey. However, in the 2018 survey all metal parameters were below the limit of detection. Total Petroleum Hydrocarbons (TPH) have generally not been detected in past water sampling, with the exception of the 2008 survey where the maximum TPH recorded was 54.7 mg/L.

The HPP 3rd Quarter 2020 Biodiversity Monitoring Plan Report stated that no changes in the in-situ water quality were recorded compared to historic records. Mean values of critical parameters such as dissolved oxygen, ammonia, suspended solids were in compliance with the DM Water Quality Objectives (DMWQO).

The findings from the Winter 2021 survey were compared with past surveys within this study area. Most results seen in the Winter 2021 surveys are within range compared to results seen in previous studies for all inorganic, hydrocarbon, and metal parameters. The only exception to this was the Arsenic concentration that was elevated in the 2021 winter survey and reached a maximum concentration of 0.045mg/L, exceeding the DMWQO of 0.01 mg/L.

Previous studies have shown elevated levels of nitrate (>0.5 mg/L), ammonia (>0.1 mg/L), phosphate (>0.05 mg/L), residual chlorine (>0.01 mg/L), chromium (>0.01 mg/L), and copper (>0.005 mg/L). These parameters were either not detected or were below the DMWQO limits during the 2021 studies. Overall, conditions at the site are largely indicative of what is expected for the area, with no concerning elevated concentrations, with the exception of Arsenic. In previous studies, no Arsenic was detected in samples, yet most samples in the 2021 winter survey showed elevated concentrations. The subsequent 2021 survey did not detect any Arsenic and previous year's surveys did no detect Arsenic which indicates the presence of Arsenic was likely a transitory event.

The results of the study of 5 Capitals' water quality for the period of April 2021 to March 2023 are mostly consistent with the values indicated in all prior studies. The overall lowest and highest values for parameters such as Temperature (19.45^{O}C to 35.46^{O}C) and Total Nitrogen (0.24-2.13 mg/l) were during the periodic surveys conducted by 5 Capitals between 2021 to 2023. All the parameters are in compliance with the standard except for Total Nitrogen, for which the maximum value (2.13 mg/l) slightly exceeds its standard limit.

Sediment Quality

Lab test results for sediment quality have been compared to the Dutch Target Values (DTVs) and Dutch Intervention Values (DIVs) (Netherlands Ministry of Infrastructure and Water Management 2013). These are two separate values that are used to ascertain the level of contamination in a soil or sediment.

The only parameters which showed exceedance to the DTV were Mercury and Nickel. The maximum Mercury concentration recorded in 2006 was in exceedance of the DTV but still within the intervention value, DIV. Maximum Nickel concentrations above the DTV were recorded in 2006, 2015, 2018 and 2021, with exceedance against DIV also recorded during

2018 and 2021 surveys for Nickel. Total Organic Carbon (TOC) values ranged greatly between surveys, with an overall minimum of 0.4% and overall maximum of 22%. This is likely to do with the variety of substrate and habitat types of the area.

The HPP 3rd Quarter 2020 BMP Report stated that of the available data from 2017-2020, all parameters were in compliance with their respective DIVs and no significant change over time was detected. The exception to this was slightly elevated Cadmium recorded during 2018-2019.

The sediment quality results found within the Winter 2021 survey were largely comparable with those found in previous surveys for this study area. As outlined earlier, the main exceedance that was found during this study was a maximum elevated concentration of Nickel of 205.19 mg/kg. However, when looking at previous results, this is not anomalous, with a maximum concentration of 244 mg/kg recorded in 2018 as well as moderately elevated levels in 2015 and 2006 surveys. This indicates it is likely inherent to the sediment type and variation between years could be related to variation in sampling locations. This study shows no other exceedances of limits for all parameters tested in the sediment samples. There is nothing of concern in the results that would indicate any contamination in the sediment in the study area in the current and previous studies.

Further details about the survey and findings from the HydroQual study conducted in 2021 as part of the EIA and the periodic monitoring findings being carried out by 5 Capitals are discussed in this ESIA, considering, that these are the most recent studies conducted in the area.

2.3.5 Marine Ecology and Nature Conservation

As outlined earlier, this ESIA summarises the marine ecological data collected by HydroQual during the 2021 EIA and later by 5 Capitals as part of the periodic operational monitoring for the HPP in the Project area. Additional surveys were conducted to fill identified gaps in data during the preparation of this ESIA. A summary of the previous surveys and additional data collection is presented in the following table. The findings from the additional and previous surveys are discussed in the following sections below.

Table 2-2 Summary of Marine Ecology Baseline Data Collection

BASELINE PARAMETER	HYDROQUAL	5 CAPITALS
Existing Data Review		
Epibenthic Ecology (Corals, Seagrass, Macro algae)	Twice - Summer & Winter, 2021	24 Months (2021 to 2023)
Epibenthic and fish species	Twice - Summer & Winter, 2021	24 Months (2021 to 2023)
Mammals, Reptiles and Avifauna	Twice - Summer and Winter, 2021	24 Months (2021 to 2023)
Mangrove ecology	Once, 2021	Quarterly from 2021 to 2023 and March-2023

BASELINE PARAMETER	HYDROQUAL	5 CAPITALS
Plankton and Macro-benthic ecology	Twice - Summer & Winter, 2021	April 2021 to March 2023
Underwater noise	Once, 2021	-
Additional Survey for this ESIA		
Fish survey at the reinstated HPP settlement lagoon	-	Once, May 2023
HPP northern breakwater survey	-	Once, May 2023

Key Findings – HydroQual EIA Survey, 2021

The habitats found in the nearshore were predominantly macroalgae and unconsolidated sediment. Patches of coral rubble were also present during the surveys conducted by HydroQual during 2021 at the following locations.

- Proposed pipeline corridor
- Mixing zone at the outfall point
- General JAWS area within the potential area of impact
- Waterfront islands breakwater

These habitat areas considered as 'coral rubble' were characterized by the distribution of dead coral skeletons that were either covered in algal growth or sediment. It is important to note that the beach at the Project site is covered in dead corals, suggesting that there are more extensive coral rubble patches in the areas that were not surveyed.

Survey conducted by HydroQual at transect based upon the existing habitat map shows the absence of healthy coral aggregations. Throughout the various dive surveys, there were no areas with healthy coral found. The only live corals observed were fully bleached or severely discoloured and most suffered partial mortality.

A significant area of historical coral reefs was found adjacent to the pipeline corridor. This includes an extensive area of coral rubble, including clear fragments. A very small number of live corals were found during searches within the pipeline corridor, all of which were 100% bleached. Given that this observation occurred in winter, it is considered unlikely that these bleached corals will be able to tolerate the high temperatures of the summer season.

Biodiversity Monitoring Reports (5 Capitals 2020) have indicated a decreasing trend in coral cover within JAWS since monitoring began in 2016. The results of the 2021 surveys by HydroQual were consistent with this trend. Given this reported trend from other sources as well as the findings of the 2021 surveys, it is concluded that it is highly unlikely that any healthy corals remain in the JAWS area.

Coral transplantation to the Dubai Waterfront Island Breakwaters has been conducted between 2016 – 2017 on behalf of the Hassyan Clean Coal Independent Power Plant project. The monitoring data for these breakwaters from the third quarter of 2020 reports that the corals

were in good health, and the coral cover was reported as having a small increasing trend since 2017. However, the 2021 baseline surveys have found that, as with the corals in JAWS, coral health on the breakwater was suffering with significant bleaching and mortality observed.

Seagrass beds were also recorded during the surveys, both within the pipeline corridor and elsewhere in the nearshore area. A total of five seagrass transects were conducted in JAWS in the winter and summer seasons. A summary of the survey results is presented later in this ESIA. The seagrass areas were characterized as patchy meadows. The substrate in this area was extremely silty and easily disturbed, likely due to the settlement of fines from the unprotected nearby causeway to the north. Nonetheless, seagrass has been established in the area, although it is sparse, and the area is more dominated by macroalgae.

Incidental marine mammal and reptile observations were made throughout survey activities in both nearshore and offshore areas, with five official sightings recorded. A single dolphin was seen offshore at one of the sampling stations. Individual green turtles were observed on three separate occasions in the nearshore area. In addition, evidence of green turtle scat and tacks were found in the nearshore seagrass area. While no dugongs or evidence of dugongs were observed during the surveys, historical reports suggest that they occasionally frequent the area.

The JAWS beach is known to be the only nesting site for the critically endangered hawksbill turtle in Dubai. The nesting beach extends from south of Palm Jebel Ali to the HPP. A walkover of the beach area was conducted by HydroQual on the 30th of March 2021, during which turtle tracks and 6 turtle nesting sites were observed.

The wetland area within JAWS consists of various small lagoons, channels, and intertidal flats. The lagoons have been modified in the past, as evidenced by clearly artificial channels and multiple road features. The lagoons are fed by a natural opening to the sea toward the north near the Waterfront Island causeway. Mangroves are present within JAWS as a result of introduction through planting, which began sometime in the mid to late 2000s. This is therefore considered a relatively young mangrove area, demonstrated by the density of growth and openness of the canopy.

Marine Survey Findings – HPP Monitoring by 5 Capitals, 2021 - 2023

The majority of bathymetric variability is found within the first 2 km near-shore area. This zone harbours most of the benthic biodiversity, such as macroalgae beds, seagrass beds and coral reefs. The marine ecological survey was conducted to monitor marine ecological conditions at eight (8) sampling locations around the project site for planktons, epibenthic infauna, epibenthic habitat, fish species, marine mammals (including cetaceans) and turtles.

Based on the survey conducted during the period, marine habitats within the site of the proposed works include several key habitats associated with JAMS. These include: -

- Coral reef
- Seagrass beds
- Macroalgal beds
- Hard Bottom substrates
- Sub-tidal sandy substrates
- Sub-tidal muddy substrates

An assessment of number of species recorded on a monthly frequency from April 2021 to March 2023 has been carried out. It demonstrates that a significant number of corals, fish, macro-algae and other epibenthic species have been recorded in the recent months (January 2023 to March 2023), whereas as no. of seagrass species remain constant throughout the time 24 months from April 2021- March 2023. The general trend in the number of species of epibenthic infauna highlights an increasing trend in the project area. The corals in the area are classed as 'patch corals', which are relatively small, flat-topped coral structures in shallow water. These corals do not contribute to the development of a solid framework (i.e., coral growing on coral) but instead grow directly on top of exposed hard substrates such as caprock.

The Project's wider area is also noted for its seabird communities, including breeding sites at the northwest tip of Waterfront Islands. The Indo-Pacific humpback dolphin, which is one of the most frequently encountered type of dolphins in the UAE, have been sighted occasionally.

Turtle monitoring conducted on 13th May 2023 identified two turtle nests inside the project's footprint. The number of marine mammals and reptile observations that were made on a monthly basis between April 2021 and March 2023 have been evaluated. It shows that, from April 2021 to March 2023, dolphins were only seen during the three months of May, August, and September 2021, whereas turtle observation peaked in May 2021.

The mangrove area within the RAMSAR site was surveyed. However, there were too many to count precisely. Most of the recorded trees were green, representing the healthy conditions of mangroves. Yellow leaves were also recorded on some plants.

Additional Surveys – Fish Survey at the HPP Lagoon, May 2023

IDE conducted the lagoon fish survey on 29th May 2023 using underwater cameras to monitor fish counts at five (5) sampling locations inside the lagoon, as indicated in the following figure. The purpose of the survey was to identify any sensitive fish species that may be impacted once the area is used during the construction of the Project. Thirteen (13) species of fish were recorded. A total of 107 fish individuals were recorded in average of 30 minutes counts from the lagoon during May 2023. Overall, the HPP lagoon area supports small number of fish species, with none of the species considered as particularly sensitive or of ecological significance.

Additional Surveys – Habitat Survey of HPP Breakwater, May 2023

The marine ecological survey was conducted along eastern breakwater at the HPP jetty on the 31st May 2023 to monitor marine ecological conditions at four (4) sampling locations for monitoring the presence of epibenthic habitat, fish species, marine mammals and turtles.

Rocky bottom breakwater consists of macro-algae, corals, and fish. Other marine life such as sea urchins and other sessile organisms were also present on the breakwater. Coral bleaching and dead corals were recorded in these locations. Siltation on corals was also seen in these locations. Two (2) species of hard coral were noted including one dead coral species were also observed. Large table corals (*Acropora* sp.) were observed dead in all four stations. Colonies of *Polycyathus sp* were observed live and healthy during survey. Live corals were not recorded. Overall sensitivity is low along eastern side of the HPP Breakwater.

2.3.6 Terrestrial Ecology

The terrestrial ecological data collected by HydroQual during the 2021 EIA and then later by 5 Capitals as part of the periodic operational monitoring for the HPP in the Project area between 2021 and 2023 are presented in this ESIA. In addition, a walkover survey was conducted in June 2023 by IDE to review current conditions.

Disturbed bare ground (both sand and gravel substrate) and sabkha, were present throughout the site. Devoid of vegetation, this habitat typically does not support extensive biodiversity. Sand sheets with shrubs / gravel plains with shrubs are present at the site. Sand sheets and gravel plains vegetated with shrubs are considered to be a common habitat.

Habitat at the intertidal area including the RAMSAR site, consist of mangroves, halophytic shrubs, lagoon/channels, and tidal flats. Mangrove and associated intertidal habitats are important carbon sinks; provide ecosystem services such as soil binding, water purification, provide shelter and resources for various fauna (marine and terrestrial), and wintering grounds for migratory birds. Approximately 20% of land cover throughout the Project's area of influence is comprised of intertidal habitats (see following figure).

Figure 2-1 Terrestrial and Intertidal Land Cover along Project Area

The habitats of highest importance present within the Project area include the intertidal mangrove forest and mudflats, as well as the vegetated sand sheet, gravel plains and sandy beach habitats. In particular, the ecotone between the intertidal habitat and vegetated sandy habitats had evidence of frequent faunal use.

The vegetation density is relatively thick, but overall diversity and health at the time of survey was average. Many areas showed signs of desiccation and the species richness of flora communities was low.

Mangrove and intertidal habitats as well as the overall vegetated sandy habitats throughout the Project area of influence are to be considered of high conservation importance.

The mammals present within the site are mostly common species and with the exception of the Arabian Gazelle, not considered to be of high conservation importance. However, shorebirds and seabirds inhabiting the intertidal areas are considered to be of moderate to high importance, given the site's importance for migratory birds; and several reptile species of high conservation value are anticipated to be possibly present on site.

The species diversity of birds on site is relatively high. It appeared that many birds were utilising the northeast portion of the intertidal habitat.

2.3.7 Socioeconomic

The project site is located within Sector 5, as outlined in the Dubai Statistic Centre Population Bulletin for 2021. Sector 5 is divided into 18 communities. The project is located in the Saih Shuaib area, divided into four communities, Saih Shuaib 1 to 4. The combined population of the four communities is estimated at 28,095.

Official data for the Hassyan area is not available. However, the project landholding is within the broader DEWA Hassyan Power and Water Complex, designated for ongoing and future power and water development projects to serve Dubai's population, business, and industry.

Currently, the complex includes the HPP, a project awarded by DEWA to 'ACWA Power', owned by the established special purpose vehicle project company Hassyan Energy Phase I P.S.C' and operated by ACWA Power's wholly owned subsidiary, 'NOMAC'.

DEWA owns the land on which the project will be developed. The DM Site Offices, approximately 700 m north of the proposed project site, are research centres donated to DM for research, training and awareness purposes. Additionally, the Emirates Marine Environmental Group (EMEG facility) operating within the DEWA landholding has utilised the land for several years for research and educational purposes. Other informal land uses of the project site or evidence of settlement were not identified on-site during site visits.

2.3.8 Community Health, Safety and Security

The Project is located in an area with industrial facilities as well as some residential and commercial receptors in the wider area.

There are few communities or other residential receptors in the proximity of the Project. Given the nature of the Project, associated construction and operation activities and distance from the Project site, these receptors are unlikely to be directly affected by the Project and therefore are not considered 'Affected Communities'.

3 KEY FINDINGS FROM ENVIRONMENTAL IMPACT ASSESSMENT

A summary of the key findings from the impact assessment including residual impacts after implementation of mitigation measures along with proposed monitoring program are provided in the following tables for both construction and operational phases of the project.

Table 3-1 Summary of Potential Impacts Assessed Before and After Mitigation and Monitoring Requirements – Construction Phase

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
Geology, soils, and groundwater	Alteration of landform	**Minor**	Site soil	Low	**Minor**	**Minor**	None
	Changes in soil and groundwater quality from accidental spills, improper waste storage etc.	**Minor**	Site soil	Low	**Minor**	**Negligible**	Visible monitoring for spills and leaks of fuels, chemicals, and other hazardous materials. Records of spill response drills and training provided to workers handling hazardous material, waste, and wastewater. Groundwater concentration of ammoniacal Nitrogen, hydrocarbons, heavy metals, oils and grease, BOD, COD
			Groundwater	High	**Moderate**	**Minor**	
	Lowering of groundwater during dewatering	**Moderate**	Groundwater	High	**Major**	**Moderate**	Daily observations of static groundwater levels in the lagoon areas close to construction during dewatering.
	Impacts from the release of hydrotesting water	**Minor**	Site soil	Low	**Minor**	**Negligible**	None
Climate and Air Quality	Dust emissions	**Minor**	Hassyan PP	Low	**Negligible**	**Negligible**	Visual monitoring of dust emissions. To be monitored quantitatively if generation is considered to be excessive or complaints are received.
		Minor	Workers and visitors at the HPP and EMEG	Medium	**Minor**	**Negligible**	
		Moderate	Project Workers	High	**Moderate**	**Minor**	
		Minor	Ecological receptors	High	**Moderate**	**Minor**	

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
			(JAMS and JAWS)				
	Exhaust emission of gaseous pollutants from vehicles & construction equipment	**Negligible**	Industrial	Low	**Negligible**	**Negligible**	Visual assessment of emissions to be undertaken on a daily basis while vehicles & equipment are in use and annual inspection of vehicles. This will include an inspection during the initial acceptance criteria of such vehicles to site.
		Minor	Project Workers	High	**Moderate**	**Minor**	
		Negligible	Workers and visitors at the HPP and EMEG	Medium	**Negligible**	**Negligible**	
		Negligible	Ecological receptors (JAMS and JAWS)	High	**Minor**	**Negligible**	
	Emissions of VOCs	**Minor**	Project Workers	High	**Minor**	**Negligible**	Daily inspection of hazardous materials storage areas for any leaks or emission of VOCs
	Odour emissions	**Minor**	Project Workers	High	**Minor**	**Negligible**	Daily olfactory observations – as part of maintenance and inspection checks
Noise and Vibration	Construction Noise	**Minor**	Industrial - HPP	Low	**Negligible**	**Negligible**	Monthly monitoring of ambient noise (LAEq)for 15 minutes at each of the baseline monitoring locations
		Minor	Commercial - EMEG	Medium	**Minor**	**Negligible**	
	Vehicular Noise	**Minor**	Industrial - HPP	Low	**Negligible**	**Negligible**	
		Minor	Commercial - EMEG	Medium	**Minor**	**Negligible**	
	Vibration	**Negligible**	Industrial - HPP	Low	**Negligible**	**Negligible**	None
Oceanography, Coastal Processes, Water and Sediment Quality	Increased turbidity and TSS	**Moderate**	RAMSAR Area	High	**Moderate to Major**	**Minor**	Continuous turbidity monitoring at 2 locations (Nakheel breakwater and HPP intake area), at 10-minute intervals during marine construction
		Minor	Nakheel Revetment Ecology	Medium	**Minor**	**Negligible to Minor**	

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
		Moderate	HPP Intakes	Medium	**Moderate**	**Negligible to Minor**	works. Data to be provided in near real-time.
	Mobilisation of contaminants	**Minor**	RAMSAR Area	High	**Minor**	**Negligible**	Daily in situ water quality measurements of suite of physical and chemical parameters
		Minor	Nakheel Revetment Ecology	Medium	**Minor**	**Negligible to Minor**	
	Pollution from vessels due to accidental release of fuel	**Moderate**	RAMSAR Area	High	**Moderate to Major**	**Minor**	Daily visual monitoring of marine construction activities
	Discharge of dewatered effluent	**Negligible**	RAMSAR Area	High	**Minor**	**Negligible**	Daily in situ water quality measurements of suite of physical and chemical parameters
Marine Ecology	Loss or disturbance of habitat within the offshore pipeline corridor	**Moderate**	JAMS Marine Habitats	Medium	**Moderate**	**Minor**	Monitoring of seagrass (transects) along the pipeline corridor within the RAMSAR area. Quarterly infauna and planktons sampling along the pipeline corridor. Monthly coral survey along the pipeline corridor
		Minor	Infauna / Macro-algae	Low	**Negligible to Minor**	**Negligible**	
		Moderate	Seagrass	Medium	**Moderate**	**Negligible to Minor**	
		Moderate	Corals	Medium	**Moderate**	**Negligible to Minor**	
	Loss of habitat or disturbance within 80 m onshore pipeline corridor	**Major**	RAMSAR site lagoons	High	**Major**	**Minor to Moderate**	Visual observations of boundary markers to ensure they are not degrading or negatively impacting the habitat outside the 80m pipeline corridor.

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
		Major	Marine Turtles and Nesting Beach	High	**Major**	**Minor to Moderate**	Beach Walkover to identify turtle nests by a DM-ED registered Environmental Consultant.
		Major	Mangroves	Medium	**Moderate to Major**	**Minor to Moderate**	Visual observations of mangroves and lagoons to check for change in condition that could indicate negative impacts e.g., tree yellowing, die off, dry or muddy lagoons etc.
	Loss of habitat from storage and treatment of dredge material	**Moderate**	Disturbed ground and lagoon used for HPP	Low	**Minor**	**Neutral**	None
	Introduction of invasive or foreign species	**Moderate**	JAMS	Medium	**Moderate**	**Negligible to Minor**	None
	Boat strike	**Major**	Marine mammals and reptiles	High	**Major**	**Minor**	Marine Mammal Observer shall be present on all marine vessels and any observation of marine mammals or reptiles shall be recorded.
	Boat Mooring	**Minor**	Marine Fauna	Medium	**Minor**	**Neutral**	None
	Boat Pollution from oil or fuel	**Moderate**	RAMSAR/JAMS	High	**Moderate to Major**	**Negligible to Minor**	Daily visual observation of marine construction areas
	Discharge of dewatered effluent	**Minor**	JAMS	Medium	**Minor**	**Neutral**	Daily water quality measurements for turbidity during dewatering works.
	Artificial lighting	**Minor**	Marine Fauna	Medium	**Minor**	**Neutral**	Daily visual observations to ensure implementation of mitigation measures
		Major	Turtle Nesting beaches	High	**Major**	**Minor**	

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
	Noise and Vibration	**Moderate**	JAMS Marine Fauna	Medium	**Moderate**	**Negligible to Minor**	
Terrestrial Ecology and Nature Conservation	Loss of habitat or disturbance within 80m onshore pipeline corridor	**Minor**	Sabkha	Low	**Negligible to Minor**	**Negligible to Minor**	Daily visual observations at construction areas for fauna species. Maintenance of a register for fauna sightings at site.
		Minor	Vegetated sand sheets, dunes	Medium	**Minor**	**Negligible to Minor**	
		Moderate	Intertidal mudflats	High	**Moderate**	**Minor**	
	Noise and Vibration	**Moderate**	All Fauna including Avifauna and nesting turtles	High	**Moderate to Major**	**Minor**	
	Dust	**Minor**	Mangrove	High	**Minor to Moderate**	**Minor**	
	Direct Injury/Mortality	**Major**	All fauna	Low	**Negligible to Minor**	**Negligible to Minor**	
	Light Pollution	**Minor**	All fauna	Medium	**Minor**	**Negligible to Minor**	
	Dewatering	**Moderate**	Mangrove	High	**Moderate to Major**	**Negligible to Minor**	
	Discharge of dewatered effluent	**Moderate**	All fauna	Medium	**Minor**	**Negligible to Minor**	
	Contamination	**Minor**	Fauna and Flora	Medium	**Minor**	**Negligible to Minor**	
	Solid Waste	**Moderate**	All fauna	Medium	**Moderate**	**Negligible to Minor**	
	Invasive Species	**Moderate**	All fauna	Medium	**Moderate**	**Negligible to Minor**	
Socioeconomic	Employment Opportunities	**Minor - Positive**	Employment Market	Low	**Minor Positive**	**Minor Positive**	Employment record keeping

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
	Purchase of construction materially locally	**Minor - Positive**	Local / Regional Economy	Low	**Minor Positive**	**Minor Positive**	Records of local procurements
	Training and Dissemination of skills to the workforce	**Negligible - Positive**	Employment Market	Low	**Negligible Positive**	**Negligible Positive**	Training records
	Temporary Disruption to EMEG activities	**Minor**	EMEG Facility & Activities	Medium	**Minor**	**Negligible**	Grievance Mechanism - Receiving and keeping track of grievances - Reviewing and investigating grievances Facilitate resolutions that are mutually acceptable by all parties, within a reasonable timeframe.
Traffic and Transportation	Increased Vehicular Flow on E11 Highway	**Minor**	E11 Highway	Medium	**Minor**	**Negligible**	None proposed
	Movement of Vehicles through onsite road	**Minor**	Current Hassyan Internal Road	Low	**Negligible**	**Negligible**	
	Vessel Movement	**Negligible**	Marine Transportation	Medium	**Negligible**	**Negligible**	
Landscape and Visual	Changes in Landscape Character	**Minor**	Landscape character of the Project site	Low	**Minor**	**Negligible**	None proposed
		Minor	EMEG Facility	Low	**Minor**	**Negligible**	
		Negligible	Users of E11 Highway	Low	**Negligible**	**Negligible**	
		Minor	Landscape Character of the Jebel Ali	High	**Moderate**	**Minor**	

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
			Marine Sanctuary				
		Minor	Landscape Character of the Lagoons and Mangrove Habitat	Medium	**Minor**	**Negligible**	
	Disturbance to the visual Envelope of receptors due to the presence of new features	**Minor**	Jebel Ali Marine Sanctuary	High	**Moderate**	**Minor**	
		Minor	Lagoons and Mangrove Habitat	Medium	**Minor**	**Negligible**	
		Minor	EMEG Facility	Low	**Negligible**	**Negligible**	
		Negligible	Users of E11 Highway	Low	**Negligible**	**Negligible**	

Table 3-2 Summary of Potential Impacts Assessed Before and After Mitigation and Monitoring Requirements – Operation Phase

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
Geology, soils, and groundwater	Accidental spills/leaks of fuels, chemicals, and hazardous materials	**Minor**	Site soil	Low	**Minor**	**Negligible**	Daily Visual inspections for spills & leaks of hydrocarbons and other potentially hazardous or chemicals. Groundwater sampling from existing wells at site and analyses of hydrocarbons, heavy metals, free chlorine, salinity, oils and grease, and pH by accredited laboratory.
			Groundwater	High	**Moderate**	**Minor**	
	Spills of Wastewater and Sludge	**Negligible**	Site soil	Low	**Negligible**	**Negligible**	
			Groundwater	High	**Minor**	**Minor**	
	Exposure to contaminated stormwater	**Negligible**	Site soil	Low	**Negligible**	**Negligible**	
			Groundwater	High	**Minor**	**Negligible**	
Climate and Air Quality	Gaseous emissions from project operations	**Negligible**	Workers and visitors at the HPP and EMEG	Medium	**Negligible**	**Negligible**	Regular maintenance & servicing of project vehicles and planned annual inspection.
		Negligible	Project Workers	High	**Minor**	**Negligible**	
	Odour Emissions	**Negligible**	Workers and visitors at the HPP and EMEG	Medium	**Negligible**	**Negligible**	None
		Minor	Project Workers	High	**Minor**	**Negligible**	None
Noise and Vibration	Noise from Project operations	**Minor**	Industrial - HPP	Low	**Negligible**	**Negligible**	Quarterly ambient noise (LAEq) monitoring for 15 minutes at baseline noise monitoring locations
		Minor	Commercial - EMEG	Medium	**Minor**	**Negligible**	
	Vehicular Noise	**Minor**	Industrial - HPP	Low	**Negligible**	**Negligible**	
		Minor	Commercial - EMEG	Medium	**Minor**	**Negligible**	
	Vibration	**Negligible**	Industrial - HPP	Low	**Negligible**	**Negligible**	

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
Oceanography, Coastal Processes, Water and Sediment Quality	Increase in ambient salinity due to Brine Discharge	**Moderate**	JAWS Marine Habitats	High	**Moderate**	**Negligible to Minor**	Monthly ex situ water sampling – minimum of 7 locations, including locations within the RAMSAR area and one further offshore as a control point. In situ (long term) water monitoring, one at the edge of the mixing zone and one outside of RAMSAR area for the duration of operation.
		Minor	Nakheel Revetment Ecology	Medium	**Minor**	**Negligible to Minor**	
	Chemical additives in SWRO Discharge	**Minor**	JAWS	High	**Minor**	**Neutral**	
		Minor	Nakheel Revetment Ecology	Medium	**Minor**	**Negligible to Minor**	
	Interaction between brine and adjacent HPP thermal discharge	**Minor**	JAMS Water Quality and Marine Ecology	Medium	**Minor**	**Negligible to Minor**	
Marine Ecology and Nature Conservation	Elevated salinity from Brine discharge	**Moderate**	Mixing Zone Ecosystem	Low	**Minor**	**Negligible or Minor**	Long-term continuous in situ water quality monitoring for duration of operation. Quarterly ex situ water quality monitoring for suite if parameters. Recording of all incidental observations or marine mammals and reptiles
		Major	JAMS	Medium	**Moderate to Major**	**Minor**	
	Entrainment and Impingement	**Moderate**	RAMSAR	High	**Moderate to Major**	**Minor**	
	Turtle Nesting	**Negligible**	Beaches	High	**Minor**	**Neutral**	Walk over turtle nesting beach monitoring to be carried out during operation in coordination with Dubai Municipality NRS
	Maintenance and Inspection Intake and Outfall pipelines	**Minor**	Intertidal Lagoons and Mangrove	High	**Minor or Moderate**	**Neutral**	Routine clean-up of lagoon area of rubbish in coordination with Dubai Municipality NRS
	General Disturbance	**Moderate**	All Fauna	Medium	**Moderate**	**Negligible to Minor**	

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
Terrestrial Ecology and Nature Conservation							Daily visual observations at operational areas for fauna species. Maintenance of a register for fauna sightings at site
	Noise and Vibration	**Moderate**	All Fauna, including Avifauna and nesting turtles	High	**Moderate to Major**	**Minor**	
	Light Pollution	**Moderate**	All fauna including Nocturnal species	Medium	**Moderate**	**Negligible to Minor**	
	Solid Waste	**Minor**	All fauna	Medium	**Minor**	**Negligible to Minor**	
	Invasive Species	**Minor**	All fauna	Medium	**Minor**	**Negligible**	
Socioeconomic	Employment opportunities, training and Dissemination of skills to the workforce	**Negligible**	Employment Market	Low	**Negligible - Positive**	**Negligible - Positive**	Employment record keeping
	Impacts on EMEG Activities	**Negligible**	EMEG Activities	Medium	**Negligible**	**Negligible**	Grievance Mechanism - Receiving and keeping track of grievances - Reviewing and investigating grievances Facilitate resolutions that are mutually acceptable by all parties, within a reasonable timeframe.
	Supply of potable water	Not measured against a specific receptor, the project is considered to play a highly positive role in Dubai's socio-economic development and maintenance.			**Positive**	**Positive**	None

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
Traffic and Transportation	Increased Vehicular Flow on E11 Highway	**Negligible**	E11 Highway	Medium	**Negligible**	**Negligible**	None proposed
	Movement of Vehicles through onsite road	**Negligible**	Current Hassyan Internal Road	Low	**Negligible**	**Negligible**	
Landscape and Visual	Changes in Landscape Character	**Minor**	EMEG Facility	Low	**Minor**	**Negligible**	None proposed
		Negligible	Users of E11 Highway	Low	**Negligible**	**Negligible**	
		Minor	Landscape Character of the Jebel Ali Marine Sanctuary	High	**Minor**	**Negligible**	
		Minor	Landscape Character of the Lagoons and Mangrove Habitat	Medium	**Minor**	**Negligible**	
	Disturbance to the visual Envelope of receptors due to the presence of new features	**Minor**	Jebel Ali Marine Sanctuary	High	**Minor**	**Negligible**	
		Minor	Lagoons and Mangrove Habitat	Medium	**Minor**	**Negligible**	
		Minor	EMEG Facility	Low	**Minor**	**Negligible**	
		Negligible	Users of E11 Highway	Low	**Negligible**	**Negligible**	
		Minor	Proposed Jebel Ali Waterfront Development	High	**Minor**	**Minor**	
		Negligible	EMEG Facility	Low	**Negligible**	**Negligible**	

Environmental Aspect	Potential Impact	Magnitude of Impact	Receptor	Sensitivity	Potential Impact Significance	Residual Impact Significance	Monitoring Requirements
	Lighting Impacts on nighttime views	**Negligible**	Users of E11 Highway	Low	**Negligible**	**Negligible**	
		Minor	Proposed Jebel Ali Waterfront Development	High	**Minor**	**Negligible**	